THE DEPARTMENT OF ENVIRONMENTAL QUALITY

mississippi geology

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

Volume 20, Number 4
December 1999

Published May 2000

ANNOTATED BIBLIOGRAPHY OF THE GEOLOGY OF MISSISSIPPI TO 1850

Earl M. Manning, Department of Geology, Tulane University, New Orleans, LA 70118
Michael B. E. Bograd, Mississippi Office of Geology

ABSTRACT

The geology of Mississippi in the time before 1850, when the Mississippi Geological Survey (now the Office of Geology) was established, has been little studied by historians. A review of 83 published papers and 4 unpublished manuscripts, from the 1784 to 1850 period, dealing with the geology of Mississippi, as well as related material, reveals that a good deal had been learned by that point.

The basic geomorphology of the state had been worked out, and the geology of several areas had been studied in detail (a few sections had even been published). Although no detailed geologic map of the state had been done, several broad geologic features were understood. The southern part of the state had been linked to the largely unconsolidated sediment along the Gulf and Atlantic coasts. A northward lobe of that belt (later the Mississippi Embayment) was known to occupy western Mississippi. The beds of northern and central Mississippi were known to dip gently westward.

Five geologic time periods had been identified in Mississippi by 1850: Carboniferous (now Mississippian) in the far northeast corner, Cretaceous in the northeast, "lower Eocene" (now late Eocene Jackson Group) in the Jackson area, "upper Eocene" (now early Oligocene Vicksburg Group—the Paleocene and Oligocene were not separated from the Eocene till later) in the Vicksburg area, and post-Tertiary (then often "diluvial" or "archaic alluvium," now late Pleistocene) in the bluffs from Vicksburg to Fort Adams (loess had been identified, but was still considered alluvial, rather than eolian, as today). The fossil faunas of Vicksburg, Jackson, and Natchez had all been at least partly studied (some elements had been figured), and a few fossils from the Cretaceous beds had been reported.

The basic Mississippi early Tertiary stratigraphy of Claiborne beds (as at Claiborne Landing in Alabama), overlain by Jackson beds (including the "*Zeuglodon* beds"), overlain by Vicksburg beds (including the "Nummulite Limestone"), had been worked out by Lyell in Alabama.

The quality of various soils for farming had been intensively studied, and the first chemical analyses of Mississippi soils had been reported. Although oil and gas production were then still in the distant future, some geologic resources (i.e. building stone, ceramic clays, ocher, and lignite) had been developed.

Many of the papers reviewed here were published in national science journals, and several of the authors had national (i.e. Dunbar, Conrad and Leidy) or international (e.g. Lyell) reputations. Also by 1850, several papers dealing with Mississippi geology had been presented at national geologic meetings, already placing Mississippi (then the "South West" frontier of the country) within the community of American geology.

INTRODUCTION

Most of the eight histories of Mississippi geology (see references in Bograd, 1988) are histories of the Mississippi Geological Survey and its later forms. They give the misleading impression that geologic research on Mississippi began with the formation of the Survey in 1850. The one history that did not deal exclusively with the Survey, Brown (1975), missed many important early references, failed to give citations for others, and tended to over-emphasize the work of a single man in the early years (Charles Lyell—certainly an important figure, but one that appears late in that early period in Mississippi). An excellent recent review of American geological literature prior to 1850 unfortunately provides no reference for Mississippi when listing state early geology bibliographies (Hazen and Hazen, 1980, p. 12-16). The aim of this paper is to try to "recover" the early period of geologic research on Mississippi and to try to evaluate what had been learned by 1850. Following the chronological annotated bibliography, a review is given of when (and from whom) specific bits of information on the state's geology were learned.

As Hazen (1974) has pointed out, although American geology at first lagged somewhat behind English geology, nearly all major branches of geology had become mature sciences in America by 1818. Even though Mississippi's geological survey began relatively late (the first had been North Carolina's, in 1824), much was done without one.

A few dates significant to Mississippi's history are included with the references, to provide context.

Paleontological data are emphasized in the annotations, partly due to the interests of the senior author, but also partly because that was the emphasis of many of the early geological researchers of Mississippi.

References cited in the annotations which are not included in the annotated references are provided at the end of the paper.

A few unpublished manuscripts are included with the other references, as they often provide background for the published works. They are indicated in the list by the symbol: (.

Certain published references which do not specifically mention Mississippi are included because they were critical to the development of Mississippi geology. Such references, and the key historical events, are indicated in the list by the symbol:].

Although the Mississippi Geological Survey was activated on June 1, 1850, the cut-off date for references cited here is (for convenience sake) the end of that year.

ACKNOWLEDGMENTS

The difficulty of writing a bibliographic paper like this one is in tracking down, and locating copies of, very obscure references. Several people greatly simplified the process for the authors.

Foremost of those who assisted the senior author are the interlibrary loan, rare book room, and circulation desk (who patiently retrieved old volumes of the *American Journal of Science* from the dark basement storeroom) staffs of the Howard / Tilton Library at Tulane University: New Orleans, Louisiana.

James Corgan (Professor Emeritus, Geology Department, Austin Peay State University; Clarksville, Tennessee) provided difficult to obtain copies of Troost (1834), Tindall (1840), and Anonymous (1844); as well as references to Nuttall (1821), Nutt (1833), Fanning (1850), and the essential Cornelius (1819). He also provided much needed encouragement.

Janie Morris (Special Collections Library, William R. Perkins Library, Duke University; Durham, North Carolina) kindly provided copies of Wailes (1825) and (1842), as well as three 1846-7 letters from Gale to Wailes, from the Wailes Papers there. Joyce Dixon (Archives and Library Division, Mississippi Department of Archives and History; Jackson, Mississippi) helpfully sent a copy of the obscure Dickeson (1842). Many of the references cited here (notably the essential 1845 Wailes and Dickeson abstracts) were located only because of the unusually carefully researched bibliography of the vertebrate fossils of Mississippi and Louisiana by Domning (1969).

The authors are particularly grateful to those who made available important unpublished 19th century manuscripts. Carol Spawn (Ewell Sale Stewart Library, The Academy of Natural Sciences; Philadelphia, Pennsylvania) sent copies of the very important Wailes (1844) and Dickeson (1845) manuscripts for their 1845 convention talks, which had not previously even been recorded as surviving. Mrs. Jimmy Wailes, of Jackson, kindly permitted the junior author to copy the Wailes (1847) manuscript in her possession.

The manuscript was reviewed by James Corgan and Lewis Dean (Geological Survey of Alabama, Tuscaloosa). The difficult job of typing the paper was done by Janice Alewine (Mississippi Office of Geology).

ANNOTATED BIBLIOGRAPHY, GEOLOGY OF MISSISSIPPI TO 1850

[1716 – Natchez established by the French.

[1729 – French colonists were massacred by the Natchez Indians, who, in revenge, were nearly exterminated by the French.

[1763 – Natchez becomes English.

[1770s – Natchez becomes Spanish.

Hutchins, T., 1784, An historical narrative and topographical description of Louisiana and West-Florida: Robert Aitken, Philadelphia, iv + 5-94 p. 1968 facsimile reproduction with an introduction by Joseph G. Tregle, Jr., University of Florida Press, Gainesville, xlviii (introduction) + iv + 5-94 + 3 (index) p.

Thomas Hutchins (1730-1789, then 54) was born in New Jersey, then British America, and spent most of his career as an engineer and surveyor for the British army (see biographical data in introduction to 1968 edition). He switched allegiance to the United States in 1781, obtaining the title "Geographer to the United States." Through all his travels he kept detailed notes and made many maps and sketches. This book describes the geographical features he observed along the Mississippi River (including the tributaries now in western Mississippi, p. 49-55) and in West Florida (a strip of land

along the Gulf Coast from present West Feliciana Parish, Louisiana, to the Apalachicola River in Florida, including southern Mississippi, p. 63-67), with reference to soil conditions and springs suitable for water supply. A map was intended for this small pamphlet, but funds were not available for it. Economic minerals were listed as well. This is probably the first published report on Mississippi geology. It includes far more geology than the other early geographic works on the state, and is apparently the first to discuss the practical use of Mississippi geological resources. Mississippi was then Spanish, and he warns that their control over the Mississippi River was a threat to American access (p. 23). In the Natchez area, he mentioned that clay suitable for pottery was available (p. 50). Hutchins owned land in the Natchez area, and extolled the fertility of its soils (p. 49-50). At Petit Goufre (named to contrast with Grand Gulf, changed by the English to Rodney), he mistook "firm rock" (silica-cemented Oligo-Miocene sandstone) for limestone (p. 52). Along the lower "Bayouk Pierre, or Stoney River" he wrote "there are several quarries of stone, and the land has a clay soil with gravel on the surface of the ground" (p. 52). Along the Big Black River are lands suitable for settlement, with many springs; he described a rapid on the river "and in one place a firm rock almost across the river, and as much of it bare, when the water is at a moderate height, as confines the stream to nearly 20 feet" (p. 53). There is building stone near the "Yazou" River, but none nearer to Natchez than Petit Goufre. Twelve miles above the mouth of the Yazoo is "a cliff of solid rock at the landing place, on which are a variety of broken pieces of sea shells, and some entire" (p. 55). This probably refers to the early Oligocene mollusks of the Vicksburg Group, near Redwood, in Warren County, and is probably the first published reference to Mississippi fossils / invertebrate fossils / fossil mollusks / and Oligocene fossils. Hutchins' description of the location and dimensions of the offshore barrier islands (p. 64-67) is of value to coastal geologists today in determining rates of erosion and migration of the islands. He also points out the good soil along the Pascagoula River (p. 64).

[1798 – Mississippi becomes American (obtained from the Spanish); the Territory of Mississippi is organized (including modern Alabama).

[1799 – Adams and Jefferson counties created; the city of Washington created.

[1802 – Jefferson College, in Washington, is incorporated.

Pendergrast, G. E., 1803, A physical and topographical sketch of the Mississippi Territory, Lower Louisiana, and a part of West Florida: Published M.D. dissertation, University of Pennsylvania (medical school), Philadelphia. Printed at the office of *The Gazette of the United States*, Philadelphia, 34 p.

Published M.D. dissertations in medical topography (the now-discredited study of how landforms affect the distribution of diseases) are a surprising early source of geological information (Corgan, 1985, p. 11; Hazen and Hazen, 1980, p. 6-7). The extent (p. 19) and width (p. 20) of the Mississippi bluffs are noted, and Mississippi soils are discussed (p. 13). There are no descriptions of geological beds. On leaving medical school, Garrett Elliott Pendergrast became a doctor in Natchez.

Volney, C. - F. Chasseboeuf, comte de, 1803, Tableau du climat et du sol des États-Unis d'Amérique: Courcier, Paris, v. 1 with xvi + 300 p., pls. 1 and 3; v. 2 with p. 301-534, pls. 2 and 4. Reprinted in America in 1804 as: A view of the soil and climate of the United States of America: J. Conrad and Co., Philadelphia, translated by C. B. Brown, in one volume, xxviii + 446 p., 4 pl. The 1804 American edition was reprinted in 1968 by Hafner Publ. Co., New York, xviii (reprint introduction) + xxviii + 446 p., 4 pl.

This is primarily a travelogue of early America, but with topographic and geologic commentary. It does not appear that Volney (1757-1820) traveled to what is now Mississippi (White, in the 1968 reprint, p. vi). Aside from vague mention of Mississippi Territory, there is only one direct mention of a current Mississippi site—a mention of the cliffs along the Mississippi River at Natchez (p. 17 of the 1803 edition, p. 14 of the 1804 and 1968 editions).

Ellicott, A., 1803, The journal of Andrew Ellicott, late commissioner on behalf of the United States during part of the year 1796, the years 1797, 1798, 1799, and part of the year 1800: Budd and Bartram, Philadelphia, vii + 300 + 151 (appendix) p., 6 maps. 1962 reprint by Quadrangle Books, Chicago.

Here Ellicott (1754-1820, 44 in 1798) oversees the transfer of Mississippi Territory (including what is now Alabama) in 1798 from Spain to the U.S. He also takes many astronomical and meteorological measurements in what is now Mississippi (appendix). Because the main part of his job is to establish the Territory's western and southern borders, the book includes detailed maps of the Mississippi River (pl. C and D) and the 31st degree of latitude (pl. E – the boundary with Spanish West Florida, including what is now southern Mississippi).

Like most of the early works, there is much geographical data, but little that is strictly geological. It is noted that "The soil in the district of Natchez is at present uncommonly fertile: but the country being high, hilly and broken, the fine rich mold [soil zone] will be washed away after a series of cultivation, and the country become less productive. This tract of good upland [the loess belt] is not very extensive, being about 130 miles in length along the Mississippi, and not more than 23 in breadth" (p. 133). It is suggested that the bluffs be taken advantage of, in the placement of forts at Walnut Hills (Vicksburg) and Loftus's Heights (northeast of Fort Adams, in Wilkinson County), as well as the "commanding eminence" on the Pearl River just north of the boundary with West Florida (p. 281).

Dunbar, W., 1804, Description of the river Mississippi and its delta, with that of the adjacent parts of Louisiana: American Philosophical Society, Transactions, series 1, v. 6, pt. 1, p. 165-187.

This report is also primarily topographic, with a good deal of Mississippi River geomorphology. Dunbar suggests (incorrectly) that the Mississippi bluffs are thick natural levee deposits (p. 174). This is the most geological of the eleven articles published by Dunbar, the Father of Mississippi Science, in the sixth volume (1804 and 1809) of the *Transactions of the American Philosophical Society* of Philadelphia. Other articles deal with meteorology, astronomy, a mastodon from Louisiana, Indian sign language, etc. William Dunbar (1749-1810, 55 in 1804) was a Scottish immigrant who settled at the plantation The Forest, south of Natchez, in 1792. He

was a trader and planter (see biography – Rowland, 1930), and greatly influenced early scientific research in Mississippi, notably that of Pendergrast, Nutt, and Wailes.

Anonymous, 1806, Extensive layers of marine shells found in Georgia and the Mississippi Territory: The Medical Repository (New York, 1797-1824), v. 9, p. 436.

It is (incorrectly) reported that a single bed of fossil shells extends from eastern Georgia, westward across Alabama, and "there is reason to believe that there is a continued layer of them in the same direction quite across the country to the Mississippi." The same concept was later expanded by Finch (1824, p. 39-41) in proposing a widespread "Calcaire Ostree" (oyster limestone) bed across the Gulf Coastal Plain. It is now known that these sites represent several unrelated shell beds of different geologic ages.

Dunbar, W., and G. Hunter, 1806, Observations. Pages 84-128, *in* M. Lewis, Message from the President of the United States, communicating discoveries made in exploring the Missouri, Red River, and Washita, by captains Lewis and Clark, Doctor Sibley, and Mr. Dunbar: Hopkins and Seymour, New York, 128 p. Also printed in 1806 by Andrew Marschalk of Natchez (one of the first Mississippi geology articles printed in Mississippi, rather than the East Coast), and A. & G. Way of Washington, D.C. Reprinted in 1809 in the American Register (Philadelphia, 1807-1811), v. 5, p. 311-345.

This is the first reference to Mississippi fossil plants and petrified wood. Dunbar was exploring the Ouachita River of northeastern Louisiana and southeastern Arkansas as part of the exploration of the Louisiana Purchase for President Jefferson (in the same way Lewis and Clark explored the far larger Missouri River in the upper purchase). Dunbar stopped at White Cliffs (Ellis Landing, 12 miles below Natchez, in Adams County, southwestern Mississippi) on his way to the Ouachita River, and briefly noted the beds present and the petrified wood found there (p. 84). Dunbar's actual log entry (from which the paragraph on Mississippi derives) is given in Rowland (1930, p. 216). Dunbar visited White Cliffs on Tuesday, October 16, 1804.

Maclure, W., 1809, Observations on the geology of the United States, explanatory of a geological map: American Philosophical Society, Transactions, series 1, v. 6, pt. 2, p. 411-428, with map. The geological map is reprinted as the frontispiece of Merrill (1924), and in Lessing (1999, p. 123).

This is the first geologic map of the United States (then extending only to the Mississippi River), making William Maclure (1763-1840, then 46) the Father of American Geology. This was the largest geological mapping project attempted to that date (Hazen, 1974, p. 1828). Biographical information on Maclure is given in Lessing (1999, p. 118-120). The map shows a very extensive Mississippi Embayment (not called that, and not mentioned in the text), showing it as a northward lobe of the otherwise coastal "Alluvial Rocks" (meaning unconsolidated sediment—the terminology is fundamentally Wernerian, but used in a structural sense). Both western and southern (below Natchez) Mississippi are shown as Alluvial Rocks. Central, central-eastern, and northeastern Mississippi are shown as "Secondary Rocks" (for lithified and slightly tectonically altered beds). German geology professor Abraham Gottlob Werner (1749-1817) set up a classification of rocks in the early 1800s (including, from oldest to youngest, Primitive, Transition, Secondary, and Alluvial) in which certain rocks were thought to be the same age everywhere (see Lessing, 1999, p. 120), something now long known to be untrue. Werner was also part of a second early controversy in geology—between neptunists (including Werner) and plutonists. Neptunists argued that all rocks were formed in the ocean (either as chemical precipitates or as deposited sediment), while plutonists thought (as we do today) that some rocks were originally molten, then crystallized as they cooled. Maclure was a staunch defender of Wernerian terminology, although he accepted the igneous origin of some rocks (Maclure, 1824; Lessing, 1999, p. 129-130), unlike most neptunists.

[1810 – West Florida (including southern Mississippi) was annexed from Spain.

[1811 – Jefferson College opened.

Maclure, W., 1811, Suite des observations sur la géologie des États-Unis servant à l'explication de la carte cijointe: Journal de Physique, Chimie, et Histoire Naturelle et des Arts, v. 72, p. 137-165, with map.

This is a slightly revised version of the geologic map in Maclure (1809). It uses the geographic map in Volney (1803) as a base. As regards the Mississippi area, it differs from the 1809 map in two significant ways: the Mississippi Embayment is considerably reduced (correctly deleting the part north of Cape Girardeau, Missouri, but incorrectly "slimming" the part to the south of it), and incorrectly expanding the "Secondary Rocks" westward (abutting the Mississippi River from about Vicksburg to Fort Adams).

Sargent, W., 1814(?), Account of several shocks of an earthquake in the southern and western parts of the United States: American Academy of Arts and Sciences, Memoirs, series 1, v. 3, pt. 2, p. 350-360 (although part 1 is dated 1809, the publication date of part 2 is unclear, but probably after 1814—written communication, 1977, Jane C. Lucey, American Academy of Arts and Sciences, Boston).

Winthrop Sargent (1753-1820), Governor of the Mississippi Territory, reports in a letter dated April 2, 1812, the effects experienced at his home two miles south of Natchez from the great New Madrid, Missouri, earthquakes of 1811-1812. He and others felt several of the larger shocks of the series. At its worst, in the initial quake of 2 a.m., December 16, 1811, the vibration was severe enough to jar his furniture and rattle the china in his cupboard (p. 351-352). Included are Sargent's meteorological observations for each day of December 1811 (p. 358-360). This is the first report of an earthquake felt in Mississippi.

The 1809 date of part 1, printed in the front of the volume, has been erroneously cited for this publication.

[1817 – Mississippi is admitted into the Union (Alabama becomes a separate territory).

Darby, W., 1817, A geographical description of the state of Louisiana, the southern part of the state of Mississippi, and territory of Alabama: 2nd ed., James Olmstead, New York, 356 p., with 3 maps.

Mississippi is, literally, a side-item in this major, early geography and map of Louisiana. Mississippi had only recently become a state when William Darby (1775-1854, 42 in 1817) published this book, the 1816 first edition of which had not included Mississippi.

The bluffs at "Walnut hills [Vicksburg], Grand and Petite [Rodney] Gulph, Natchez, White Cliffs, and Loftus Heights" are noted (p. 290, 299), and the high quality of the flood-plain soil (the "Mississippi bottom" soil, p. 305) in that area is emphasized (the "Bluff soil" is considered of medium grade). The poorer quality of the soil in areas covered only in pine (the "Pine woods" soil) is also noted (p. 291, 292). The soil of the bluff region is said, generally, to be "amongst the most valuable and productive in the United States, in proportion to its extent" (p. 306). The rock exposed at Loftus Heights (just north of Fort Adams, in western Wilkinson County) is especially noted (p. 294, 306), said to be the last hard rock seen along the Mississippi when traveling south. It is called "a Breccia, or Pudding stone" (the latter is now considered a separate rock, conglomerate), which is "only visible when the river is extremely low" (p. 294). From the description of the rock as siliceous pebbles cemented with iron, it seems likely that it is a limonite-cemented bed of river gravel, a type of "bog iron" conglomerate formed when an iron-bearing gravel bed becomes water-saturated. Unidentified "petrifactions" are recorded as being found with the rock (p. 294), probably silicified wood. Darby suspects that there may be a bed of "horizontal sandstone, or the secondary floetz of Werner" (p. 294) below the "Breccia" at the surface. He argues (incorrectly) that the 1812 earthquake was felt at Natchez because of this hard subsurface bed (p. 306).

It is notable that Darby's discussion (and map) of Mississippi geography (p. 290-297, dealing primarily with rivers, soils, and plants) is not confined to the area along the Mississippi River, but includes the entire state (although the northern part was less well studied, as it was still Indian-controlled). Even much later geologic work was far less comprehensive. Darby notes that springs are generally found in areas underlain by clastic ("stratified argillaceous schist"), rather than calcareous, beds (p. 307).

Darby, W., 1818, The emigrant's guide to the western and southwestern states and territories: Kirk and Mercein, New York, 311 p.

The information in Darby (1817) is repeated (nearly verbatim) in an immigrant's guide to the Old SouthWest. The material on the bluffs (p. 114, 118), soils, "Breccia" at Loftus Heights (p. 116, 122), etc., is repeated.

Maclure, W., 1818, Observations on the geology of the United States of North America; with remarks on the probable effects that may be produced by the decomposition of the different classes of rocks on the nature and fertility of soils: applied to the different states of the Union, agreeably to the accompanying geological map: American Philosophical Society, Transactions, series 2, v. 1, no. 1, 91 p., 2 pl.

As noted by Lessing (1999, p. 127-128), the map used in this journal article (called map 1817A by Lessing) was sometimes used in a privately printed Maclure publication dated 1817 but printed about 1821, and is a somewhat older printing (it includes, for example, Missouri and Illinois as territories rather than as states, as they are in the Maclure 1817B map in Maclure, 1821(?)). Mississippi is drawn much the same as in the 1817B map—the Mississippi Embayment is comparable and most of the state is shown as Secondary Rocks. There is a slight difference in the width of the southern band of Alluvial Rocks (the Gulf Coastal Plain)—its northern boundary on the east side of the state is farther north (moved from about Buckatunna to about Quitman). Although both maps show the position of the Chickasaw (northern Mississippi) and Choctaw (central Mississippi) tribes, there are interesting geographic differences. The older 1817A map of this publication does not include Jackson, but clearly shows the Natchez Trace; the newer 1817B map of the 1821(?) publication shows Jackson but the Trace only roughly.

Cornelius, Rev. E., 1819, On the geology, mineralogy, scenery, and curiosities of parts of Virginia, Tennessee, and the Alabama and Mississippi territories, &c. with miscellaneous remarks, in a letter to the editor: American Journal of Science, series 1, v. 1, p. 214-226, 317-331 (in two parts). The letter was written earlier, before Mississippi became a state. Alabama gained statehood toward the end of 1819.

This is the first report on the geology of the "interior" of Mississippi (east of the narrow band along the Mississippi River). Reverend Elias Cornelius (1794-1832, only 25 in 1819), a geology student of Benjamin Silliman (1779-1864; one of the first geology teachers in America [starting in 1802], and editor of the *American Journal of Science*, which began in 1818) at Yale, traveled down the Natchez Trace in Mississippi, in its early days. He was the second to report invertebrate fossils (mollusks) from Mississippi, and the first to note such fossils from a well at the Choctaw agency (probably from what is now the late Eocene Jackson Group of what is now southern Madison County), and "two kinds" of "oyster-shells" in the "white marl" from the Chickasaw nation of northeastern Mississippi (probably the oysters *Exogyra* and *Pycnodonte*), from what is now known as the late Cretaceous chalk beds (both sites on p. 327). These records were frequently cited in early Mississippi geology literature, often obliquely, without noting Cornelius himself. Cornelius also discussed the nature of the bluffs at Natchez (p. 325-326), the Alluvial (in the Wernerian sense, as opposed to Secondary) nature of most of northern Mississippi (p. 324), and petrified wood, siliceous pebbles, iron oxide, and "a great variety of useful ochres" (p. 325) in Mississippi. Cornelius (1819) could be said to be the first broad geological survey of Mississippi, greatly exceeding in quality all the earlier work.

Nuttall, T., 1821, Observations on the geological structure of the valley of the Mississippi: Philadelphia Academy of Natural Sciences, Journal, v. 2, pt. 1, p. 14-52.

Thomas Nuttall (1786-1859, then 34), famous for his extensive travels in America, was an ornithologist and botanist, not a geologist. Here he notes the various beds of lithified rock seen along the Mississippi River in southwestern Mississippi (p. 41)—at the base of the hills at Fort Adams (now the late Miocene Pascagoula Formation), at Grand Gulf (the Oligo-Miocene Catahoula Formation), and at Walnut-hills (renamed Vicksburg in 1819, a name not commonly used till much later) (the early Oligocene Vicksburg Group limestones)—and incorrectly considers them all a single bed. He discusses the Mississippi bluffs (p. 44), and refers to Cornelius' paper (footnote, p. 41).

Maclure, W., 1821(?), Observations on the geology of the United

States of America; with some remarks on the effect produced on the nature and fertility of soils, by the decomposition of the different classes of rocks; and an application to the fertility of every state of the Union, in reference to the accompanying geological map: printed for the author by Abraham Small, Philadelphia, 127 p., 2 pl. Dated 1817, but actually printed later.

This is a major revision of Maclure's maps of 1809 and 1811. As discussed by Lessing (1999, p. 127-128), there are two peculiarities about this privately-produced publication. First, various copies of it include three slightly different versions of the geologic map (called by Lessing 1817A, B, and C). Second, the 1817B map appears to have been printed quite a bit later than 1817 (based on the corrections in state and territorial boundaries), probably after 1821 (Lessing, 1999, p. 128).

In the 1817B map (a copy is included in the 1969 reprint of Merrill, 1924), Mississippi appears as a state, rather than as a territory, and includes the coastal part (originally Spanish West Florida), giving the state nearly its present boundaries. The Mississippi Embayment has been further reduced, to a narrow band along the Mississippi River, from about Fort Adams to only about Greenville. The major changes in the Embayment in Maclure's maps corroborate the idea that Maclure probably had not studied the area carefully himself, but gathered information on it from travelers. Because of the very narrow Mississippi Embayment, and because the southern end of the Appalachians is placed farther east than in the earlier maps, most of Mississippi north of Natchez becomes Secondary Rocks in this map (today all but the extreme northeast corner of the state is considered what Maclure mapped as Alluvial Rocks [Mississippi Embayment and Gulf Coastal Plain]).

[Buckland, W., 1823, Reliquiae Diluvianae; or observations on the organic remains contained in caves, fissures, and diluvial gravel, and on other geological phenomena attesting the action of an universal deluge: J. Murray, London, 303 p., 27 pl.

The term "diluvial" (from "diluvium," Latin for "deluge") is proposed here, partly as a term for flood deposits (called "drift" previously), and partly as a chronologic term for beds and fossils today considered Pleistocene. Reverend William Buckland (1784-1856, then 39) was an Anglican minister and Oxford University geologist (probably the first professional geologist). Buckland named the first dinosaur (*Megalosaurus*) a year later. In early Mississippi geological literature, Mississippi River gravels were often considered diluvial, rather than alluvial—primarily because rivers were not thought to have either great erosive or carrying power.

Finch, J., 1824, Geological essay on the Tertiary formations in America: American Journal of Science, series 1, v. 7, no. 1, p. 31-43.

This is a landmark in the history of coastal plain stratigraphy. It obliquely refers to Cornelius' work (p. 40 and 41) and directly refers to Nuttall's (p. 37). English geologist John Finch argues that the broad term "Alluvial Formation" (as by Maclure) should be abandoned in favor of a series of seven different beds, in what is now the Atlantic and Gulf Coastal Plain. Some beds (e.g., the "London Clay") are assigned to European beds. The "Diluvial" (bed 7) is treated as both a flood and a post-Tertiary unit. The first fossil to be named from either the Gulf or Atlantic Coastal Plain, *Ostrea* (now *Crassostrea*) *gigantissima* (from the late Eocene of Shell Bluff, eastern Georgia), is formally described (p. 40). An excellent review of this important species is given in Howe (1937).

Drake, D., 1825 (written in 1817), Geological account of the valley of the Ohio: in a letter from Daniel Drake, M.D. to Joseph Correa de Serra: American Philosophical Society, Transactions, series 2, v. 2, no. 4, p. 124-139, 1 pl.

A gravel deposit "not many miles above Natchez" (p. 135) is noted, and considered evidence of a flood. What is now called loess is considered the final flood deposit (p. 135-137), and erratics (large, geologically out-of-place, boulders, now thought to have been moved south by a thick continental glacial ice sheet) are interpreted as carried in floods by icebergs (p. 137-138). River valleys are thought by Dr. Drake (1785-1852, 32 in 1817) to have been created by ocean floods, explosions, or ruptures, rather than by uniformitarian river erosion (p. 126)—a Wernerian, catastrophist analysis of rivers. In early geology, uniformitarians saw the rock record as produced by slow, steady processes, while catastrophists saw it as from a series of sudden catastrophes. Today it is seen as mostly uniformitarian, but with occasional catastrophes. Flood deposits are far rarer than the catastrophists thought.

Wailes, B. L. C., 1825, Inaugural address of the Adams [County, Mississippi] Athenaeum, printer not indicated, 1 p. Copy in the Wailes Papers, Special Collections Library, Duke University.

This is a printed presidential address to a new local literary and intellectual society. Benjamin Leonard Covington Wailes (1797-1862, then only 28), a Washington, Mississippi, planter, naturalist, and historian, later wrote the first geological report for the Mississippi Geological Survey (Wailes, 1854). The only geological references here are to note that Mississippi is poor in minerals, but has a rich, fertile soil. This is the first of many lengthy reports by Wailes. An excellent biography of Wailes has been done (Sydnor, 1938).

Flint, T., 1826, Recollections of the last ten years, passed in occasional residences and journeying in the valley of the Mississippi: Cummings, Hilliard, and Co., Boston, 395 p. Reprinted by DeCapo Press, New York, 1968.

Timothy Flint (1780-1840, 46 in 1826) traveled extensively in the Mississippi Valley between 1816 and 1826, and wrote this popular travelogue of his life there. The only geologic note is on the (loess) bluffs from Walnut Hills (Vicksburg) to Baton Rouge (p. 293-296).

Mitchill, S. L., 1826, Catalogue of the organic remains, which, with other geological and some mineral articles, were presented to the New-York Lyceum of Natural History, in August 1826, by their associate, Samuel L. Mitchill: J. Seymour, New York, 40 p.

Two mastodon teeth are reported from "near Natchez" (p. 10). This is the first report of Mississippi vertebrate fossils / Pleistocene fossils / Natchez area fossils / or mastodon. Also noted are "A group of gryphaea shells, not consolidated, from the Chickasaw country, where they are said to be very numerous" (p. 9). These are probably late Cretaceous *Pycnodonte* and *Exogyra* shells from northeastern Mississippi. There is also a very early report of the thick bed of (middle Eocene Gosport Formation) mollusks from the area of Fort Claiborne, on the Alabama River in southwestern Alabama (p. 8).

later made famous by Conrad. Dr. Samuel Latham Mitchill (1764-1831, then 62), a medical professor at Columbia College (later University) and proponent of medical topography, is best known for his discussion of American fossils in the introduction to the American edition of Cuvier's *Theory of the Earth.*

Darby, W., 1828, View of the United States, historical, geographical, and statistical: H. S. Tanner, Philadelphia, 654 p., with maps.

This is a tiny (about 3x5 inches), but thick, geographic handbook of the U.S. The northern limit of the coastal plain in Mississippi (thought to be equivalent to the Fall Line of the Atlantic coast) is (incorrectly) given as between Natchez and the mouth of the Big Black River (p. 82). The book, also incorrectly, says that the Mississippi River never changes its course (p. 470). Much is repeated from Darby (1817) on the soils and bluff region of Mississippi (p. 548-549). He notes that "The metallic productions [metal ores] of this state deserve no particular notice" (p. 549).

Vanuxem, L., and S. G. Morton, 1828, Geological observations on the Secondary, Tertiary, and Alluvial formations of the Atlantic coast of the United States of America: Philadelphia Academy of Natural Sciences, Journal, series 1, v. 6, pt. 1, p. 59-71.

This is probably the formal start of biostratigraphy in America. Mississippi geology is only noted in saying that the Coastal Plain deposits meet the Mississippi Embayment ("the alluvial basin of the Mississippi") "below Natchez" (p. 61, in reference to Maclure's later maps). Lardner Vanuxem (1792-1848, then 36) had done the first geological survey of South Carolina in 1826 (only the second of any American state, after North Carolina in 1824). Samuel George Morton (1795-1851, then 33) was a Philadelphia anatomy teacher, who became one of the first to formally study American invertebrate fossils. This paper follows Finch (1824), without ever citing that paper, but goes beyond it in using fossils for correlation. This paper marks the point at which an informed correlation to European beds was first made. Finch's uncited *Ostrea gigantissima* is, improperly, renamed *O. gigantea* (p. 69), or perhaps simply misspelled (Howe, 1937, p. 357-358). The term "diluvial" is avoided, in favor of "ancient alluvial" ("alluvial" is used here only for modern sediment).

Morton, S. G., 1829a, Description of two new species of fossil shells of the genera *Scaphites* and *Crepidula*: with some observations on the Ferruginous Sand, Plastic Clay, and Upper Marine formations of the United States: Philadelphia Academy of Natural Sciences, Journal, series 1, v. 6, pt. 1, p. 107-119, pl. 7.

Possibly a very oblique reference is made to the fossil oyster shells of northeastern Mississippi reported by Cornelius (1819), among others (including Anonymous, 1806, and Finch, 1824), in saying that "... vast deposits of oyster shells, which, extending through nearly all the more southern States, have attracted the attention of every class of travellers" (p. 116-117). Finch (1824) is finally cited, but partly to criticize it.

(Lesueur, C.-A., 1829 manuscript, The geology and paleontology of Walnut Hills, Mississippi: Lesueur Collection, no. 45120-45178, with 12 pl.; Museum of Natural History, Le Havre, France.

Charles-Alexandre Lesueur (1778-1846, 51 in 1829) was a French naturalist and artist who traveled extensively in the United States, especially in the Mississippi Valley. This manuscript, on the geology and paleontology of the Walnut Hills (Vicksburg) area, includes twelve beautiful lithographed plates illustrating the geologic section at Vicksburg and the invertebrate (including microfossils) and vertebrate (including otoliths) fossils of what is now known as the early Oligocene Vicksburg Group. Unfortunately, the plates were not published till 153 years later (Dockery, 1982a; 1982b, Appendix 2), and the manuscript still has not been published. Had it been published in 1829, it would have been the first described Mississippi geological section, its first described fossil fauna, and its first illustrated fossils.

[Morton, S. G., 1829b, Note: containing a notice of some fossils recently discovered in New Jersey: Philadelphia Academy of Natural Sciences, Journal, series 1, v. 6, pt. 1, p. 120-129.

Finch (1824) is again referred to extensively, but not cited. Beds in Alabama are considered "Ferruginous sand," a bed "contemporaneous with the great Chalk formation of Europe" (p. 127), today considered late Cretaceous.

[Conrad, T. A., 1830, On the geology and organic remains of a part of the peninsula of Maryland: Philadelphia Academy of Natural Sciences, Journal, series 1, v. 6, pt. 2, p. 205-230, pls. 9 and 10.

Timothy Abbott Conrad (1803-1877, only 27 in 1830) later became America's foremost student of fossil mollusks (not least Mississippi's). In one of his early papers, he here follows Finch (1824, p. 39, when discussing sites in Virginia) in assigning American beds to the London Clay. Although Lyell did not name the "Eocene" till three years later (Lyell, 1833), this was clearly an attempt by Conrad to identify beds of Eocene age in America. The beds he assigned, from the Piscataway area of Maryland, are now assigned to the late Paleocene Aquia Formation. Because of the fossils cited (p. 215-217), notably *Venericardia planicosta*, Conrad had far more basis for making the correlation than Finch, six years earlier.

[Conrad, T. A., 1832, Fossil shells of the Tertiary formations of North America: printed for the author by Judah Dobson, Philadelphia, v. 1, no. 1, viii + 20 p., 6 pl. Reprinted by the Paleontological Research Institution, Ithaca, NY, 1893 and 1963, p. 9-34, pl. 1-6.

This is the first formal description of a fossil (the clam *Cardita* [now *Venericardia*] *planicosta*) specifically from the Gulf Coastal Plain, from Claiborne Bluff, Alabama (p. 20). The material had been sent to Philadelphia; Conrad had not then seen any Southern sites. By assigning the site to the English "London Clay" or French "Calcaire grossier" (p. 14), Conrad here first assigns a bed of the Gulf Coastal Plain to what became (the following year) the "Eocene." A serious stratigraphic error was also made here, which greatly confused later work. What became known as "Nummulite Limestone" (now early Oligocene Vicksburg Group, with *Lepidocyclina* misidentified as "*Nummulites*") in Alabama was identified incorrectly as "Secondary" (referring to what is now called Cretaceous), and thought to be *below* the Claiborne Bluff beds (now middle Eocene Claiborne Group) (p. 14).

Flint, T., 1832, The history and geography of the Mississippi Valley, to which is added a condensed physical geography of the Atlantic United States and the whole American continent: 2nd ed., E. H. Flint and L. R. Lincoln, Cincinnati, vol. 1, 469 p.

This is an important U.S. geography book, expanded from

Flint's well known 1826 travelogue. Volume one deals with the Mississippi Valley, while the shorter volume two treats the rest of the country. It is largely a compilation, although the sources are only rarely indicated in the text.

The bluffs along the Mississippi River are noted (p. 101). Flint correctly suggests that the Mississippi Valley below the mouth of the Ohio (the northern limit of the Mississippi Embayment) "must then have been an arm of the sea," but incorrectly sees the much later bluffs along the river (including the Natchez bluffs) as having been "capes, that projected into this estuary" (p. 103). Following Dunbar (1804), Flint incorrectly considers the loess of the bluffs (here incorrectly called an "impalpable clay," meaning one in which no grit could be felt) a distal overbank deposit of the Mississippi River, the last river sediment to drop out of suspension (p. 104). Loess is wrongly considered alluvial long after this. Much information is taken, without citation, from Darby (1817), including material on the Mississippi River bluffs, Mississippi soils, and the "breccia" at Loftus Heights (p. 228-229). Building stone is reported from the Yazoo and Big Black river areas (p. 230).

Smith, J., 1832, Geology of Natchez: Atlantic Journal and Friend of Knowledge ("Rafinesque's Journal", Philadelphia, 1832-1833), v.1, no. 4, p. 135.

Baltimore physician James Smith here briefly describes the section at the Natchez bluffs. Because Dunbar and Hunter (1806) only sketched the beds present at White Cliffs, Cornelius (1819) did the same with those at Natchez, and Lesueur's (1829) Vicksburg section was published much later, Smith's is the first formal geologic section of a Mississippi site. He reports five strata in the approximately 220 foot Natchez bluff section: a four foot soil bed at the top, an 80 foot bed of "marly clay" (leached loess) below that, a 25 foot "Bank of clay and shells" (unleached loess) below, a 100 foot bed of "Pure marly clay" (loess) below, and a 20 foot bed (to river level) of siliceous gravel "with impressions of [Paleozoic] shells" at the base of the bluff.

Nutt, R., 1833, Miscellaneous geological topics relating to the lower part of the vale of the Mississippi; alluvion by rain; up filling and extension of valleys; subsidence of the sea; original vale of the river with its wings and present channel. From unpublished mss. on the Theory of the Earth: American Journal of Science, series 1, v. 23, no.1, p. 49-65.

This is the first full geologic paper on Mississippi written by someone actually living in the state (although Pendergrast had lived in Mississippi, his 1803 paper was primarily geographic, rather than geologic; Dunbar also lived in Mississippi, but his brief mention of Mississippi beds in his 1806 paper was only a side issue in a paper primarily on Louisiana and Arkansas).

Dr. Rush Nutt was a doctor and planter who lived in Rodney, southwest of Port Gibson. He was much influenced by Dunbar. This paper includes a full geologic section of the Mississippi bluffs (p. 49-50), the first report that the (Pleistocene loess) snails of the bluffs were terrestrial forms (p. 50), and the first discussion of the "blue clay" (probably unoxidized loess—Vestal, 1942, p. 17) of the bluffs (p. 52). He also discusses the Mississippi River and its delta (p. 60-62) and the New Madrid earthquake (p. 62-63). The dissolution of the (loess) snail shells by leaching (p. 55) is noted, as is the development of deep ravines in the bluff sediment (now loess) (p. 56). He also discusses the geomorphology of the Mississippi River at length (p. 58-65).

Morton, S. G., 1833a, Supplement to the "Synopsis of the Organic Remains of the Ferruginous Sand Formation of the United States": American Journal of Science, series 1, v. 23, no. 2, p. 288-294, pls. 5 and 8.

Another possible oblique reference to Cornelius (1819) is made, in stating that Mississippi "has an extensive marl tract in the Chickasaw fields, near the borders of Tennessee" (p. 288). Morton also says in the Mississippi section, "The characteristic fossils have been sent to me by my friend Mr. Brewster" (p. 288), although none of the described fossils is identified as being from Mississippi.

Here the first Oligocene fauna, and first Gulf Coastal Plain fauna, is described, from what is elsewhere called the "*Nummulites* Limestone" from "near Claiborne, Alabama." This is probably what is today the early Oligocene Marianna Limestone, lower Vicksburg Group; probably of Washington or Clarke County, southwestern Alabama. The four newly named invertebrates: *Nummulites* (now *Lepidocyclina*) *mantelli*, *Pecten* (now *Anatipecten*) *anatipes*, *Pecten perplanus*, and *Gryphaea* (now *Gryphaeostrea*) *plicatella*, are, unfortunately, described as from the "Ferruginous Sand Formation"—meant by Morton to indicate a "Secondary" (now late Cretaceous) age. In this he follows the error of Conrad (1832).

[Morton, S. G., 1833b, Supplement to the "Synopsis of the Organic Remains of the Ferruginous Sand Formation of the United States": American Journal of Science, series 1, v. 24, no. 1, p. 128-132, pls. 9 and 10.

Here Morton starts using the chronological term "Cretaceous" (p. 129) in place of the litho / chronological "Ferruginous Sand" (the name refers to the late Cretaceous glauconitic sands of New Jersey, sometimes then called "marls").

[Conrad, T. A., 1834, Observations on the Tertiary and more recent formations of a portion of the Southern States: Philadelphia Academy of Natural Sciences, Journal, series 1, v. 7, pt. 1, p. 116-157 (no figures).

Here is the first formal use of the term "Eocene" for American beds ("London Clay" and "Calcaire grossier" had been used earlier), one year after Lyell had named it in the final volume of his *Principles of Geology* (Lyell, 1833). As used here, for beds in Maryland, North and South Carolina, Georgia, Virginia, Alabama (in reference only to Claiborne Bluff), and Louisiana, the "Eocene" included both the Paleocene (named and separated from the Eocene by Schimper in 1874) and Oligocene (named and separated by von Beyrich in 1854). No Mississippi beds or fossils are cited. The "*Nummulites* Limestone" is here still placed below the Claiborne beds (p. 122).

Morton, S. G., 1834, Synopsis of the organic remains of the Cretaceous Group of the United States: Key and Biddle, Philadelphia, vi + 88 p., 19 pl.

An influential first review of American Cretaceous fossils (primarily mollusks), this is a compilation of all of Morton's papers on fossils, from 1827 to 1834. This paper includes another oblique reference to Cornelius (1819), in saying, "We learn from travellers,

that the Cretaceous rocks chiefly compose the countries of the Chickasaws and Choctaws, and it is highly probable that nearly the whole state of Mississippi is of the same formation" (p. 22). This is a bad mis-reading of Cornelius, as he assigned no ages, and because the fossils from the Choctaw Agency well were probably late Eocene Jackson Group. Morton also repeats the statements from Morton (1833a, p. 288) about the Chickasaw marl tract and Mississippi fossils sent by Mr. Brewster (p. 24). He also adds a sentence apparently referring to Cornelius (1819): "In the Choctaw country similar fossils are also very abundant." Here the Vicksburg Group early Oligocene invertebrates are still, incorrectly (following Conrad, 1832), considered Cretaceous, and thought to outcrop below the Claiborne beds.

Darby, W., and T. Dwight, Jr., 1834, A new gazetteer of the United States of America: 2nd ed., Edward Hopkins, Hartford, 608 p.

The "Mississippi" entry notes the bluffs along the Mississippi River (p. 296) and soils (p. 297); the "Natchez" entry notes that the Natchez section is mostly "clay," in places including beds of sand, with "a substratum of pudding stone rock" (a limonite-cemented sand and gravel bed) at river level (p. 319).

Troost, G., 1834, On the localities in Tennessee in which bones of the gigantic Mastodon and Megalonyx Jeffersoni are found: Geological Society of Pennsylvania (Philadelphia, 1834-1836), Transactions (one volume only, 1834-1835), v. 1, no. 1, p. 139-146.

There is a very brief mention of a mastodon tooth with a jaw fragment attached to it, from "near Natchez, on the Mississippi river" (p. 143). This is primarily a work on Tennessee mastodon sites. Gerard Troost (1776-1850, then 58) had become the first State Geologist of Tennessee in 1831. Little as it is, it is only the second reference to a vertebrate fossil from Mississippi (after Mitchill, 1826, which was also on mastodon teeth from the Natchez area).

Anonymous, 1835, Notice of the Transactions of the Geological Society of Pennsylvania: American Journal of Science, series 1, v. 27, no. 2, p. 347-355.

Troost's note on the mastodon tooth from near Natchez is cited (p. 354) in a review of the only published volume of the Transactions of the Geological Society of Pennsylvania.

Conrad, T. A., 1835, Eocene fossils of Claiborne, with observations on this Formation in the United States, and a geological map of Alabama, in Fossil Shells of the Tertiary Formations of North America: printed for the author by Judah Dobson, Philadelphia, v. 1, no. 3 (second version), p. 29-56, pl. 16-20. Reprinted by the Paleontological Research Institution, Ithaca, NY, 1893 and 1963, p. 75-116, pl. 16-20.

A very oblique reference to Cornelius (1819) is included, by way of Finch (1824), in saying that fossil oyster beds occur all the way from South Carolina west to the Mississippi River (p. 29). A serious error is made in saying that the Natchez bluff is of Eocene age (see Bartlett, 1846), correlating to the Eocene bed along the Ouachita River in northeastern Louisiana (the type locality of the late Eocene whale *Basilosaurus*, at Grandview Bluff, in southern Caldwell Parish) (p. 35, 36). This repeats the error from Conrad (1832) that the (now early Oligocene) limestone of Alabama is of late Cretaceous age (p. 35, 36).

[Featherstonhaugh, G. W., 1835, Geological report of an examination made in 1834, of the elevated country between the Missouri and Red rivers: printed for the U.S. War Department by Gales and Seaton, Washington, D.C., 97 p., with geologic cross section.

This is the first geologic report commissioned by the U.S. Government. It is a traverse, with detailed geologic cross-section, from Washington, D.C. to the Ozark region of Missouri and Arkansas. Unfortunately, the traverse passed north of Mississippi, and does not mention its geology.

George William Featherstonhaugh (1780-1866, 55 in 1835), then the first U.S. Geologist (1834-35), was an Englishman and a friend of English geologist Roderick Murchison. His usage of geologic chronologic terms (in a state of great change in the 1830s) was right up to date, unlike most American geological papers of the time. The geology of Alabama is discussed in this report, as well as several of its fossil sites, including Claiborne Bluff and Prairie Bluff (p. 38).

[Featherstonhaugh, G. W., 1836, Report of a geological reconnaissance made in 1835, from the seat of government, by the way of Green Bay and the Wisconsin Territory, to the Coteau de Prairie, an elevated ridge dividing the Missouri from the St. Peter's River: printed for the U.S. War Department by Gales and Seaton, Washington, D.C. (Senate document 333), 168 p., 4 pl. (including geologic cross section).

This is another geologic traverse, from Washington, D.C., to South Dakota—again passing north of Mississippi. It includes a good review of geology to that point (the terms "Cambrian" and "Silurian" were then only a year old). The Permian and Jurassic were then unknown in America.

(Anonymous, 1836 manuscript, in: Phillips, H., Jr., ed., 1884, Early Proceedings of the American Philosophical Society for the promotion of useful knowledge, compiled by one of the secretaries, from the manuscript minutes of its meetings from 1744 to 1838: American Philosophical Society, Proceedings, v. 22, part 3, 875 p., 6 pl.

In a later printing, it is reported (p. 683) that on April 1, 1836, Mr. [William Henry] Huntington (misspelled Huntingdon) of Natchez had made a donation to the society's "cabinet" (collection). This donation included late Pleistocene mammals from the loess at Natchez, later described by Leidy (see Domning, 1969, p. 398). The material was transferred to the Philadelphia Academy in 1849.

Gibson, J. B., 1836, Remarks on the geology of the lakes and valley of the Mississippi, suggested by an excursion to the Niagara and Detroit rivers, in July, 1833: American Journal of Science, series 1, v. 29, no. 2, p. 201-213.

A brief reference is made to Drake's (1825) brief comment noting a gravel bed just above Natchez (p. 209). This is primarily a bad biostratigraphy paper on western New York and Pennsylvania, but interesting for its staunch diluvialism. It is argued that the Great Lakes beds and Mississippi Valley were carved by ocean flood (p. 208-210), and that mastodons became extinct as a result of the flood (p. 210-211, 213), then a commonly held belief. John Bannister Gibson, Esq. (1780-1853, then 56) was Chief Justice of the

Pennsylvania Supreme Court.

Bromme, T., 1837, Mississippi. A geographic-statistical-topographic sketch for immigrants and friends of geography and ethnology: Translated from the German and edited by C. F. Heartman, published in 1942. Journal of Mississippi History, v. 4, no. 2, p. 95-112.

This is a discussion of Mississippi, written for potential German immigrants. Traugott Bromme (1802-1866, then 35) was a German who traveled extensively in America. The content is primarily geomorphology, but (as one would expect in a publication aimed mostly at farmers) includes a good deal on the soils of various parts of the state (p. 100-101). There is also some discussion of the beds below the soil and geologic resources available in the state (clay, gravel, marl, iron ore, lead, chalk, slate, freestone, and pit coal, p. 101).

Tindall, J. L., 1840, Soil and agriculture of Monroe County, Mississippi: Southern Cultivator (Columbia, Tennessee, 1839-1840 only), v. 2, no. 14, p. 209-210.

This is a discussion of the soil and agriculture of Monroe County, in northeastern Mississippi, in a planter's magazine. It notes "different varieties of marine shells, some very perfect, and others partially decomposed" in the soil of Monroe County (p. 209). This likely refers to the late Cretaceous oysters *Exogyra* and *Pycnodonte*; probably from the Tombigbee Sand, Mooreville, or Demopolis formation.

[Agassiz, L., 1840, Études sur les glaciers: H. Nicolet, Neuchâtel, Switzerland (reprinted in 1967 by Hafner, New York).

This was the first monograph on the geology of glaciers. Louis Agassiz (1807-1873, 33 in 1840) was a Swiss geologist and paleontologist, who immigrated to America in 1846. With the explanation of how glacial till (unsorted clay to boulder-sized particles plowed up by glacial ice) is formed, Diluvial (flood) Theory began to disappear. Still, Glacial Theory was not generally accepted in the U.S. until 1867 (Hallam, 1983, p. 79).

Hitchcock, E., 1841, Final report on the geology of Massachusetts: J. H. Butler, Northampton, 831 p., 55 pl., in two volumes.

Drake's (1825) report of a gravel bed above Natchez is briefly noted (p. 781). This was the first report of Agassiz's Glacial Theory in America. Curiously, this huge monograph on the geology of Massachusetts (the first geological survey of an entire state) was written while Edward Hitchcock (1793-1864, 48 in 1841) was still a committed diluvialist, and is mostly written with a pro-flood perspective. The discussion of Glacial Theory is primarily included as a postscript bound into the front of the first volume, in research published since the book was completed (notably Agassiz, 1840). Hitchcock was one of the first American geologists to defend Glacial Theory, although the influence of Lyell's work seems to have caused him to quickly abandon it (Silliman, 1994).

Wailes, B. L. C., 1842, Address delivered at Washington, Miss., before the Agricultural, Horticultural and Botanical Society of Jefferson College: Baldwin and Risk, Natchez, 20 p. Typed transcript of the Library of Congress original in the Wailes Papers, Special Collections Library, Duke University.

Wailes, then 45, was president of the society through its entire existence (Sydnor, 1938, p. 153), from 1839 to about 1844. It had evolved from the Jefferson College and Washington Lyceum (1835-1839). The only geological item is a call to establish "a geological and agricultural survey of the state," to be run by the society (p. 6).

Dickeson, M. W., 1842, Fossil remains: Southern Planter (Natchez and Washington, Mississippi; 1842 only), v. 1, no. 7-8, p. 26-27 (no figures).

A call for the excavation and preservation of mastodon remains found in the Natchez area is made. Wailes had discovered a partial mastodon skeleton in the Natchez area in the early 1830s (Sydnor, 1938, p. 172), and may have alerted Dickeson to them. Dr. Montroville Wilson Dickeson (1810-1882, 32 in 1842) was a Philadelphia physician, who lived in Natchez from 1842 to 1846. He had extensively traveled the country, collecting a variety of things—coins (he was an authority on early American numismatics; Dickeson, 1859), archaeological artifacts (he was an early excavator of Indian mounds; Culin, 1900), freshwater mollusks, invertebrate fossils (Cretaceous of New Jersey, Ordovician of Cincinnati, etc.), and vertebrate fossils (which seems to be the primary reason for his extended stay in Natchez). Biographical information on Dickeson is given in Culin (1900, p. 113-114). This is the first extended discussion of the mastodons of the Natchez area (or of any Mississippi vertebrate fossils). No age is assigned the (now late Pleistocene) material.

Anonymous, 1844, Fossil remains in Mississippi: The Guardian (Columbia, Tennessee), v. 4, no. 1, p. 157-158 (from the Macon [Mississippi] Independent newspaper), (no figures). The newspaper article was also reprinted in 1844 in the Western Literary Journal and Monthly Review (Cincinnati, 1844-1845), v. 1, p. 251-252.

This is a reprint of a newspaper article in a publication of the Columbia Female Institute, of Columbia, Tennessee. A discussion is given of the Wailes collection at Jefferson College (Wailes was probably the first geology teacher in Mississippi). This is the first report from Mississippi of *Basilosaurus* / fossil whales (*Basilosaurus* is here incorrectly identified as a marine reptile) / Eocene vertebrates (although no age date is given here) / fossils from the Jackson area / / *Megalonyx* (no age is assigned the Pleistocene fossils, probably from Adams County) / fossil ground sloths / fossil horses // mosasaurs / marine reptiles / Mesozoic vertebrates / Cretaceous vertebrates (incorrectly dated as "lias," or early Jurassic) / fossils from the Macon area / and fossil shark teeth. It also notes petrified wood (probably of Oligo-Miocene age), and reworked (Paleozoic) fossils in gravel from Adams County, Mississippi. Wailes collected extensively around the state, and obtained material from others. The article itself calls for specimens to be sent to the college. Following directions in Wailes' 1861 will (Segrest and Jimmy Wailes collection, Jackson) that it be sold to a "scientific or literary institution or college," Wailes' personal collection, including some of his fossils and papers, was purchased from his heirs by Louisiana State University in 1870 (Boyd, 1870, p. 13-14).

Featherstonhaugh, G. W., 1844, Excursion through the slave states, from Washington on the Potomac to the frontiers of Mexico; with sketches of popular manners and geological notices: Harper and Brothers, New York, 168 p.

This is a Southern travelogue, in which proper Englishman

Featherstonhaugh comments on all aspects of the South, including its geology. He comments on the deeply ravined bluffs at Vicksburg (p. 137), the rock exposed at Grand Gulf (p. 138), and the bluffs at Rodney and Natchez (p. 138).

(Wailes, B. L. C., 1844 manuscript, Report on the geology of Mississippi: Collection 305, papers of the Association of American Geologists and Naturalists, 1840-47, Ewell Sale Stewart Library, Philadelphia Academy of Natural Sciences, 31 handwritten p., 1 pl.

This is a report on the geology of Mississippi, made at the request of the Agricultural Society of Jefferson College (about the time it expired). This remarkable manuscript was the prototype for Wailes' 1854 geological survey of Mississippi, the first published by the newly formed Mississippi Geological Survey. Wailes, then 47, here fulfills his own earlier call for a geological survey of the state (Wailes, 1842, p. 6). The survey is spotty, discussing the geology of several isolated sites (Vicksburg, Natchez, Jackson, Yazoo City, White Cliffs, Grand Gulf, the chalk region of northeastern Mississippi, and exposures along several rivers), which does not permit a geologic map of the full state to be assembled.

The manuscript covers a wide variety of topics relating to Mississippi's geology. The state is divided into geographic regions (p. 2), and the soil quality of each region is discussed. The topographic features of the Mississippi River (oxbow lakes, cut-offs, natural levees, floods, etc.) are noted (p. 4-5). The bluffs along the river are discussed at length (p. 5-14), noting their soils, height, extent, and ravines. Petrified wood (p. 9), concretions (p. 12), ocher (p. 13), clay (p. 16), etc., are discussed. Several fossil faunas are discussed: the (early Oligocene) fauna from Vicksburg (p. 18), the (Cretaceous) oysters from near Pontotoc (p. 18), the (Pleistocene) mammals of the Natchez area (p. 26-27), the Eocene fauna from Jackson (p. 28-29), and the (Mississippian) fossils found in gravel (p. 30). The only one of these faunas firmly dated in the manuscript is the Jackson Eocene. There is also an extensive review of commercially utilized geological materials, including building stone, lime, lignite, marl, artesian springs, etc. (p. 20-25). A modified version of this manuscript was later read and reported on at a geological meeting in 1845. It was later published (Wailes, 1846a-h), also somewhat revised.

(Dickeson, M. W., 1845 manuscript, [The geological section of the Natchez bluffs, and a description of a fossil skeleton from the Natchez area.]: Collection 305, papers of the Association of American Geologists and Naturalists, 1840-47. Ewell Sale Stewart Library, Philadelphia Academy of Natural Sciences, 4 handwritten p., 1 pl.

This is a four-page (one large, folded sheet, written on front and back) manuscript on the fossils and strata present in the Natchez area. It is part of a letter written to Benjamin Silliman, Jr., the secretary of the Association of American Geologists and Naturalists (AAGN, 1840-1847, originally an annual meeting of state geological survey people, but expanded to include naturalists in 1842), who was to read the paper at their 1845 meeting in New Haven, Connecticut. Silliman (1816-1885, 29 in 1845, son of the famous Yale geology professor mentioned earlier) met Dickeson and Wailes when his father lectured on geology at Natchez April 3 to 5, 1845 (Sydnor, 1938, p. 178; v. 10 of B. Silliman Sr.'s journals, Yale University library). It is likely that he persuaded them to submit papers for the AAGN conference because the southwestern part of the country (as Mississippi then was) was poorly represented in the Association. Dickeson's manuscript details the geology of the Natchez area, including a composite geologic section (with illustration) of the various beds present along the bluffs. The section appears to include repeated beds, due to slumping, but includes a wealth of useful details. It is an unfortunate commentary on early Mississippi geological research that none of the early writers who described the Natchez section (Cornelius, 1819; Smith, 1832; Nutt, 1833; and Dickeson, 1845 MS) appear to be aware of any of the others' work, giving the impression of poorly-read, part-time geologists repeatedly rediscovering the same "terra incognita." He also discusses his research on the vertebrate fossils of the Natchez area, including a skeleton he thought was of an undescribed species (actually it was the then little-known Ice Age ground sloth *Paramylodon*).

Dickeson, M. W., 1845 abstract, On the geology of the Natchez bluffs: Association of American Geologists and Naturalists, Proceedings, v. 6, p. 77-79.

This is an abstract of Dickeson's report (read on May 6, 1845), given in the proceedings of the 1845 AAGN meeting. Both Dickeson and Wailes must have thought their articles would be published as full papers, rather than as two-page abstracts, as both sent illustrations to be included. Dickeson's (still undated) Natchez section is printed nearly complete, but other parts are shortened or eliminated. The "curious *nondescript* QUADRUPED" ("nondescript" here meaning "undescribed") skeleton from the same area is described in detail.

Wailes, B. L. C., 1845 abstract, On the geology of Mississippi: Association of American Geologists and Naturalists, Proceedings, v. 6, p. 80-81.

This is an abstract of his 31-page 1844 manuscript, obviously greatly reduced, read by Benjamin Silliman, Jr., at the New Haven AAGN meeting on May 6, 1845. A good deal has been greatly changed, and even added, to the original manuscript. Some statements even contradict the manuscript, such as the end statement, that "The real geological age of the zeuglodon [*Basilosaurus*] is still a matter of doubt" (Wailes had made it clear that it was Eocene; Wailes, 1844 MS, p. 28).

A few things were reported here that were not included in the Anonymous (1844) report on Wailes' collection. These include the first published report (excluding Lesueur's 1829 manuscript) on the fossil fauna from Vicksburg (as Walnut Hills), including mollusks, corals, and shark teeth (p. 80). The fauna was described much later by Conrad (1847, 1848).

Anonymous, 1845a, Convention of American Geologists and Naturalists, at New Haven (sixth day): New York Daily Tribune (newspaper) of May 8, 1845; v. 5, no. 25, p. 2.

This is a newspaper report of Dickeson and Wailes' reports at the New Haven AAGN meeting (printed two days later). The original manuscripts (Wailes, 1844 MS; Dickeson, 1845 MS) are further mangled. The most notable item was an addition to Wailes' paper—a comment that "*a piece of a human skull*" had been found with the skeleton of the "nondescript" animal (the ground sloth *Paramylodon*). This was the first reference in print to Natchez Man

(actually part of a human pelvis, not a skull fragment, and now known to be archaeological material [see Lyell, 1847b] dropped down onto the fossil skeleton). The report of humans associated with extinct animals in Natchez caused a considerable controversy. Surprisingly, the Natchez Man remains are not mentioned in either manuscript or either abstract. It must have been improperly added to Wailes' talk by the AAGN secretary. Wailes has been unfairly criticized for announcing "his erroneous speculations" about Natchez Man at a national scientific meeting (Sydnor, 1938, p. 175; Brown, 1975, p. 297).

Anonymous, 1845b, [Report on the sixth convention of the Association of American Geologists and Naturalists, at New Haven.]: American Quarterly Journal of Agriculture and Science ("Emmons' Journal," Albany, 1845-1846; New York, 1846-1848), v. 2, no. 1, p. 132-170.

This report reviews of the Dickeson and Wailes talks at the AAGN convention in New Haven (p. 168-169). This review basically reprints the *N. Y. Daily Tribune* newspaper reviews. This is the first mention of Natchez Man in a scientific journal (p. 169). The publication caused Wailes considerable anguish (Gale, in Emmons, 1847b, p. 291).

[Bartlett, J., 1846, [On *Zeuglodon* near Natchez, Mississippi.]: Boston Society of Natural History, Proceedings, v. 2, p. 96.

This is a mistaken report "that the bones of *Zeuglodon* are found near Natchez." This actually refers to the original *Basilosaurus* site along the Ouachita River in northeastern Louisiana. This may be the basis of the earlier error in Conrad, 1835. John Bartlett (1820-1905, then only 26) is the source of the Natchez loess snails described by Binney later the same year.

Conrad, T. A., 1846a, Observations on the Eocene Formation of the United States, with descriptions of species of shells, &c. occurring in it: American Journal of Science, series 2, v. 1, nos. 2 and 3, in two parts: p. 209-221 (no. 2), p. 395-405 (no. 3), pl. 3-5.

The Vicksburg fauna is briefly noted and is the first Mississippi material to be placed (in print) in the Eocene, in the broad sense, including the Oligocene (p. 210). Conrad, now 43, had collected there in the spring of 1844 (Conrad, 1847, p. 280).

Conrad (1846a) and Lyell (1846a) almost simultaneously reported that the "white friable limestone" (including both Jackson and Vicksburg groups in Conrad, and the Vicksburg "Nummulite Limestone" of Lyell) which Conrad (1832) and Morton (1833a, 1834, etc.) had reported as Cretaceous, was actually Eocene (p. 209-210). *Zeuglodon* (now *Basilosaurus*) and the "*Zeuglodon* beds" had sometimes been identified as Cretaceous (because *Basilosaurus* was originally identified as a plesiosaur [Harlan, 1834, p. 402] and only later as a whale [Duméril, 1838]). Here Conrad makes clear that both beds are certainly Eocene (p. 210). Curiously, at this point Conrad knew *Basilosaurus* only from Louisiana and Alabama. Conrad seems to have been unaware of the *Basilosaurus*, and *Zeuglodon* beds, from the Jackson area of Mississippi until Wailes showed the material to him, as Wailes was finishing his geological report on Mississippi (Wailes, 1854). Conrad here was aware that the Claiborne, Jackson, and Vicksburg groups were all Eocene, but was not clear about their relative position.

[Lyell, C., 1846a, [Notes on the geology of Alabama and Georgia]: American Journal of Science, series 2, v. 1, no. 2, p. 313-315.

This is a report from Claiborne, Alabama, written during his second American trip (1845-1846). It is dated February 4, before he arrived in Mississippi in March. It is a brief, but critical, letter sent from the field. Charles Lyell (1797-1875, 49 in 1846), English lawyer turned geologist, had published a celebrated three-volume (1830-1833) geology text, which made him one of the founders of geology. His books were the most extensively reviewed geological works in American periodicals before 1850 (Hazen and Hazen, 1980, p. 9). A detailed book on Lyell's work in America has recently been published (Wilson, 1998).

Here, in addition to making clear that the *Zeuglodon* beds (now Jackson Group) and "Nummulite Limestone" (now the *Lepidocyclina* beds of the Marianna Limestone, lower Vicksburg Group) are Eocene rather than Cretaceous, Lyell makes the critical observation that the "Nummulite Limestone" (Vicksburg) overlies the *Zeuglodon* beds (the Jackson), which, in turn, overlies the Claiborne bluff beds (Claiborne Group) (p. 314). This sequence was essential to the understanding of Mississippi's early Tertiary stratigraphy.

Emmons, E., 1846, Yazoo marl – Mississippi: American Quarterly Journal of Agriculture and Science ("Emmons' Journal"), v. 3, no. 2, p. 295-296.

This is the first published chemical analysis of a Mississippi soil sample. J. Ingersoll, a Yazoo County planter, sends the editor of an agricultural journal a sample from the modern Yazoo River bed, including freshwater mussels (some still with organic matter inside). The analysis is incomplete, presenting only half of the chemical content (he later reports that it contains 10 percent carbonate – see Ingersoll, 1846). The editor, Emmons, considers the sample "a valuable substance for fertilizing lands which are deficient in lime and other inorganic matters."

Ebenezer Emmons (1799-1863, then 47), the senior editor of this Albany, New York, journal, was then an eminent New York geologist, having published in 1842 the northeastern part of the massive New York geological survey. He later became State Geologist of North Carolina, in 1851.

[Lyell, C., 1846b, On the newer deposits of the southern states of North America: Quarterly Journal of the Geological Society of London, Proceedings, v. 2, pt. 1, p. 405-410.

A second contribution from Lyell's second American trip, Lyell here expands upon the previous letter in an article for the May 6 meeting of the Geological Society of London. It was probably also written from Alabama, before he reached Mississippi in March. Again, he here makes clear the relative position of the Vicksburg / Jackson / Claiborne groups (p. 408-409), and even provides a cross-section (p. 409) showing the "Nummulitic limestone" overlying the *Zeuglodon* beds in southwestern Alabama. This was clearly worked out before Conrad did so (1846b).

Hall, J., 1846a, Notice of the geological position of the cranium of the *Castoroides ohioensis*: Boston Society of Natural History, Journal, v. 5, no. 3, p. 385-391.

The giant beaver *Castoroides ohioensis* (from what is now considered late Pleistocene loess) is first reported from Mississippi

from "the neighborhood of Natchez" (p. 391). James Hall (1811-1898, then only 35) later became famous for his detailed study of the Paleozoic invertebrates of New York State.

Wailes, B. L. C., 1846a-h, Geological gleanings in Mississippi: Scientific American (New York weekly magazine, 1845-), v. 1; no. 42, [p. 2] (a – July 9); 43, [p. 3] (b – July 16); 44, [p. 3] (c – July 23); 45, [p. 3] (d – July 30); 46, [p. 3] (e – Aug. 6); 47, [p. 3] (f – Aug. 13); 48, [p. 3] (g – Aug. 20); 49, [p. 3] (h – Aug. 27).

Wailes' 31-page 1844 manuscript, which had been used in his 1845 AAGN report and the abstract published from it (Wailes, 1845), is published nearly complete in a popular science and industry magazine. Wailes likely submitted it when he realized that only an abstract would be published by the AAGN. The then recently started *Scientific American*, calling itself "The Advocate of Industry and Enterprise, and Journal of Mechanical and Other Improvements," was then published every Thursday morning, and consisted of four large pages. Wailes' large manuscript was briefly announced (noting that it would be especially interesting to "our western patrons") in issue number 42, then printed in seven regular weekly installments (Wailes, 1846b-h), always as a full column on the third (unnumbered) page. One almost has the impression that the long article was used as filler, because columns sometimes stop and start in the middle of discussions, with no introductory or ending comments.

The first installments are nearly printed verbatim, with only editorial corrections of spelling, punctuation, and deletion of personal pronouns and mention of people's names (Wailes himself is only indicated by his initials "B. L. C. W." at the end of the last installment). Wailes makes only small additions and deletions in the early installments, but longer additions (especially concerning fossils) in the later ones (Wailes, 1846e-g). Mention of "nummulite limestone" south of Jackson (1846f), specific mollusk genera from Pleistocene pond deposits at Washington and loess north of Natchez (1846g), and a list of thirteen mollusk genera from Vicksburg (1846h), all suggest the contribution of Charles Lyell, whom Wailes had met in Mississippi four months earlier (although, in the several discussions of the Mississippi bluffs, the term "loess" is never used). Unfortunately, no illustrations accompany the columns, even though figures of *Basilosaurus* bones had been included with the earlier copy of the same manuscript, used for the 1845 report.

As noted in the 1844 manuscript, but first published here, beds of Eocene age in the modern, restricted sense are reported from Mississippi (from the Jackson area) for the first time (1846h). Also previously noted in the original manuscript, the important observation is first published that the loess (here called loam) lacks stratification (1846c), something that would be expected if it actually was a fluviatile deposit (as nearly all geologists thought at the time).

Two important fossil records were added since the 1844 manuscript was written: the first report of tapirs (misspelled "Tapier") from Mississippi (1846h) (from the late Pleistocene loess beds of Mammoth Bayou, near Natchez), and the first Mississippi report of fossil echinoderms (1846f and h) (irregular echinoids from the Jackson area, identified as "spatangus" – possibly the late Eocene *Schizaster*).

Other important data published here include extensive discussions of the commercial use of geological materials and phenomena in Mississippi: soils (1846b); ochers, sand, and potters' clay (1846d); building and paving stone (1846e and f); marl fertilizer and lignite (1846f); and mineral waters, springs, and artesian wells (1846g). An early chemical analysis of a Mississippi soil, probably a late Pleistocene pond deposit from Washington, is printed (1846g) from the 1844 manuscript (p. 23-24), done for Wailes by L. D. Gale, who taught chemistry and geology for nearly two years (Gale, in Emmons, 1847b, p. 290) at Jefferson College in Washington, Mississippi (his name is given in the manuscript but cut out of the 1846 publication).

In an addition to the manuscript, and reversing the conclusion of the manuscript (1844 MS, p. 27), it is argued that Dickeson's "nondescript" animal (now the late Pleistocene ground sloth *Paramylodon*) was not blind (people "being misled by those professing a knowledge of anatomy"), but had orbits (1846g). The longest addition to the manuscript comes at the very end of the seven-part publication (1846h), a discussion of one of Wailes' favorite subjects—Mississippi petrified wood. Petrified palm is also reported from Mississippi for the first time (because it lacks growth rings, palm technically is not wood). The discussion deals mostly with the question of whether the logs were silicified before or after they were transported (today it is known to have been after). Wailes here supports the older view—that they were silicified before being transported, in the same way that (glacial erratic) boulders were transported in the north. This argument presages the misguided use of "transported petrified logs" as evidence of a huge ocean flood in Mississippi in Wailes (1847 MS, p. 6).

Conrad, T. A., 1846b, Tertiary of Warren Co., Mississippi: American Journal of Science, series 2, v. 2, no. 4, p. 124-125 (no figures).

This is the first formal analysis of a Mississippi fossil fauna—the Vicksburg fauna. The phrase "Vicksburg group" is here used for the first time, and its age is first made clear. Even though the Oligocene was not named till 1854, Conrad here notes that the Vicksburg fauna was between the known Eocene and Miocene faunas, but with "decidedly more affinity with the Eocene group than with that of the Miocene" (p. 124). He treats it as "Upper or newer Eocene." He notes 103 species and lists 51 genera, including a giant foraminiferan, scaphopod, gastropods, pelecypods, and an acorn barnacle. Conrad later gave a full description of the fauna (1847) and illustrated it (1848). Conrad still had not seen the important mollusk fauna from Jackson at this point.

Ingersoll, J., 1846, [Letter to Emmons about getting a second analysis of Yazoo County sediment]: American Quarterly Journal of Agricultural Science, v. 4, no. 7, p. 166.

Ingersoll, a planter at Tesheevah (Techeva) Plantation in Yazoo County, thanks Emmons for the chemical analysis of the modern Yazoo River bed sample (he is referring to a letter from Emmons, rather than to the published report—see Emmons, 1846). He asks that another analysis be done with the shells included (Emmons had analyzed only the fine fraction), to increase the carbonate content and thereby increase the value of the sediment as a soil neutralizer. Emmons declines the request.

Binney, A., 1846, [A discussion of the fossils and geology of the

bluffs of Natchez, on the Mississippi River]: Boston Society of Natural History, Proceedings, v. 2, p. 126-130 (no figures).

This is the first published report to identify the silt of the Mississippi bluffs as loess (p. 128), even preceding Lyell (1847a). Amos Binney (1803-1847, then 43) was president of the Boston Society of Natural History. This is also the first analysis of the loess snail fauna, identifying them as mostly terrestrial (leaf litter) forms, with some fluviatile forms (now thought to be from pond deposits interbedded with the eolian loess). Binney argues that the loess is fluviatile (river and stream deposited), rather than diluvial (flood-deposited), in nature (p. 129). Loess was not identified as eolian (wind-deposited; in the case of loess, rock ground to a powder by the glaciers, deposited along river flood plains, then picked up by strong glacial winds and redeposited on forests along the rivers) till Raphael Pumpelly's (1837-1923) work of 1879, and was not generally accepted as eolian till the early 1900s (Shimek, 1904). Even Lyell considered it fluviatile (despite its contained terrestrial fauna), probably because it was found along rivers.

Without citing either Wailes (1845) or Dickeson (1845), Binney obliquely refers to their research on the Natchez section and the Paleozoic fossils in the gravel from there (p. 126). He also repeats Bartlett's (1846) old error of *Zeuglodon* bones from the lowest beds at Natchez (p. 128).

Hall, J., 1846b, [On the fossil cranium of *Castoroides Ohioensis*]: Boston Society of Natural History, Proceedings, v. 2, p. 167-168.

This is another brief note that giant beaver remains had lately been found at Natchez (p. 168).

Conrad, T. A., 1846c, Eocene Formation of the Walnut Hills, &c., Mississippi: American Journal of Science, series 2, v. 2, no. 5, p. 210-215 (no figures).

This has detailed discussions of both the Vicksburg Group beds and loess at Vicksburg, with analyses of the faunas of each. He notes the in-place *Panopea* clams in the Vicksburg Group beds (p. 211), but incorrectly concludes that it is a beach deposit (p. 211), rather than a high-energy, shallow marine habitat a long way from shore, as it is interpreted today. He notes that the loess snails are leaf litter forms, but still considers it a fluvial deposit (p. 213-215). He calls it "loam," rather than loess, and considers it a Mississippi River overflow deposit (p. 215), rather than eolian. As did Binney (1846, p. 128) earlier about Natchez, Conrad considers the bluffs recently uplifted (p. 214) in order to account for their position high above river level, which is no longer accepted today.

Dickeson, M. W., 1846, [On fossil bones from the vicinity of Natchez]: Philadelphia Academy of Natural Sciences, Proceedings, v. 3, no. 5, p. 106-107 (no figures).

This is the first analysis of a vertebrate fossil fauna from Mississippi—of the late Pleistocene mammals from the loess of the Natchez area. Dickeson exhibits his collection at the Academy of Natural Sciences of Philadelphia on October 6, 1846 (he had also exhibited them earlier at the 7th AAGN Convention at Columbia College, New York, on September 4, 1846—*New York Daily Tribune*, v. 6, no. 128, p. 2, for September 5, 1846). This is the first report of fossil bear (*Ursus*), bison (as *Bos*), and deer (as *Cervus*) from Mississippi. He also exhibits a skull and jaw of the ground sloth *Megalonyx*, and probably the *Paramylodon* skeleton (the "nondescript"). He also describes the Natchez Man pelvic bone for the first time (p. 107). He argues that it was *in situ*, not float (p. 107). The partial pelvis was not figured till much later (Leidy, 1889). He incorrectly considers the "blue clay" (unoxidized loess) as distinct from the "diluvial drift" (oxidized loess) (p. 107).

It is thought (Osborn, 1913, p. 357) that it was Dickeson's display of the Natchez vertebrates at the Philadelphia Academy that first turned Dr. Joseph Leidy's (1823-1891, only 23 in 1846) interest toward vertebrate fossils. Leidy became the Father of American Vertebrate Paleontology. A biography of Leidy has been published recently (Warren, 1998). Dickeson's collection of Natchez area fossils was, much later (not at the time of the display, contrary to Warren, 1998, p. 77), purchased by the Philadelphia Academy, and is still there.

Emmons, E., 1847a, Analysis of soils: American Journal of Agriculture and Science ("Emmons' Journal" had been publishing twice yearly, so had dropped the "Quarterly" from its name), v. 5, no. 1, p. 50-52.

Here Wailes has sent the journal editor five marl and soil samples from Hinds County for chemical analysis. Emmons has the analyses done, and reports that one sample, a compact, yellowish, unweathered marl (probably late Eocene Yazoo Formation), contains 70 percent carbonate and nearly 4 percent potash. He says "This will be found without doubt a valuable fertilizer – it contains almost half the amount of potash which the green sands of New Jersey do, that are so remarkable for giving fertility to the exhausted soil of that State" (p. 51). Emmons doubts Wailes' suggestion that it is a freshwater deposit, noting that the potash content is too high (p. 52).

Monette, J. W., 1847, Geology of the Mississippi Valley. General observations relative to the geological revolutions and physical changes in the valley of the Mississippi: DeBow's Commercial Review of the South and West (New Orleans, 1846-1850), in two parts, v. 3, no. 2, p. 124-129; v. 3, no. 3, p. 215-225.

John Wesley Monette (1803-1851, then 44) was a medical doctor then living in Washington, Mississippi (biographical information on Monette and a discussion of his extensive writings are given in Riley, 1906). He was president of Jefferson College there, for a time. He is best known for his 1846 history of the settlement of the Mississippi Valley (Sydnor, 1938). Monette intended his greatest work to be a multi-volume physical geography of the Mississippi Valley; the manuscript, begun as early as 1833, was mostly never published (Riley, 1906).

This work (the second half of the introduction to his huge, largely unpublished, work—see p. 220 of the outline in Riley, 1906), on the geology of the Mississippi Valley, deals more with sweeping speculation on floods (he lists three, including Noah's and Peleg's) and upliftings and sinkings of the land, than with any practical geology. It is probably the most overtly religious of the early Mississippi geological papers. He seems to suggest that the loess of the Mississippi bluffs (with their Pleistocene mammal skeletons) is part of the Mississippi Embayment deposits (the "tertiary formation") when he says that the tertiary formation "extends southward to Natchez and Baton Rouge, bearing in its commingled deposits the

carcasses and skeletons of the enormous denizens of the first green earth of a former northern world" (p. 217). Today these deposits are thought to end in the late Eocene. Even though Monette read Lyell (p. 224), he seems mostly to rely on very out-of-date references. It is the work of a very committed diluvialist.

Emmons, E., 1847b, Correction of Col. Wailes's communication: American Journal of Agriculture and Science, v. 5, p. 290-292.

Not long after the review of Wailes' 1845 AAGN report was printed in "Emmons' Journal" (see Anonymous, 1845b), Wailes wrote to complain about the distortions made in it. Here Emmons, two years later, attempts to make amends by publishing a long letter to the editor from a friend of Wailes, including a long excerpt from an October 3, 1846, letter from Wailes to the friend, pointing out the errors. The friend, Leonard Dunnell Gale (1800-1883, then 47), was a former student of Silliman, Sr., at Yale (Sydnor, 1938, p. 141); had worked as a New York geologist for several years; taught chemistry and mineralogy at Jefferson College in Washington, Mississippi (as a colleague of Wailes) for nearly two years (1844-1846) (Wailes, 1844 MS, p. 23-24; Gale, in Emmons, 1847b, p. 290); moved back to New York (Gale letter, September 19, 1846; Special Collections Library, Duke University); then went to Washington, D.C., to work as a patent examiner at the U.S. Patent Office, and to teach chemistry at the Medical College (ibid., Gale letter to Wailes, April 14, 1847; Gale, in Emmons, 1847, p. 290). In his own defense, Emmons notes that his journal only reprinted a newspaper account of the meetings, that no one from the journal even attended the conference. Still, he wishes to correct "the erroneous impressions" (p. 290) created by his journal in reprinting the article.

Gale notes that Wailes' report "was commented on rather severely at the time, exhibiting to ridicule the author and his subject" (p. 290-291). Wailes says in his letter that he had given his manuscript (Wailes, 1844 MS) to AAGN secretary Benjamin Silliman, Jr., when Silliman was in Natchez, to create from it a Wailes report "chiefly for the purpose of indicating some of the localities of fossils in this state" (p. 291). Wailes permitted Silliman to use his manuscript "at his discretion" (p. 291). Both Gale and Wailes incorrectly blame Dickeson, rather than Silliman, for including the garbled information on the Natchez Man bone in Wailes' talk (because the opinions on it were Dickeson's), but Dickeson's manuscript and letter to Silliman (Dickeson, 1845 MS) do not even mention the human bone. Wailes stresses his opinion that it had slid from the top of the bluffs ("from the graves of early settlers" – p. 292) down over the fossil beds. Reports dealing with the Natchez Man bone by both Gale and Wailes were presented at the 1847 AAGN meeting in Boston (Anonymous, 1847a and b; Gale, 1847 and 1848).

Most likely, the errors Wailes complains about here in his 1845 AAGN report (including even the mention of the Natchez Man bone), as well as the subsequent errors in newspaper and journal reports on that talk, were the result of additions and misstatements given in the talk by its presenter, Silliman. Despite Wailes' confidence here, "that he was judicious I have no doubt" (p. 291), Silliman certainly altered Wailes' manuscript considerably, possibly with an eye toward making it more controversial.

Dickeson's "nondescript" skeleton, with which the Natchez Man bone was found, is here first correctly identified in print as the grazing ground sloth "Mylodon of Owen" (Gale quote, p. 292), the North American forms of which are now placed in *Paramylodon*. Who first made this identification is unclear. A quote from anatomist Jeffries Wyman in a June 15, 1847, letter from Gale to Wailes (Wailes Papers, Special Collections Library, Duke University) says it "is probably the M. laqueatus of Harlan (corresponding with your view)", but it is uncertain if the view meant was Gale's or Wailes', and if Wailes', if it derived from Leidy.

Lyell, C., 1847a, On the delta and alluvial deposits of the Mississippi, and other points in the geology of North America, observed in the years 1845, 1846: American Journal of Science, series 2, v. 2, no. 3, art. 4, p. 34-39.

This is an abstract of a talk given to the British Association in September, 1846, with observations made on his second American trip. As Binney (1846) had done, he compares the loam of the Mississippi River bluffs to the loess of the German Rhine Valley (p. 36-37). He notes that the mollusk shells of the loess are of extant terrestrial, fluviatile, and lacustrine species (p. 36), but that it also includes bones of extinct mammals (p. 37). He presents a remarkable cross-section from western Louisiana to eastern Georgia (p. 37), showing the igneous and metamorphic core of the southern Appalachians overlapped, in turn, by the Carboniferous, Cretaceous, Eocene, Pleistocene, and Recent alluvium. Oddly, Lyell here dates the Mississippi loess as "Post-pliocene" (footnote, p. 37), even though he had coined the term "Pleistocene" in 1839 (he may still have thought of it as "Newer Pliocene"). The loess was not dated as "Pleistocene" (or considered glacial-derived) till much later. Of Mississippi, it shows the section from Vicksburg to Jackson, then northeast toward Tuscaloosa, Alabama (showing westward dipping beds of loess over Eocene over Cretaceous). It is probably the clearest representation of Mississippi geology of its time, well before the first detailed state geologic maps were done (Lieber, 1854; Harper, 1857).

Despite insistence that Lyell was generous in assigning credit to Americans who had assisted him (Silliman, 1995), very likely a lot of the fossil data (Pleistocene mammals, Vicksburg fauna, *Basilosaurus* and the Jackson fauna, and Cretaceous mosasaurs) on p. 37 is derived from information Lyell received from Dickeson and Wailes (he was Wailes' guest in March, 1846 and examined his fossil collection [Sydnor, 1938, p. 178; Wilson, 1998, p. 241], and Dickeson showed him the Natchez bluffs [Wilson, 1998, p. 240]), but they are not cited. It is thought that Lyell first identified the "loam" of the Natchez bluffs (and of the Mississippi River Valley) as loess after Wailes showed him the loess and freshwater clay deposits at Washington (Wilson, 1998, p. 243).

Lyell, C., 1847b, On the alleged coexistence of man and the Megatherium: American Journal of Science, series 2, v. 3, no. 8, p. 267-269.

This is a reprinted December 6, 1846, letter to the London *Times*, a response to reports in both American and English papers of the Natchez Man pelvic bone being found with extinct mammals. Like the Wailes letter in Emmons (1847b), this slightly later letter refutes Dickeson's (1846, p. 107) argument that the human bone is

the same age as the *Paramylodon* ("nondescript") ground sloth skeleton it was found with (incorrectly here called "Megatherium," apparently in mistaken reference to *Megalonyx*). Lyell argues that the pelvic bone could have come from an archaeological burial at the top of the bluff, tumbled down over the partly exposed skeleton, then been covered with colluvial loess (p. 269). Lyell notes that Wailes "made the same conjecture respecting the probable manner in which the fossil may have been conveyed to the spot where it was found" (p. 269). Lyell's and Wailes' opinion has been borne out in recent Carbon-14 dating of the bone (Cotter, 1991), which gives a date of 5,580 ± 80 years for the human pelvic bone (p. 38), but a far older date (17,840 ± 125 years, p. 39) for the fossil sloth skeleton it was "associated" with. Lyell saw the specimen and the site with Dickeson and Wailes on Friday, March 14, 1846 (Bograd, 1996, p. 53; Wilson, 1998, p. 243).

Lyell also discusses other aspects of the loess—its mollusk and mammal faunas, its topography, extent, erosion, relatively recent age, and comparison to the German loess (most also discussed in Lyell, 1847a). Lyell seems to object mostly to the idea of man in the loess because he feels, incorrectly, that it would suggest that man came before the development of the Mississippi basin (p. 268). Even though Lyell was correct in thinking Natchez Man is of archaeological (less than 10,000 years, rather than paleontological, which is greater than 10,000) age, it is now well established that man was contemporaneous with extinct mammals in America in the late Pleistocene (and even hunted mammoths and mastodons here).

One minor point made by Lyell is of far more significance than has been credited. By noting the bones of extinct animals washed out of the loess bluffs (mixed with modern human bones) on the gravel bars "of the islands in the Mississippi at low water" (p. 269), Lyell may be the first to note the rich Pleistocene fauna of the gravel bars of northwestern Mississippi.

Lyell, C., 1847c, On the relative age and position of the so-called Nummulite Limestone of Alabama: American Journal of Science, series 2, v. 4, no. 11, p. 186-191.

Following Lyell (1846a), Lyell here makes a detailed argument that both the Nummulite limestone (the early Oligocene Marianna Limestone, lower Vicksburg Group, of Alabama) and *Zeuglodon* beds (late Eocene Jackson Group of Alabama) are of Eocene age (in the broad sense); and that the Nummulite limestone overlies the *Zeuglodon* beds (p. 186).

What is more significant in this paper is the very early (following only Anonymous, 1844, Wailes, 1845, and Wailes, 1846f and h) reference to the fossil fauna of Jackson, Mississippi (p. 191), the first place that the Jackson fauna was discussed in detail. Here a cross-section is given showing the relative position of the beds at Jackson and Vicksburg (p. 191), and a list of Jackson's coral, snail, tusk shell, bivalve, and *Zeuglodon* (now *Basilosaurus*) fauna is given for the first time (p. 191). Lyell was likely shown much of the Jackson fauna (including the *Basilosaurus* bones) by Wailes, when Lyell visited him in Washington (Sydnor, 1938, p. 178; Wilson, 1998, p. 241). Lyell was later taken to a fossil site on the Pearl River in Jackson, by a local physician, Dr. Gist, on Thursday, March 20, 1846 (Bograd, 1996, p. 54; Wilson, 1998, p. 246). In his study of the Jackson fauna, Lyell was far ahead of Conrad. Conrad first presented a list of Jackson fossils in Wailes' geologic report on Mississippi (Wailes, 1854, p. 289), in which were included the first figures of the fossils, which Wailes had drawn (pl. 14-17). He described the fauna later (Conrad, 1855). Wailes, through Conrad, donated the figured Jackson specimens to the Philadelphia Academy on May 8, 1855 (Proc., ANSP, v. 7, no. 10, p. xxv).

The paper also includes a discussion of the Vicksburg fauna (p. 190-191), which Conrad (1846b) had already studied (and Lesueur long before, in his unpublished 1829 manuscript). Lyell collected at Vicksburg on March 20, 1846, the same day he collected at Jackson (Bograd, 1996, p. 53-54; Wilson, 1998, p. 245-246).

Lyell also included an extended note from Edward Forbes, who incorrectly assigns *Nummulites mantelli* Morton, 1833a (for which the "Nummulite Limestone" was named) to the giant porcelaneous foraminiferan *Orbitolites* (p. 187), rather than to a new genus (later *Lepidocyclina* Gümbel, 1870), which is what it was at the time. Morton (1833a, p. 291) had originally identified it as a tiny cephalopod, as all foraminifera were in the 1830s. They are now known to be amoeba-like one-celled animals, with a tiny shell embedded in their protoplasm.

Leidy, J., 1847, On the fossil horse of America: Philadelphia Academy of Natural Sciences, Proceedings, v. 3, no. 11, p. 262-266, pl. 2.

This is the first formal description of a new fossil / vertebrate fossil species from Mississippi. Also, it is the first formally described vertebrate from the Natchez area. In Leidy's first full paper on vertebrate paleontology (he was then only 24), he described *Equus americanus*, new species (p. 265), from twelve cheek teeth from the Natchez area, collected by Dickeson (the types are in the Academy of Natural Sciences of Philadelphia collection). Because the name *E. americanus* was preoccupied, Leidy in 1858 changed the name to *Equus complicatus* (it remains valid today). Leidy (1847) is also significant in that the six illustrations of the four isolated horse cheek teeth from Natchez (pl. 2) are the first illustrations of a fossil / vertebrate fossil / Pleistocene fossil / horse fossil / Natchez fossil from Mississippi. It is surprising that a vertebrate fossil was described and figured before an invertebrate fossil in Mississippi. Had Lesueur's (1829) manuscript figures or Wailes' (1844) manuscript figures been published, either could have been the first. This was the first of many articles (1847-1889) by Leidy on the Pleistocene mammals of the Natchez loess (see Domning, 1969, for references).

Conrad, T. A., 1847, Observations on the Eocene Formation, and descriptions of one hundred and five new fossils of that period, from the vicinity of Vicksburg, Mississippi; with an appendix: Philadelphia Academy of Natural Sciences, Proceedings, v. 3, no. 11, p. 280-299 (no figures).

This is the first formal description of fossil invertebrates from Mississippi, and the first description of new invertebrate fossil species (105 new species) from Mississippi. It is the formal description of the mollusks, coral, and bryozoa collected by Conrad at Vicksburg in the spring of 1844 (p. 280). He notes that only two Vicksburg species are also found at Claiborne Bluff, but that several are close

to Miocene species (p. 280). Unlike Lyell (1847c), Conrad was here still unfamiliar with the late Eocene Jackson fauna, which distorted his comparisons. He considers the Vicksburg fauna equivalent to that of the "Nummulite Limestone" of Alabama (p. 281). Both are placed in the Vicksburg Group today. Conrad considered the Vicksburg Group "Newer Eocene" (p. 280). It is considered early Oligocene today (the Oligocene Epoch was not separated from the Eocene till later [von Beyrich, 1854]). The Vicksburg fauna was not illustrated till the following year (Conrad, 1848).

(Wailes, B. L. C., 1847 manuscript, On the Mississippi Bluff Formation, near Natchez: manuscript dated September 1, 1847, of a talk read on September 21, 1847, at the eighth (and last) meeting of the Association of American Geologists and Naturalists, held at the Natural History Society in Boston (read by the association secretary, Dr. Jeffries Wyman); collection of Segrest and Mrs. Jimmy Wailes, Jackson, 16 handwritten p.

This was the first talk of the six-day meeting (American Journal of Science, v. 4, no. 12, p. 428). Wailes, then 50, wrote this rather unfortunate paper to fulfill a formal request by the AAGN to investigate and report "on the geology of the vicinity of Natchez" (Proc. AAGN, 1845, p. 85).

Here Wailes makes explicit what he had only suggested in earlier works—that the deposits at Natchez were all made by huge ocean floods (assisted by icebergs, p. 4-5; as Lyell then believed). He had called the pre-loess Pleistocene Mississippi river gravel (which its contained Paleozoic fauna clearly showed had been transported southward from the MidWest) diluvial in nature, but that could have been interpreted to mean glacial deposition. Here not only that gravel, but the loess, and even the petrified logs in the Oligo-Miocene bed below the gravel, were all identified as flood deposits. The petrified logs were considered evidence of the violent nature of the flood (p. 6). The loess was thought to be the last material to come out of suspension from "the waters of that wild and turbulent ocean flood which we imagine to have poured over this hemisphere" (p. 9). Of the transported gravel, Wailes felt that their size and weight "is such as to forbid the idea of their removal by any agency now in operation" (p. 4). It did not seem possible to him that the Mississippi River could have carried them southward, as is now generally thought.

There is useful information on the geology of the bluffs in the manuscript but, unfortunately, it is overshadowed by the speculation on flood deposition. He provides a good deal of data on the distribution of the loess (notably, that the deposit is wedge-shaped in cross-section, p. 15), its concretions, its fossils (including the ground sloth *Mylodon*, now *Paramylodon*, p. 11), etc., and even notes that there are pond deposits interbedded with the loess (the beds that produce the freshwater mollusks) (p. 14). Following Wailes (1846c), he makes the very important point that the thick loess is homogeneous, and shows no bedding, which would have been expected in an alluvial deposit (p. 12), but he did not consider eolian deposition. He obliquely argues that the Natchez Man bone had washed down from the top of the ravine (p. 14), agreeing with Lyell.

Anonymous, 1847a, Scientific proceedings. American Association of Naturalists and Geologists [Association of American Geologists and Naturalists]: Literary World (New York weekly literary magazine), v. 2, no. 36, p. 227-231, and no. 37, p. 255-257.

This is a review of the 1847 AAGN meeting in Boston, derived from the *Boston Evening Journal* and *Boston Atlas* newspapers. The review of Wailes' talk (p. 228) shows that the only thing that newspapers find newsworthy is that the Natchez Man bone probably is not a fossil. All other data on the Natchez bluff is ignored. Another talk opens up a heated debate on the Diluvial Theory / Glacial Theory question (p. 229). A second talk is presented at the meeting on the Natchez bluff and the Natchez Man bone. It is by Leonard Gale, the man who had defended Wailes' 1845 report (Gale, in Emmons, 1847b). Gale was Wailes' former colleague at Jefferson College (Sydnor, 1938, p. 176), who had since moved to Washington, D.C. The entire report here reads, "*Dr. Gale* presented a paper on the Natchez Bluff formation, corresponding generally with that laid before the Association from Mr. Wailes, and embodying similar views with respect to the fossil human bone said to have been taken from that locality" (p. 255).

At the end of the meeting, an account is given of the progress being made on the building of the newly established Smithsonian Institution, in Washington, D.C. (p. 256).

Anonymous, 1847b, [Report on the eighth convention of the Association of American Geologists and Naturalists, at Boston]: American Journal of Agriculture and Science, v. 6, no. 18, p. 208-219.

A short review of Wailes' 1847 AAGN talk (p. 208-209) is given. It is unclear if the review is a reprint of a newspaper account, as their 1845 report (Anonymous, 1845b) was. In any case, this seems to be the only published record of the Wailes 1847 convention report in a scientific journal. Dickeson presented two talks at the 1847 meeting personally (Anonymous, 1847a, p. 255), but these were on cypress swamps and Indian mounds, not geology.

This review reports Wailes' view that the gravel (below the loess) at Natchez contains material transported from far to the north, and were "certainly" carried southward by a huge flood (p. 208). The review garbles the original 1847 manuscript, in saying that "ice has been here the most important agent" (p. 209), rather than as icebergs assisting the floodwater. It also makes unclear (p. 209) that the manuscript (p. 8) cites the "upheaval" of the Rockies or "a volcano in the Arctic Ocean" as possible causes of the great southward ocean flood. It does point out Wailes' contention that the freshwater mollusks (and possibly the extinct mammal remains as well) do not derive from the loess, but were washed down into the ravines from post-diluvial lake deposits at the top of the bluffs (p. 209). Most of the useful information on the loess has not been included.

Gale, L. D., 1847 abstract and comments, On the Natchez Bluff Formation: American Journal of Agriculture and Science, v. 6, no. 19, p. 208-209.

This is a more complete report of the talk given by Gale on September 24, 1847, at the Boston AAGN meeting, than that given in Anonymous (1847a). Like Lyell (1847b) and Wailes (in Emmons, 1847b; 1847 manuscript) earlier, Gale says that the Natchez Man bone has probably washed down the ravine from an Indian burial at the top of the bluff. He describes the bluff section, describing it as "fresh-water drift," and incorrectly notes marine shells in the "loam"

(loess), in addition to land shells and mastodon bones. W. B. Rogers (1804-1882), long a proponent of Diluvial Theory, and L. Agassiz, founder of Glacial Theory, use the opportunity of Gale's talk to argue their respective positions.

[1848 – University of Mississippi ("Ole Miss") established.

[Christy, D., 1848, Letter on geology. Erratic rocks of North America: J. M. Christy, Rossville, Ohio, 11 p. (no figures).

This pamphlet is credited (Merrill, 1924, p. 629) as being the first to establish the southern limit of the drift in the U.S., determined largely from the distribution of glacier-borne erratic boulders. This made it clear that the gravel in Mississippi (or any deposit south of southern Illinois) was not part of the "Northern drift" (as Wailes, 1847 MS, had argued). It is important to note that David Christy was a diluvialist, and considered this drift the result of a rapid post-Tertiary flood, and not (as is thought today) due to glaciation. The MidWest drift was not identified as the product of continental glaciation until 1851.

Gale, L. D., 1848 abstract, On the Natchez Bluff Formation: American Journal of Science, series 2, v. 5, no. 14, p. 249-250.

This is another abstract of Gale's 1847 AAGN talk (it was never published in full). He argues that the Natchez Man pelvic bone is modern a bit too strongly, by saying that both the human bone and the giant ground sloth bones found with it are reworked. Because the sloth skeleton found with the human bone is a large, semi-articulated skeleton, it is not possible to argue that the sloth is reworked.

Lyell, C., 1848, (reprint of Lyell, 1847c), On the relative age and position of the so-called Nummulite Limestone of Alabama: Quarterly Journal of the Geological Society of London, Proceedings, v. 4, pt. 1, p. 10-16.

The figures are greatly improved over the originals. Fig. 1 (p. 14) clearly shows the *Zeuglodon* beds overlying the Claiborne beds, unclear in the original (Lyell, 1847c). Fig. 2 (p. 16), the section across Mississippi, makes clear that the beds at Vicksburg overlie those at Jackson.

Leidy, J., 1848, [Additional observations on the fossil horse of America.]: Philadelphia Academy of Natural Sciences, Proceedings, v. 3, no. 12, p. 328, pl. fig. 6.

This is a brief addendum to Leidy (1847), on fossil horses from America. Here, Leidy notes (and figures, pl. fig. 6, opposite p. 326) an additional upper cheek tooth fragment of a horse, from Dickeson's Natchez area collection, and suggests it may be a separate species. It is probably also *Equus complicatus*.

Conrad, T. A., 1848, Observations on the Eocene Formation, and descriptions of one hundred and five new fossils of that period, from the vicinity of Vicksburg, Mississippi, with an appendix: Philadelphia Academy of Natural Sciences, Journal, series 2, part 2, v. 1, article 9, p. 29-134, pl. 11-14.

These are the first illustrations of Mississippi Oligocene fossils / Tertiary invertebrates / fossil mollusks. Here Conrad finally figured the Vicksburg fauna he had described in 1847. Dockery (1982b, p. 14, 232-237) reprints plates 11-13 of this work in his Appendix 1.

Gibbes, R. W., 1848, Monograph of the fossil Squalidae of the United States: Philadelphia Academy of Natural Sciences, Journal, series 2, part 2, v. 1, article 12, p. 139-147, pl. 18-21.

Dr. Robert Wilson Gibbes (1809-1866, then 39), a Charleston, South Carolina, physician, was a correspondent of Wailes, and exchanged fossils with him. He wrote some of the earliest American reviews of fossil sharks and mosasaurs. In this monograph on American fossil sharks, Gibbes illustrates (as *Carcharodon angustidens*; see Dockery and Manning, 1986) an upper anterior tooth of *C. auriculatus* from Wayne County, Mississippi (pl. 19, fig. 13). This is likely from the late Eocene Jackson Group. This is the first true Eocene fossil / Tertiary vertebrate / fossil shark illustrated from Mississippi.

Bolton, R., 1849, On the physical geography and geology of the northern portion of the state of Mississippi: American Association for the Advancement of Science, Proceedings, v. 1, p. 71-74.

This is a paper presented at the first AAAS (the AAGN changed their name to the American Association for the Advancement of Science that year, evolving from a group of state geological survey geologists in 1840 to one of all American scientists) meeting in Philadelphia in 1848, mostly of a geomorphological character. He divides the area into three north/south belts, from east to west: calcareous (the late Cretaceous chalks and marls of the Black Belt), arenaceous (mostly middle Eocene Claiborne Group sandstones), and alluvial (Recent Mississippi River alluvium). Richard Bolton makes considerable advancement beyond Cornelius (1819) and Wailes' (1844 manuscript, 1846e and f) early work in northern Mississippi.

Of particular significance is Bolton's assignment of the calcareous beds of northeastern Mississippi to the "Rotten limestone" (referring to marl and chalk beds) of Alabama (p. 72), as these beds had then been assigned to the Cretaceous. Because the Mississippi fossils previously assigned by Morton (1834) and Conrad (1832) to the Cretaceous were actually late Eocene and early Oligocene, and because the oysters Cornelius (1819, p. 327) and the mosasaur remains Wailes (1845, p. 81) had reported from northeastern Mississippi had never been assigned an age, Bolton seems to be the first to assign a Cretaceous age to the beds of northeastern Mississippi.

Bolton also seems to be the first to assign a Carboniferous age to the rocks of the northeast corner of Mississippi (p. 72). Lyell (1847a), in his section including Mississippi, had shown Carboniferous beds in that area, but does not make clear where the Mississippi / Alabama border is placed. Bolton may also be the first to note lignite and petrified wood in the Claiborne / Wilcox sandstones of north-central Mississippi (his middle band) (p. 73).

Conrad, T. A., 1849, Descriptions of new fossil and recent shells of the United States: Philadelphia Academy of Natural Sciences, Journal, series 2, part 2, v. 1, article 15, p. 207-209.

Here Conrad (now 46) describes three more new snail species from the Vicksburg Group at Vicksburg, collected by a J. D. Anderson, of Vicksburg. He notes that he had earlier collected the same bed on "Dr. George Smith's plantation, about six miles N.E. of Vicksburg" (p. 208).

Lyell, C., 1849, A second visit to the United States of North America, volume 2: J. Murray, London, xii + 385 p.

This is the travelogue of Lyell's second visit to America (1845-1846), a classic of popular geological literature (Hazen and Hazen,

1980, p. 10). There is a fair amount of Mississippi geology in this account, although little or none of it was new at this point. Most had been published in his short articles (including Lyell, 1846a and b, 1847a-c, 1848).

To briefly review, he covers the geologic sections at Fort Adams, Ellis's (White) Cliffs, and Natchez (p. 194); he identifies the Natchez loam as loess, and discusses its snails and mammals (p. 194); he discusses visiting the Natchez Man site at Mammoth Ravine in northern Natchez with Dickeson and Wailes (p. 196), and argues that Natchez Man has been reworked into the loess (p. 197-198); he discusses the Devil's Punch-bowl, a depression near Natchez (p. 200); he discusses the section at Vicksburg (p. 256); Fig. 10 (p. 257) reprints and improves on the part of his cross section from Lyell (1847a, p. 37) which shows the Mississippi River area, east as far as Jackson; the remaining part of that figure is shown, in improved form, on p. 262 (fig. 11); the geologic section of Mississippi, from Vicksburg east to Jackson, then northeast toward Tuscaloosa (including Pleistocene, Oligocene / Eocene, and Cretaceous beds) is discussed (p. 260-261); and the Northern Drift is discussed (p. 264-265).

A little of the last few pages mentioned above should be noted. Like Binney (1846) and Conrad (1846c), Lyell felt that the Mississippi bluffs had been uplifted (p. 261) after the deposition of the loess. This is partly because he saw the loess as an overbank-type fluvial deposit, and partly because he did not allow for the level of the river to change. Today the loess is seen as eolian, and probably deposited considerably above river level. The area is not seen as uplifted today.

Lyell also felt that the loess was deposited *after* the "northern drift" was formed (p. 264-265). At this point, Lyell still did not ascribe to Glacial Theory (Hallam, 1983, p. 77). He thought that erratic boulders were carried southward in a flood by icebergs (p. 265). It has been argued (Silliman, 1994) that a major reason why it took so long for Glacial Theory to replace Diluvial Theory in America was because so many American geologists followed Lyell's views. Today the surface loess (the Peoria loess) is thought to have formed at the same time as the last (Wisconsinan, late Pleistocene) glaciation, whose ice sheet is thought responsible for both moving the erratics and grinding the rock flour that became the loess.

Leidy, J., 1850, *Tapirus Americanus fossilis*: Philadelphia Academy of Natural Sciences, Proceedings, v. 4, no. 9, p. 180-182.

In a report on the fossil tapirs of America, Leidy, following Wailes (1846h), notes a tapir tooth crown with fossil horse and mastodon material in Dickeson's collection from Natchez (p. 182).

Gibbes, R. W., 1850, New species of fossil Myliobates, from the Eocene of South Carolina, and new fossils from the Cretaceous, Eocene, and Pliocene of South Carolina, Alabama, and Mississippi: American Association for the Advancement of Science, Proceedings, v. 2, p. 193-194.

Gibbes mentions the occurrence of teeth of *Basilosaurus cetoides* and a "Cast of a *Cancer*" (probably the internal mold of a crab carapace) from Jackson (p. 193). He may have been written to by Wailes about it, or heard about it through Wailes' 1845 talk or Lyell's papers.

Thornton, J. B. C., 1850, Geological letter of Doct. Thornton: Journal of the House of Representatives of the State of Mississippi, Fall and Marshall, state printers, Jackson, p. 166-169 (with a reprint, p. 170-173, of an 1849 American Association for the Advancement of Science convention resolution by fifteen geologists, asking state legislatures to establish, or re-activate, state geological surveys).

This is an open letter to the governor of Mississippi, urging that a geological survey of the state be established (p. 166). Thornton notes recent geologic research in Mississippi, and points out that a geological survey would aid both farming and mining interests in the state. He says that "many resources and hidden treasures of importance to the state, yet remain to be discovered by the geologist" (p. 168).

Desor, E., 1850, [Remarks on the relation of the alluvium to the drift of the Mississippi.]: Boston Society of Natural History, Proceedings, v. 3, p. 242-243.

This is a brief comment by Edouard Desor (1811-1882, then 39), a colleague of Agassiz, arguing that the (loess) bluffs of the Upper and Lower Mississippi Valley were a single, continuous bed, all of the same age. Like Lyell, Desor considered the loess fluviatile, deposited by the Mississippi River in a low basin, and later uplifted. He notes that the Natchez bluff "is two hundred feet high and contains land and fresh water shells and mastodon bones" (p. 243).

Anonymous, 1850a, An act to further endow the University of Mississippi, approved March 5, 1850 (reprinted in Hilgard, 1901, p. 284-285).

By this act of the Mississippi Legislature, the Mississippi Geological Survey is established, to begin on June 1, 1850. It is formed as "a general geological and agricultural survey," expanded in 1852 to include a zoological survey as well.

Unfortunately, the Survey is constructed as a kind of endowed chair in geology for the University of Mississippi, and is run by the University Trustees. They use it largely to pay the salary of their current chemistry and geology professor, John Millington (1779-1868, 70 in 1850). Millington did no field work, or even chemical analyses to further the Survey's work. All Survey work was done by his assistants—Oscar M. Lieber (1830-1862, 21 in 1851) from July, 1851 to January, 1852, and B. L. C. Wailes (then 55) afterwards. When Millington finally submitted a Survey report to the Legislature (Millington, 1852), it was based entirely on his "assistant's" work. The first state survey was entirely written by his assistant (Wailes, 1854), the *de facto* State Geologist. It was not till the third State Geologist, Lewis Harper (who took over in 1854), that the position became a research job rather than just a teaching post.

Wyman, J., 1850, Notice of fossil bones from the neighborhood of Memphis, Tennessee: American Journal of Science, series 2, v. 10, no. 28, p. 56-64.

This is a brief mention of bone fragments of the giant beaver *Castoroides* collected by Dickeson from the Natchez area (p. 56), probably following Hall (1846a and b). Jeffries Wyman (1814-1874, then 36), a Boston physician, was a famous anatomist of the time.

Morris, M., 1850, Geology in the state of Mississippi: American Journal of Science, series 2, v. 10, no. 28, p. 133.

It is reported that the Mississippi Legislature has appropriated $5,000 per year to establish a geological survey ($1,000 per year went to the assistant). It is noted that the Survey was finally begun

as a result of "the publication of numerous popular articles on geology," an "exhibition to the Legislature of a rich cabinet of Mississippi specimens," and Thornton's (1850) plea in the House of Representatives.

Fanning, Rev. T., 1850, Natural science in Mississippi: The Naturalist (of Franklin College, Nashville, Tenn.; 1850 only), v. 1, p. 58-59.

This note suggests features to be looked for in a Mississippi state geologist.

Anonymous, 1850b, Iron manufacture in East Mississippi: DeBow's Southern and Western Review, series 1, v. 9., no. 3, p. 331-332.

The *Eastern Clarion* newspaper reports "specimens of fine looking *iron*, extracted from ore found ... in Neshoba county" (probably from glauconitic sandstones of the middle Eocene lower Claiborne Group). The author speculates that, if sufficient coal could be obtained to smelt the plentiful ore, a fortune in iron could be made. It is now accepted that most Gulf Coastal Plain iron ores are too low grade to cheaply produce iron.

ADVANCES IN MISSISSIPPI GEOLOGY PRIOR TO 1851

[– indicates papers only indirectly related to Mississippi.

Hutchins (1784) – First paper to discuss Mississippi geology. First report of practical use of Mississippi geologic resources (building stone, pottery clay, etc.). First record of Mississippi fossils / invertebrate fossils / fossil mollusks / Oligocene fossils (age not given; Yazoo River, near Redwood).

Dunbar and Hunter (1806) – First reference to Mississippi fossil plants / petrified wood (at White Cliffs).

Maclure (1809) – First geologic map of Mississippi (in the first geologic map of the U.S., by the Father of American Geology). First map to show the Mississippi Embayment (as a northward lobe of the coastal "Alluvial Rocks," referring to unconsolidated sediment). Central, central-eastern, and northeastern parts of the state shown as "Secondary Rocks" (for slightly tectonically altered beds).

Cornelius (1819) – First report on the geology of the part of the state east of the narrow band along the Mississippi River. Geology along the Natchez Trace. First report of Mississippi fossil oysters. First report of Mississippi Eocene / Jackson Group / subsurface fossils (small shells from a well at the Choctaw Agency in present Hinds County; age not reported in paper). First report of Mississippi Cretaceous oysters (from the Chickasaw Nation, northeastern Mississippi; age not reported in paper). First rough survey of the geology of the state.

Mitchill (1826) – First report of Mississippi vertebrate fossils / Pleistocene fossils / Natchez area fossils / mastodon (two mastodon teeth from near Natchez).

[Conrad (1830) – American beds first assigned to the London Clay, precursor to the term Eocene (Maryland).

[Conrad (1832a) – First fossil formally described from the Gulf Coastal Plain (*Venericardia* from Claiborne Bluff, Alabama). First Gulf Coastal Plain site assigned to the London Clay.

Smith (1832) – First formal geologic section of a Mississippi site (Natchez bluffs).

Nutt (1833) – First full geological paper on Mississippi geology written by someone living in the state. First report that the bluff (loess) snails are terrestrial forms (Natchez / Rodney area).

[Morton (1833a) – First description of Oligocene invertebrates from the Gulf Coastal Plain ("*Nummulites* limestone" of southwestern Alabama). Unfortunately, following Conrad (1832a), they were identified as from the "Ferruginous Sand Formation," meant to indicate a "Secondary" age (now late Cretaceous).

[Morton (1833b) – The term Cretaceous is used in place of "Ferruginous Sand."

[Conrad (1834) – The term Eocene is first used for American beds (coined in 1833 by Lyell for European beds)—in Louisiana, Alabama, Georgia, Virginia, South and North Carolina, and Maryland. As originally used, included Paleocene and Oligocene.

[Agassiz (1840) – With this analysis of glacial geology, the notion of widespread flood deposits (such as the early interpretations of the gravel beds of the Natchez area) began to disappear.

Dickeson (1842) – First full report on the mastodon remains of the Natchez area. First full work of Mississippi vertebrate paleontology.

Anonymous (1844) – Discussion of Wailes' collection at Jefferson College in Washington, Mississippi. First report of Mississippi Eocene vertebrates (age not given) / *Basilosaurus* / fossil whales (*Basilosaurus* as a marine reptile) / fossils from the Jackson area. First report of a Mississippi (late Pleistocene) ground sloth / *Megalonyx* / fossil horse (Natchez area). First report of Mississippi (late Cretaceous) mosasaurs / fossils from the Macon area / Cretaceous (as early Jurassic) vertebrates / Mesozoic vertebrates / marine reptiles. First report of Mississippi fossil shark teeth (locality unreported). First report of Mississippi (Paleozoic) fossils in gravel / reworked fossils (probably Natchez riverfront).

Dickeson (1845) – First report of a second ground sloth from Mississippi, later identified as *Paramylodon* (originally described as a "curious *nondescript* QUADRUPED") (Natchez area).

Wailes (1845) – First report of the fossil fauna from Vicksburg / first fossil corals reported from Mississippi.

Dickeson / Wailes (1845) – First reports on Mississippi geology presented at a meeting of American geologists. In a sense, Mississippi entered the community of American geology at this point.

[Conrad (1846a) / Lyell (1846a) – The "Nummulite limestone" (today part of the early Oligocene Vicksburg Group) and "*Zeuglodon* beds" (today the late Eocene Jackson Group) of Alabama, after many years of being identified as Cretaceous, are finally placed in the Eocene (in the broad sense, including Oligocene).

[Lyell (1846a) – The critical sequence "Nummulite limestone" (Vicksburg Group) overlying "*Zeuglodon* beds" (Jackson Group) overlying Claiborne Bluff beds (Claiborne Group) is established (in southwestern Alabama). Oddly, the sequence is challenged much later (by Meyer in 1885). The basic early Tertiary stratigraphy of Mississippi is established.

Emmons (1846) – First published chemical analysis of a Mississippi soil sample (modern Yazoo River bed, Yazoo County).

Hall (1846a) – First report of fossil giant beaver (*Castoroides*) in

Mississippi (Pleistocene, Natchez area).

Wailes (1846h) – First published reports of Eocene (in the modern sense) beds in Mississippi (Jackson area), Mississippi fossil tapir (Natchez area), echinoderms (echinoids from the Jackson area), and petrified palm (no locality given).

Conrad (1846b) – First full work of Mississippi invertebrate paleontology. First formal analysis (rather than just general description) of a Mississippi fossil fauna / invertebrate fauna / the Vicksburg fauna. The relative age of the Vicksburg fauna is first established, as between the known Eocene and Miocene faunas (eight years before the term Oligocene is coined). It is called "upper or newer Eocene." The phrase "Vicksburg Group" is first used.

Binney (1846) – First identification of the Mississippi bluff material as loess (slightly prior to Lyell, 1847a). First analysis of the loess snail fauna (Natchez area), with first report that there were freshwater mollusks along with the more common terrestrial (leaf litter) forms. The loess is here (and long past the end point of this list—1850) considered a fluviatile deposit (it is not correctly identified as eolian till Pumpelly, 1879).

Dickeson (1846) – First formal analysis of a Mississippi vertebrate fauna / the Natchez fauna. First report of Mississippi fossil bear (as *Ursus*), bison (as *Bos*), and deer (as *Cervus*).

Wailes (in Gale, in Emmons, 1847b) – First to argue that the Natchez Man pelvic bone (first reported at the 1845 AAGN convention) is reworked Recent material, and not the same age as the fossils it was found with. Dickeson's (1845) "nondescript" skeleton first identified as a mylodont ground sloth (Gale, in Emmons, 1847b).

Lyell (1847a) – First geological cross section of Mississippi (Vicksburg east to Jackson, then northeast toward Tuscaloosa). First to show the westward dip of the Mississippi Embayment beds in Mississippi.

Lyell (1847c) – First full discussion of the Jackson fossil fauna. The fauna was not formally fully listed and illustrated till later (Conrad, in Wailes, 1854).

Leidy (1847) – First description of a new vertebrate fossil species from Mississippi (the Pleistocene horse *Equus americanus*, later renamed *E. complicatus* Leidy, 1858, from Natchez). First illustrations of a Mississippi fossil / vertebrate fossil / fossil horse / fossil from the Natchez area / Pleistocene fossil. The first of many papers by Leidy on Mississippi vertebrate fossils, and the first full paper on vertebrate fossils by the Father of American Vertebrate Paleontology.

Conrad (1847) – First description of a Mississippi invertebrate fossil fauna (105 new species, from Vicksburg).

[Christy (1848) – First paper to establish the southern limit of the drift (later identified as the limit of continental glacial ice) in the U.S. This made clear that the Mississippi river gravel (considered drift as early as Drake, 1825) was unrelated to the "Northern drift" (interpreted later as glacial deposits).

Conrad (1848) – First illustrations of Mississippi fossil invertebrates / Oligocene fossils / Tertiary invertebrates / fossil mollusks (the Vicksburg fauna).

Gibbes (1848) – First illustration of a Mississippi Eocene fossil / Tertiary vertebrate / fossil shark (*Carcharodon* tooth from Wayne County).

Bolton (1849) – First assignment of Mississippi beds to the Cretaceous (as the "Rotten limestone" of Alabama). First assignment of Mississippi beds to the Carboniferous. First to note lignite and petrified wood in the (Claiborne / Wilcox group) sandstones of north-central Mississippi.

REVIEW—WHAT WAS KNOWN OF MISSISSIPPI GEOLOGY PRIOR TO THE ESTABLISHMENT OF THE SURVEY IN 1850

One gets the mistaken impression from most of the histories of Mississippi geology, because nearly all are histories of the Mississippi Geological Survey, that little had been learned of the geology of the state prior to the establishment of the state survey in 1850. A quick review of the above information shows, to the contrary, that a good deal had been learned by that point.

The basic geomorphology of the state had been worked out. The geologic section had been determined at several spots around the state, notably the Mississippi River bluffs from Vicksburg to Fort Adams, the Jackson area, north-central and northeastern parts of the state.

Five geologic time periods had been identified in the state (although only three were correctly named): Carboniferous (now early Carboniferous, or Mississippian) in the far northeastern corner of the state, Cretaceous of the chalk and marl beds in the northeastern part, "lower Eocene" (now late Eocene Jackson Group) in the Jackson area and in Wayne County, "upper Eocene" (now early Oligocene Vicksburg Group) at Vicksburg, and post-Tertiary (previously "diluvial" or "Northern drift," now late Pleistocene) loess in a 12-mile broad strip along the Mississippi River from Vicksburg to Fort Adams.

Much had been determined about the paleontology of the state. Oysters and mosasaurs had been reported from the Cretaceous beds. The "lower Eocene" (late Eocene) fauna from the Jackson area was just starting to be discussed by Lyell and Conrad, although the early whale *Basilosaurus* had been reported as early as 1844, and had been correlated to the *Zeuglodon* beds of Louisiana and Alabama. The "upper Eocene" (early Oligocene) Vicksburg fauna was in the most advanced state by 1850, due to Conrad's research—many new species from there had been described and figured. The loess fauna was also well known by 1850: the leaf litter snail and freshwater mollusk faunas had been identified and discussed in detail by Binney, and the vertebrate fauna had been much discussed and was starting to be formally described (mastodon, two ground sloths, horse, tapir, deer, giant beaver, and bear had been reported) by Leidy. The first new fossil vertebrates had also been described and illustrated by Leidy. Mississippi fossils were well represented in the collections in Philadelphia.

Although the broad sweep of the state's geology was still unclear (only the most rudimentary geologic map had been done by Maclure), certain broad features had been discerned. The southern part of the state had been found to be part of the broad coastal plain of the Gulf and Atlantic states by Maclure, and was made up of mostly

younger, unconsolidated sediment. The western part of the state north of Natchez was then interpreted as part of a northward lobe of coastal sediment that extended to eastern Missouri (the rough outlines of the Mississippi Embayment had been worked out by Maclure). Lyell had shown the slight westward dip of the beds of central and northeastern Mississippi. Lyell had also (in Alabama) explained the basic early Tertiary stratigraphy of Mississippi, with Vicksburg Group over Jackson Group over Claiborne Group (the last had not yet been identified in Mississippi).

How well known was Mississippi's geology, nationally and internationally, in 1850? By the end of 1850, at least eighty published reports (papers and abstracts) dealing with Mississippi geology had been printed. Although some were local (i.e., *The Guardian* of Columbia, Tenn.; *Southern Planter* of Natchez; or *DeBow's Review* of New Orleans) or obscure (i.e., Conrad's privately published papers or Bromme's pamphlet for German immigrants), many were in national science journals (i.e., the *American Journal of Science*, the *American Quarterly Journal of Agriculture and Science*, the *Proceedings of the Philadelphia Academy of Natural Sciences*, the *Proceedings of the Boston Society of Natural History*, the *Transactions of the American Philosophical Society*, etc.). Some authors lived in Mississippi (e.g., Wailes, Nutt, Monette, Pendergrast), and some (e.g., Binney and Leidy) never even visited the state. Some who wrote about the state had national reputations (i.e., Dunbar, Conrad, and Leidy), and Lyell had an international reputation.

By 1850, several talks on Mississippi geology had been presented at national geological meetings (the Association of American Geologists and Naturalists, and its daughter group, the American Association for the Advancement of Science), including talks by Wailes and Dickeson in 1845, Wailes and Gale in 1847, and Bolton in 1848.

Mississippi geology, especially, came to be known to the larger geological community through the writings of those who traveled through the state and reported carefully on it, notably Hutchins in the late 1700s, Cornelius in 1819, Conrad in 1844, and Lyell in 1846. It is worth noting that, rather than challenging geological work (Hazen and Hazen, 1980, p. 6), many who wrote on Mississippi geology from a religious perspective (notably Rev. Cornelius) did much to advance it. The same could be said for doctors (Pendergrast, Mitchill, Morton, Dickeson, Leidy, Gibbes, and Wyman), planters (Dunbar, Nutt, Wailes, and Ingersoll), lawyers (Lyell), and even politicians (Sargent), even if they weren't always current with the literature.

Although the commercial use of rock and mineral resources in Mississippi (as well as the soil quality for farming, including the first chemical analyses of soils) had been briefly noted by 1850 (Hutchins, 1784; Darby, 1817; Cornelius, 1819; Flint, 1832; Bromme, 1837; Wailes, 1845; Emmons, 1846; Wailes, 1846b-g; Anonymous, 1850b; etc.), these resources weren't studied in full till later.

What was still to be learned of Mississippi's geology in 1850? Not everything can be mentioned, of course, but some important points give a rough idea of where the state stood in 1850. The first statewide geologic report wasn't published till 1854 (Wailes). The extent of the Yazoo Basin ("Mississippi Delta") wasn't mapped till 1854 (Lieber). The first detailed geologic map of the state (Lieber's 1854 map wasn't much improved over Maclure's 1809 map) didn't appear till 1857 (Harper), which showed the extent of the loess and distinguished beds of early and late Tertiary age. The Oligocene wasn't separated from the Eocene till 1854, and the Paleocene not till 1874. The loess and pre-loess gravel weren't formally identified as "Pleistocene" till after 1850. The Midway, Wilcox and Claiborne groups weren't identified in Mississippi till much later. Beds of Miocene and Pliocene age were known in southern Mississippi by 1850, but not identified to age (i.e., the Grand Gulf beds [now Catahoula and Fleming formations] and "Davion's Rock" [now a bed of the Pascagoula Formation] of Miocene age, and the red gravel [now Citronelle Formation] of Pliocene age).

Glacial Theory was finally generally accepted in America in the 1860s, displacing Diluvial Theory. At the same time, it became accepted that rivers carve their own valleys (rather than requiring sudden flooding), and that gravel lag beds could be transported by river water.

Petrified wood, known from Mississippi since 1806, wasn't studied botanically till long after 1850 (thin sections weren't widely used in America till the 1870s).

Loess was finally identified as of eolian, rather than fluviatile, origin in 1879 (Pumpelly), but this wasn't widely accepted till the early 1900s.

The Devonian wasn't identified in the far northeastern corner of the state till after 1850, nor were the various units (and fossils) of the Upper Cretaceous beds of Mississippi.

The first commercial production of gas (1926) and oil (1939) in Mississippi were still in the distant future. A full understanding of the subsurface geology (including the subsurface Appalachians) was far ahead, as was the basic pattern of sea level rise and fall. Still, a broad foundation for Mississippi geology had been laid by 1850.

REFERENCES

Bograd, M. B. E., 1988, History of the Mississippi Geological Survey, p. 245-254, *in* A. A. Socolow, ed., The state geological surveys, a history: Association of American State Geologists, 499 p.

Bograd, M. B. E., 1996, Charles Lyell's visit to Mississippi in 1846: Mississippi Geology, v. 17, no. 3, p. 51-55.

Boyd, D. F., 1870, Report of the superintendent of LSU, session of 1870-1871: Republican, New Orleans, 49 p.

Brown, B. W., 1975, The first hundred years of geology in Mississippi: The Southern Quarterly, v. 13, no. 4, p. 295-302.

Conrad, T. A., 1855, Observations on the Eocene deposit of Jackson, Mississippi, with descriptions of thirty-four new species of shells and corals: Philadelphia Academy of Natural Sciences, Proceedings, v. 7, no. 7, p. 257-263.

Corgan, J. X., 1985, Early medical dissertation research in Tennessee geology: Earth Sciences History, v. 4, no. 1, p. 10-16.

Cotter, J. L., 1991, Update on Natchez Man: American Antiquity, v. 56, no. 1, p. 36-39.

Culin, S., 1900, The Dickeson collection of American antiquities: Free Museum of Science and Art of the University of Pennsylvania, Bulletin, v. 2, no. 3, p. 113-168, pl. 12-18.

Dickeson, M. W., 1859, The American numismatic manual: Lippincott, Philadelphia (reprinted 1860, 1865).

Dockery, D. T., III, 1982a, Lesueur's Walnut Hills fossil shells: Mississippi Geology, v. 2, no. 3, p. 7-13.

Dockery, D. T., III, 1982b, Lower Oligocene Bivalvia of the Vicksburg Group in Mississippi: Mississippi Bureau of Geology, Bulletin 123, 261 p., 62 pl. + 15 reprinted plates.

Dockery, D. T., III, and E. M. Manning, 1986, Teeth of the giant shark *Carcharodon auriculatus* from the Eocene and Oligocene of Mississippi: Mississippi Geology, v. 7, no. 1, p. 7-19, 4 pl.

Domning, D. P., 1969, A list, bibliography, and index of the fossil vertebrates of Louisiana and Mississippi: Gulf Coast Association of Geological Societies, Transactions, v. 19, p. 385-422 + errata sheet.

Duméril, M., 1838, Remarques de M. Duméril à l'occasion du mémoire de M. de Blainville: Compte Rendu des Séances, Acad. Sci., v. 7, no. 17, p. 736.

Hallam, A., 1983, Great geological controversies: Oxford University Press, New York, 182 p.

Harlan, R., 1834, Notice of fossil bones found in the Tertiary Formation of the state of Louisiana: Philadelphia Academy of Natural Sciences, Transactions, (new series), v. 4, no. 12, p. 397-403, pl. 30, figs. 1-2.

Harper, L., 1857, Preliminary report on the geology and agriculture of the state of Mississippi: E. Barksdale, Jackson (printed in New York for Barksdale), 350 p., 7 pl., geologic map.

Hazen, R. M., 1974, The founding of geology in America: 1771 to 1818: Geological Society of America Bulletin, v. 85, no. 12, p. 1827-1834.

Hazen, R. M., and M. H. Hazen, 1980, American geological literature, 1669 to 1850: Dowden, Hutchinson and Ross, Stroudsburg, Pa., 430 p.

Hilgard, E. W., 1901, A historical outline of the geological and agricultural survey of the state of Mississippi: American Geologist, v. 27, p. 284-311.

Howe, H. V., 1937, Large oysters from the Gulf Coast Tertiary: Journal of Paleontology, v. 11, no. 4, p. 355-366, pl. 44.

Leidy, J., 1858, [Notice of remains of extinct vertebrata from the valley of the Niobrara river, &c.]: Philadelphia Academy of Natural Sciences, Proceedings, v. 10, p. 11.

Leidy, J., 1889, Notice of some fossil human bones: Wagner Free Institute of Science, Transactions, v. 2, p. 9-12, 2 pl.

Lessing, P., 1999, William Maclure's Wernerian Appalachians: Southeastern Geology, v. 38, no. 3, p. 117-134.

Lieber, O. M., 1854, A sketch of the geology of the state of Mississippi: Mining Magazine, v. 3, p. 41-47.

Lyell, C., 1833, Principles of geology, v. 3: J. Murray, London.

Lyell, C., 1839, Elements of geology, French translation: Pitois Levrault, Paris.

Maclure, W., 1824, Miscellaneous remarks on the systematic arrangement of rocks, and on their probable origin, especially of the Secondary: American Journal of Science, series 1, v. 7, no. 2, p. 261-264.

Merrill, G. P., 1924, The first hundred years of American geology: Yale University Press, New Haven, xxi + 773 p. (reprinted by Hafner Publ. Co., New York, 1964 and 1969).

Meyer, O., 1885, The genealogy and the age of the species in the Southern Old-tertiary: American Journal of Science, series 3, v. 29, no. 174, p. 457-468.

Millington, J., 1852, Report of the professor of geology and agricultural chemistry in the University of Mississippi: Palmer and Pickett, Jackson, 8 p.

Osborn, H. F., 1913, Biographical memoir of Joseph Leidy (1823-1891): National Academy of Science, Biographical Memoirs, no. 7, p. 335-396, 1 pl.

Pumpelly, R., 1879, The relation of secular rock-disintegration to loess, glacial drift, and rock basins: American Journal of Science, series 3, v. 17, p. 133-144.

Riley, F. L., 1906, Life and literary services of Dr. John W. Monette: Publications of the Mississippi Historical Society, v. 9, p. 199-237.

Rowland, E., 1930, Life, letters and papers of William Dunbar of Elgin, Morayshire, Scotland, and Natchez, Mississippi: Mississippi Historical Society Press, Jackson, 410 p.

Schimper, W. P., 1874, Traité de paléontologie végétale (v. 3): J. B. Bailliére et fils, Paris.

Shimek, B., 1904, The loess of Natchez, Miss.: Laboratory of Natural History, State University of Iowa (Iowa City), Bulletin 5, no. 4, p. 299-326, 7 pl.

Silliman, R. H., 1994, Agassiz vs. Lyell: authority in the assessment of the diluvium–drift problem by North American geologists, with particular reference to Edward Hitchcock: Earth Sciences History, v. 13, no. 2, p. 180-186.

Silliman, R. H., 1995, The Hamlet affair: Charles Lyell and the North Americans: Isis, v. 86, p. 541-561.

Sydnor, C. S., 1938, A gentleman of the Old Natchez region: Benjamin L. C. Wailes: Duke University Press, Durham, xii + 337 p. (1970 reprint: Greenwood Press, Westport, Conn.).

Vestal, F. E., 1942, Adams County mineral resources: geology: Mississippi State Geological Survey, Bulletin 47, 200 p.

von Beyrich, H. E., 1854, Ueber die Stellung der hessischen Tertiarbildungen: K. Preuss. Akad. Wiss. Berlin Monatsber., p. 664-666.

Wailes, B. L. C., 1854, Report on the agriculture and geology of Mississippi: Lippincott, Grambo and Co., Philadelphia, for E. Barksdale, Jackson, 371 p., 17 pl. *(continued, pg.72)*

MISSISSIPPI GEOLOGY
Department of Environmental Quality
Office of Geology
P. O. Box 20307
Jackson, Mississippi 39289-1307

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

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

Editors: Michael B. E. Bograd and David Dockery
Graphic Designer: George Brown

(References, *continued from page 71*)

Warren, L., 1998, Joseph Leidy, the last man who knew everything: Yale University Press, New Haven, xvi + 303 p.

Wilson, L. G., 1998, Lyell in America; transatlantic geology, 1841-1853: Johns Hopkins University Press, Baltimore, xii + 429 p.