



Establishment and early development of the Mississippi Geological Survey, USA

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Abstract. Admitted as the twentieth US state in 1817, Mississippi received authorization for a state geological survey on 5 March 1850. The survey's first decade was marked by geologically illiterate directors, but competent assistants assured quality work. John Millington (1779–1868), the first state geologist, assigned fieldwork to his assistant, Oscar Lieber (1830–1862), who resigned shortly after Millington's 1852 report. Leiber published Mississippi's first geological map in 1854. The next assistant, Benjamin L.C. Wailes (1797–1862), investigated geology's influences on Mississippi's agriculture. Wailes left the survey when he was not promoted and Lewis Harper was named state geologist. Harper struggled with university administration, and the survey was moved to the penitentiary under his tenure. Eugene Hilgard (1833–1916) became the next assistant geologist, but with multiple errors in Harper's 1857 report, the legislature proposed to abolish the survey. The survey was suspended briefly with Harper's resignation, but Hilgard returned in early 1858 to become Mississippi's first competent state geologist. Although the American Civil War (1861–1865) disrupted the publication of Hilgard's report, his 1860 two-part *Report on the Geology and Agriculture of the State of Mississippi* eventually became the definitive text on Mississippi's geology for the next half century.

Key words: Mississippi Geological Survey, United States state surveys, Eugene Hilgard, Benjamin Wailes, American Civil War, Mississippi geology.

INTRODUCTION

Many state geological surveys were authorized before the United States national survey was established, with southern US states enacting reconnaissance surveys in support of agriculture (Rabbitt, 1989). North Carolina and South Carolina initiated surveys in the 1820s, and a dozen US states followed in the 1830s. In 1849, a resolution issued by the American Association for the Advancement of Science (AAAS) promoted state geological surveys. Several prominent scientists supported the resolution, including Henry Darwin Rogers (1808–1866), Louis Agassiz (1807–1873), and Benjamin Silliman (1779–1864) (Bograd, 1988). It was not until 3 March 1879 that the United States Congress created the United States Geological Survey.

Founded in 1850, the Mississippi Geological Survey was one of the southern state surveys that preceded the United States Geological Survey, and its purpose soon became a reconnaissance and investigation of geology's influences on agriculture within the state. In the first decade of the survey, the directors, as figureheads, were chosen to lead the survey, but fieldwork was conducted by the assistant state geologists, who were skilled and competent. Not only did some of these early Mississippi survey directors misrepresent their assistant geologists' data and publish reports filled with inaccuracies, but the assistant geologists were not promoted upon retirement of their supervisors (Fig. 1). This changed in 1858, when assistant state geologist Eugene Hilgard (1833–1916) was named state geologist. Hilgard became the first effective director of the Mississippi Geological Survey, and he maintained the survey through Mis-

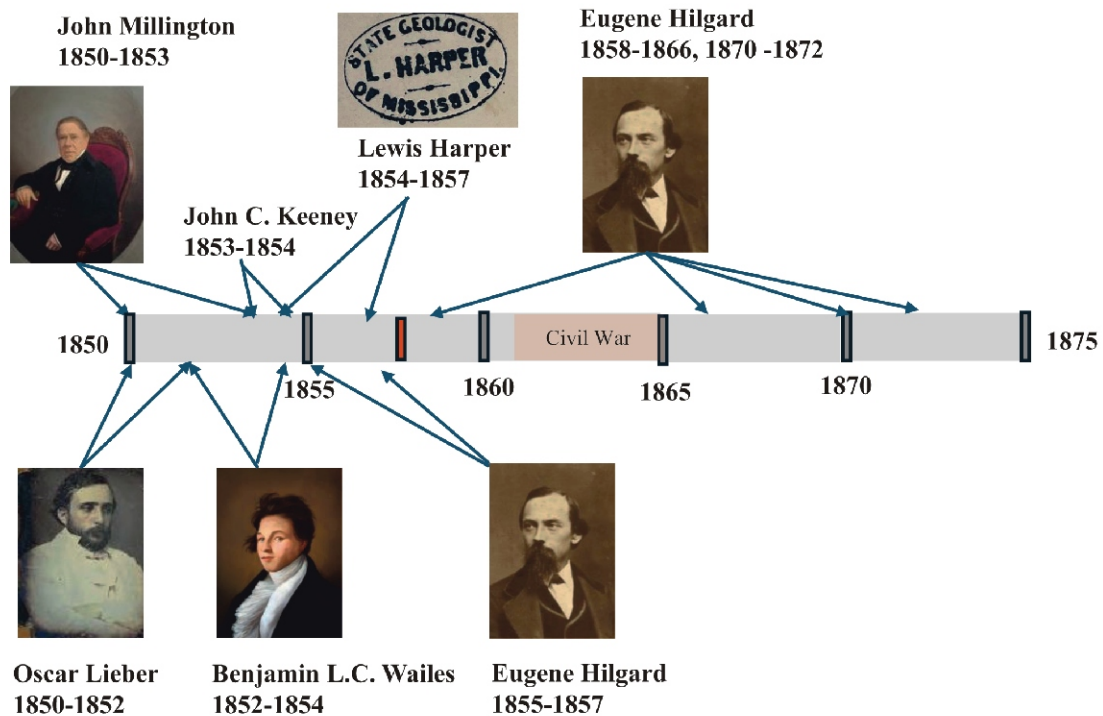
issippi's succession from the United States of America and the American Civil War. Hilgard's two-part report served as the definitive resource for knowledge of Mississippi's geology for half a century.

ORIGIN OF THE MISSISSIPPI GEOLOGICAL SURVEY

In 1817, Mississippi was admitted as the twentieth state in the United States of America. Three decades after achieving statehood, the Mississippi Legislature authorized the establishment of the Mississippi Geological Survey on 5 March 1850, through an endowment at the University of Mississippi. Previously, Mississippi's governor had signed the 1849 AAAS resolution in support of state geological surveys, and other men in the state had actively advocated for a state survey (Bograd, 1988). A physician and professor of chemistry and natural philosophy, John Millington (1779–1868), was appointed as the first state geologist in June 1850 and directed to teach geology and agricultural chemistry classes (Bograd, 1988). Millington was one of the first four faculty members upon the 1848 establishment of the University of Mississippi (Lowe, 1963), and, as a septuagenarian with a heavy workload, he allocated the fieldwork to his newly appointed assistant, Oscar Lieber (1830–1862) of South Carolina (Fig. 2). Millington directed Lieber to use the 1839 John La Tourette map, published in Mobile, Alabama, to first investigate northeastern Mississippi and then to travel down the floodplain of the Mississippi River to Vicksburg (Bograd, 1988). La Tourette's map, constructed at a scale of 1 inch to 6 miles (2.54 cm to 9.66 km), included coastal details of the state.

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Mississippi Geological Survey *State Geologists*



Assistant State Geologists

Fig. 1. Timeline of the early years of the Mississippi Geological Survey, illustrating the state geologists and the assistant state geologists of the nineteenth century

The first assistant geologists resigned when the directors misused their reports and the legislature did not promote them upon retirement of the directors. Eugene Hilgard (1858–1866) broke this cycle when he was promoted after Lewis Harper’s controversial tenure as state geologist. Hilgard would serve two terms as state geologist



The relationship between State Geologist Millington and his assistant Lieber was troubled; Millington misused Lieber’s reports, and Lieber thought he would not be credited for hypothesizing the existence of coal measures in the northeastern part of the state (Lieber, 1854; Bograd, 1988). Later, Lieber wrote in his report that his findings “being ordered to pass through the hands of another officer, were so mutilated that, when read to the trustees of the University, I was made to say that no coal could possibly be expected in Mississippi, although it might be found in Alabama, which every child in geology knows to be one of the richest coal States in the Union” (Lieber, 1854: 41–42).

Lieber resigned within days after Millington published his geological report in 1852. He next worked with Alabama’s geological survey and, in 1856, he was appointed the state geologist of South Carolina. Ironically, Lieber published the first geologic map of Mississippi in 1854, two years after he left the Mississippi Geological Survey (Fig. 3A). He began the summary noting that since his tenure at the geological survey was only 7

Fig. 2. Oscar Lieber (1830–1862) served as assistant geologist under John Millington and conducted the actual fieldwork for the Mississippi Geological Survey

Frustrated by the mishandling of his reports, he resigned shortly after Millington’s first published report (Image from the South Caroliniana Library, University of South Carolina, Columbia, SC)

months “my examinations could but be of a cursory nature. Notwithstanding this, as I extended my survey over the whole State, omitting only the entirely unimportant portion, in order that I might be able to decide in what part of the State special investigations would be most necessary, I shall be able to give a very correct general view of the geology of that State, which was at the time the extreme boundary of proper geological inspection” (Lieber, 1854: 41–42).

His map, even with limited investigation and resources, exhibits the rudimentary form of the modern geological map of Mississippi (Fig. 3B), though Lieber misidentified the Eutaw and Tuscaloosa formations in northeastern Mississippi as Tertiary instead of Cretaceous. Lieber also declared that “It may appear strange that this article has been tendered to the Editors of this valuable Magazine, since mining, except possibly for coal, will scarcely find a field in that State, as the carboniferous limestone, or possibly a Silurian limestone, is the oldest formation to be found; but the subject is of sufficient interest, I believe, to merit its insertion” (Lieber, 1854: 42).

The oldest limestones in the state were “quarried for technical purposes” (Lieber, 1854: 42), and while coal deposits had not been discovered in Mississippi, Lieber prided himself “on having been the first to call attention to their probable existence” (p. 43). Lieber (1854: 44) also pointed out that the Cretaceous strata was the most fossiliferous, and “furnishes the richest soils in the State, always excepting the alluvium of the Mississippi”. He noted that lignite was found west of the Cretaceous strata in the northern counties “in more or less conspicuous quantities” (p. 45). Lieber (1854: 46) also correctly projected that Mississippi would “never be essentially other than an agricultural State”. The next assistant state geologist’s focus would include agricultural resources within a broader geological context.

A CONTINUED IMPORTANCE OF ASSISTANT STATE GEOLOGISTS

Following Lieber’s departure, Benjamin L.C. Wailes (1797–1862) was named assistant professor of geology and agriculture at the University of Mississippi in January 1852 and served as the next assistant geologist (Fig. 4). As a boy, Wailes had moved to the Mississippi Territory with his family in 1807 (Jackson, 2017), and it was at his home area near Natchez where he amassed a personal collection of rocks and fossils from southwestern Mississippi. Wailes had careers as a cotton planter, politician, naturalist, and teacher at Jefferson College; he would later serve as the first president of the Mississippi Historical Society (Bograd, 1988). Wailes also had previous interactions with Mississippi’s indigenous peoples and worked as an assistant agent to the Choctaw.

As assistant state geologist, Wailes received funding in March 1852 under an appropriation of the Legislature for “fitting up and preparing a room for the reception for specimens +c” at the State Capitol (Mississippi Department of Archives and History Series 2828, 1852). This appears to be the origin of the Geological Room in the Capitol. Also in 1852, the Mississippi Legislature amended the state geological survey to encompass a complete natural history survey (Lowe, 1963). Wailes conducted his fieldwork under this broader survey goal.

From 1852 through 1853, Wailes traveled more than 11,265 kilometres investigating Mississippi – primarily the southern and eastern parts of the state – and he collected thousands of specimens (Lowe, 1963; Bograd, 1988). When Millington resigned as Mississippi state geologist in 1853 because of poor health, Wailes served under Mississippi’s second state geologist, John C. Keeney. In 1854, the *Report on the Agriculture and Geology*

of Mississippi. Embracing a sketch of the social and natural history of the state was published, with Wailes listed as the author, even though he did not have the official title of state geologist.

This first published report of the Mississippi Geological Survey reflected its broader natural history mission, with less than one quarter (89 pages) of the volume being allocated to geology (Bograd, 1988; Dockery and Thomsson, 2016). A geological map was absent, though Mississippi’s history, flora, and fauna were featured, and 78 pages of the report were devoted to agriculture (Lowe, 1963). Geological illustrations included fossil plates, the geological strata of the state (Plate IX), cross-sectional views, and images depicting artesian wells, including the process of and implements for boring artesian wells (Plate XII), and the theory of artesian wells (Plate XI). Wailes’s agriculture illustration (Plate VIII) documented the enslaved Americans who were forced to labor in the production of cotton (Fig. 5). Only 2000 copies of the report were printed, with 1000 copies sold and 1000 copies distributed for free (Lowe, 1963).

INCARCERATION OF THE MISSISSIPPI GEOLOGICAL SURVEY

Wailes’s report was well received, and he anticipated being named the next state geologist when Keeney resigned in 1854 after serving only a year in the position. However, Wailes, like Lieber who preceded him, was not rewarded for his skilled survey work and instead was passed over for state geologist. When Lewis Harper was selected as the third Mississippi state geologist, Wailes immediately resigned his position.

Born Ludwig Hafner, Harper was a law student from Germany who was teaching natural science in Alabama when he was named as Mississippi state geologist. Harper did not concentrate on the survey and continued his focus on his university teaching assignment; the survey’s work was suspended in February 1854 through September 1855 (Lowe, 1963).

To ensure the Mississippi Geological Survey’s duties were executed, the University of Mississippi administration relieved Harper of teaching duties and requested that professor of physics F.A.P. Barnard identify a competent assistant state geologist at the August 1855 AAAS meeting (Bograd, 1988). Barnard offered the position to Eugene Woldemar Hilgard (1833–1916), a German native who was then a chemist at the Smithsonian Institution (Fig. 6).

Hilgard arrived in Oxford, MS, in September 1855, and he and Harper set out for fieldwork in early October. The Mississippi Executive Chamber files detail the purchase of a multitude of supplies for the geological survey, including microscopes (one for a laboratory, and a smaller one for traveling), blankets, and geological hammers. With a “camp outfit, an ambulance, and a negro serving as driver and cook” (Lowe, 1963: 42), they traveled first through northeastern Mississippi to its eastern boundary, investigating Cretaceous strata, and then southward, through Tertiary strata, to Leakesville, MS, on the Chickasawhay River (Lowe, 1963), terminating the investigation still 97 kilometres from the coast because of the lateness of the season. They returned to Oxford by traveling westward to Fort Adams, and then up the Mississippi River to Memphis, Tennessee, before heading south to the university. In the spring of 1856, Hilgard revisited northeastern Mississippi for a more thorough investigation of its Paleozoic, Cretaceous, and Tertiary deposits, and concluded that mineral commodities were absent in the state (Bograd, 1988); Lieber’s hypothesized coal measures were not present in northeastern Mississippi. Hilgard’s attention turned toward agriculture, which would soon dominate the focus of the Mississippi Geological Survey.

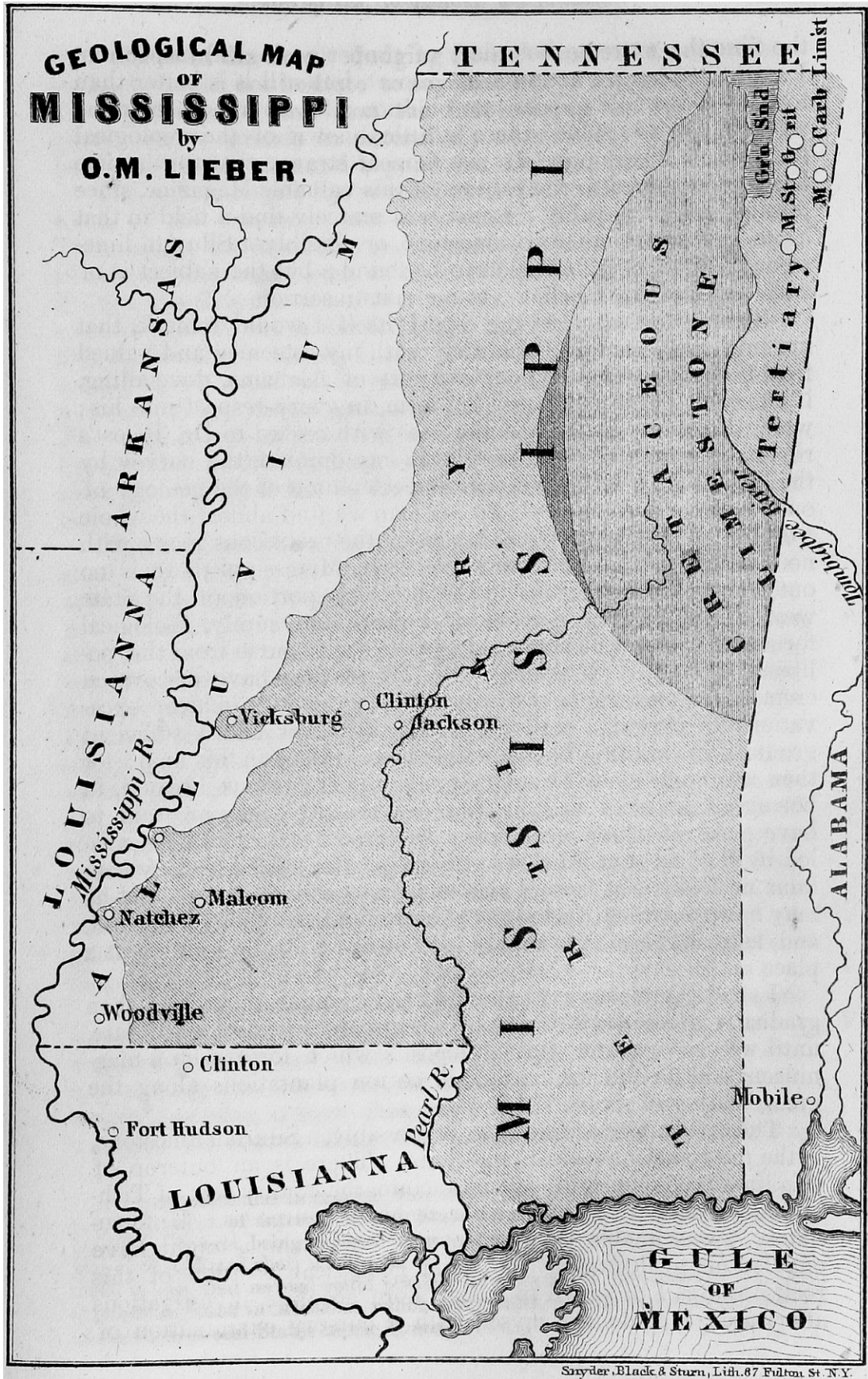


Fig. 3A. Oscar Lieber published Mississippi's first geological map in 1854, after he resigned from the Mississippi Geological Survey in 1852 (from Lieber, 1854)

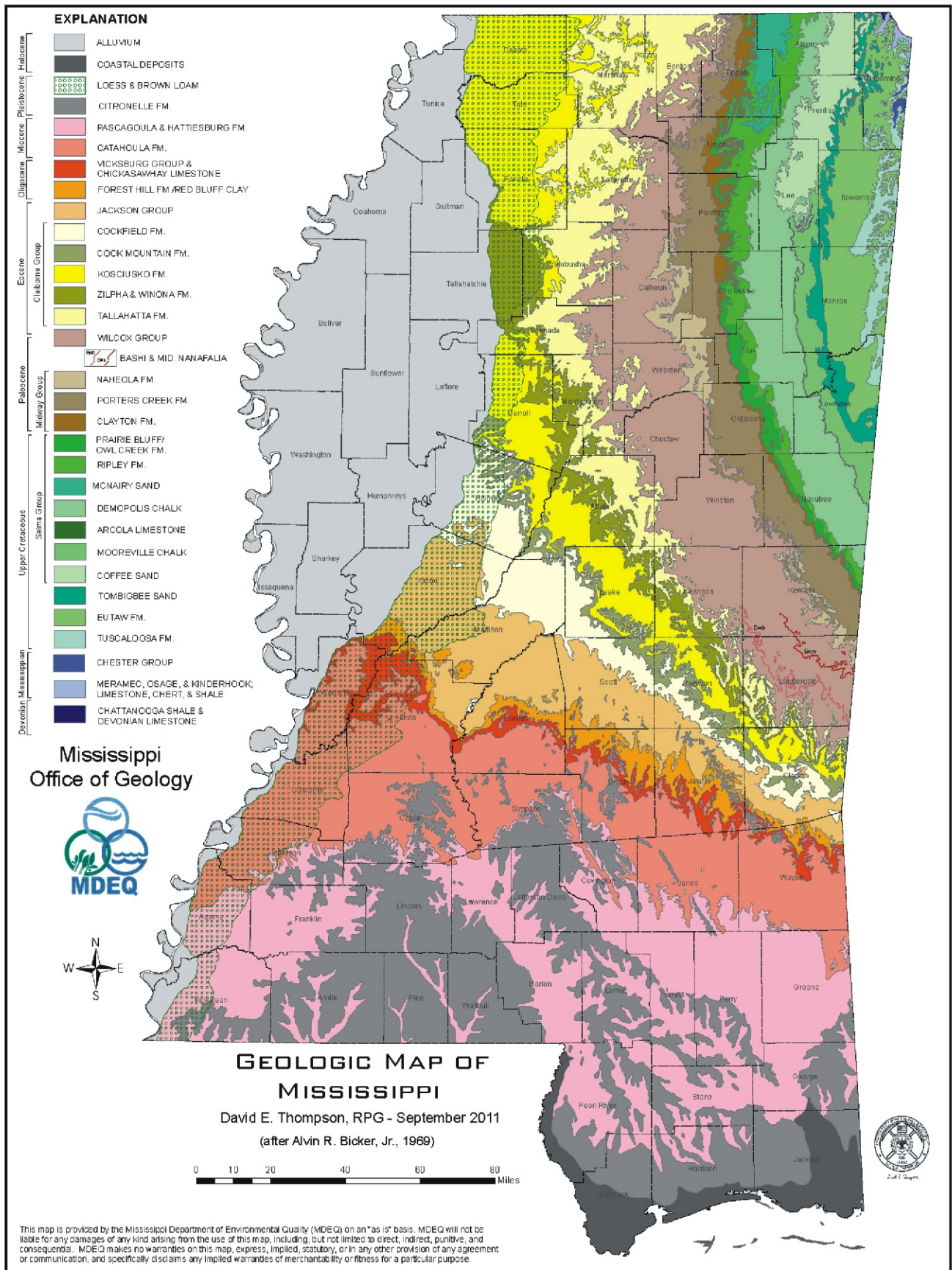


Fig. 3B. The twenty-first century Geologic Map of Mississippi demonstrates that Lieber correctly identified the pattern of Cretaceous strata in the northeast corner of the state

However, Lieber misidentified the Eutaw and Tuscaloosa formations as Tertiary, and did not detect all the small outcrops of Paleozoic strata in the extreme northeastern part of the state (from Thompson, 2011)



Fig. 4. Benjamin L.C. Wailes (1797–1862) was named the second assistant state geologist of Mississippi

Although Wailes published the first report on Mississippi's geology, less than a quarter of the book focused on geology. He resigned his position when he was not selected as state geologist upon the retirement of John C. Keeney. John J. Audubon painted this miniature (6.35 cm high) of Wailes on ivory

State geologist Harper's relationship with the university administration was problematic (Bograd, 1988). Harper published an attack on F.A.P. Barnard, then chancellor of the university, during Barnard's temporary absence, and this resulted in Barnard's scathing rebuttal of Harper (Lowe, 1963). The relationship became so fraught that the legislature excised the Mississippi Geological Survey from the university and made it a separate agency, which was subsequently relocated from Oxford, Mississippi, to the state's capital city of Jackson. The Mississippi Geological Survey's new office space was at the state penitentiary, and Harper's assigned assistant was a convict (Bograd, 1988). This 'incarceration' of the Mississippi Geological Survey underscored the rift between the university and Harper.

Rifts also had emerged between Harper and his competent assistant geologist. Hilgard frequently disagreed with Harper, who had little scientific training (Lowe, 1963), but as assistant geologist, Hilgard turned over his notes to his superior. In 1857, Harper published the *Preliminary Report on the Geology and Agriculture of the State of Mississippi*, which was rife with errors after Harper repurposed Hilgard's work to fit his own ideas (Bograd, 1988); Harper had even reversed the Eocene of north-central Mississippi with the Miocene in the southern part of the state (Bograd, 1988). Dissatisfied, Hilgard (1900) stated that Harper's report was a scientific curiosity, but he claimed his original data in his 1860 publication: "wherever I have availed myself of the observations, either of my predecessors or of other scientific observers, I have given due credit. With reference to Harper's Report, therefore, I have simply to say, that nine-tenths of all the data given there in relation to the north-

western portion of the State are extracts, sometimes literal, from my field notes, made in the capacity of Assistant in 1856" (Hilgard, 1860: xi).

The fallout from Harper's report resulted in a legislative proposal to abolish the survey. On October 15, 1857, the Executive Office in Jackson issued a *final* salary warrant "in favor of Dr. L. Harper late State Geologist ... for his salary from 2nd day of September to the 12th date of October 1847 inclusive the close of his official term as State Geologist" (Mississippi Department of Archives and History Series 2828, 1857). Hilgard returned to the Smithsonian Institution during the Mississippi Geological Survey's suspension. However, for the first time in the survey's history, the Mississippi Legislature would promote an assistant state geologist.

EUGENE HILGARD, FIRST ACTIVE STATE GEOLOGIST

Eugene Hilgard returned to Mississippi in early 1858 as state geologist to serve the Mississippi Geological Survey as the first active director since the survey's inception. He resumed field investigations in April 1858, examining Cretaceous and Tertiary outcrops. In 1859 he traveled from Columbus, MS, down the eastern part of the state to the coast, westward to the Pearl River, and farther westward to the Mississippi Bluffs and the loess region to Vicksburg (Lowe, 1963). Hilgard wrote to Governor McWillie on October 5, 1859, that he was "extremely busy, day and night, in gathering my materials and writing out my report to the next legislature, in which I hope to prove myself worthy of the kind words contained in your last years [*sic*] message, and to convince the legislators and agriculturalists that the Survey is not a (humbug say service), perhaps I may there be successful in obtaining the relief which was so rudely refused me last session. It is my misfortune that those who will take it upon themselves to judge of my efficiency and competency, are neither competent themselves to judge, nor have they any idea of the amount of labor involved in obtaining results which may afterwards be expressed in a few words. Yet, this time, I shall have more friends to speak for me knowingly, and my strongest antagonists of last year are either silenced or on the other side; so I hope for the best" (Mississippi Department of Archives and History Series 2828, 1859).

While the survey and Hilgard had apparently encountered the legislature's criticism in 1858 – likely as a reflection of Harper's tenure as state geologist – the legislature approved Hilgard's incomplete report in 1859 and appropriated partial funding (\$3500, equivalent to ~\$132,500 US dollars today) for its publication – Hilgard himself personally paid \$250, and the public printer an additional \$250 (Lowe, 1963). In 1860, the Mississippi Legislature re-established the Mississippi Geological Survey, and, under Hilgard's tenure, the survey office left the state penitentiary and returned to the University of Mississippi, although state law required an office to be maintained in Jackson.

Hilgard's 1860 two-part *Report on the Geology and Agriculture of the State of Mississippi* encountered some difficulties with printing and binding, given that the southern United States were on the verge of war. On April 27, 1860, Hilgard wrote to Governor J. Pettus that "the printing ought by all means to be done, not only at the South, but at Jackson, for there are full arrangements for doing so, and it can be done at reasonable advances over northern prices. But it is not so with the binding; the glaring disproportion of 16 cts at N.Y. to 50 cts at N.O. + Jackson, show that no arrangements exist for binding on the larger scale in these localities. I have applied for further estimates, from Charleston Richmond and St. Louis; I have not as yet re-



Fig. 5. Benjamin L.C. Wailes's 1854 *Report on the Agriculture and Geology of Mississippi* documented the enslaved Americans who toiled in the production of cotton in Mississippi

([https://commons.wikimedia.org/wiki/File:Report_on_the_agriculture_and_geology_of_Mississippi_Embracing_a_sketch_of_the_social_and_natural_history_of_the_state_\(1854\)__\(14595925499\).jpg](https://commons.wikimedia.org/wiki/File:Report_on_the_agriculture_and_geology_of_Mississippi_Embracing_a_sketch_of_the_social_and_natural_history_of_the_state_(1854)__(14595925499).jpg))

ceived answers, however, though I expect them every day... My manuscript will be ready to go to press by the beginning of June, and there is no time to be lost, unless the work is to be delayed by mere waiting for the map. The terms offered by Mr. Colton, given you in my last letter (\$750 for 5000 copies), are the lowest which can be obtained according to the inquiries I have made; no one else could offer to do it in a manner at all creditable for less than \$1000, since the map would, with others, be required to be engraved ... The wood-cuts, also, ought to be put in progress of preparation – I have reduced these to ten or fifteen, by employing for all mere profiles, skeletons which can be set up by the printer" (Mississippi Department of Archives and History Series 2828, 1860).

Hilgard then reported that he wrote to Major Weill of Carroll, the Chairman of the Geological Committee. Major Weill emphatically stated the printing should be conducted in the South. Therefore, Hilgard's 2-part report was printed in Jackson, Mississippi, but then shipped to St. Louis, Missouri, for binding. However, war disrupted the book's final dissemination.

On December 20, 1860, South Carolina seceded from the United States of America, and Mississippi followed on January 9, 1861. These states were eventually joined by 11 other states

to form the Confederate States of America in the American Civil War (1861–1865). Printed but unbound, Hilgard's report languished in a warehouse, and the Mississippi Geological Survey's work was suspended. The only official documents from the Mississippi Geological Survey from July 5, 1861, through the end of the American Civil War (June 2, 1865), were Hilgard's quarterly requisitions for his salary as state geologist.

Meanwhile, Hilgard served the Confederate Army on the Nitre Bureau and was tasked with locating nitre deposits that could be used to manufacture explosives. When the U.S. Army marched into Oxford, where the University of Mississippi is located, Hilgard convinced General A.J. Smith to spare the university buildings since they had been used as a hospital by both Union and Confederate soldiers (Lowe, 1963).

After the war concluded, Hilgard wrote on October 25, 1865, that he "appointed Marion Smith, State Librarian, to the charge of the Geological Room in the Capitol" (Mississippi Department of Archives and History Series 2828, 1865). The display that Wailes had established 13 years earlier had survived the war. Following the end of the American Civil War and the reunification of the United States of America, the Mississippi Geological Survey resumed its active work in 1866.



Fig. 6. Eugene Woldemar Hilgard (1833–1916) served as the third assistant state geologist of Mississippi

Like his predecessors, he was a competent field geologist. Elite Photographic Studio (Jones, Rulofson & Co.), Public domain, via Wikimedia Commons

When Hilgard's report was finally bound and distributed, it became the definitive source for Mississippi geology for the next half century. Hilgard's map corrected Harper's errors (Fig. 7). The survey returned to its regular work, and George Little (1838–1924) of Alabama was appointed assistant geologist in 1866. Toward the end of that year, Hilgard resigned as state geologist to become a permanent professor of chemistry at the University of Mississippi. He recommended to the legislature that assistant geologist Little be promoted to state geologist. Following Hilgard's recommendation, the Mississippi legislature promoted Little and appointed him as state geologist, following the promotional pathway that Hilgard himself had earned.

HILGARD'S RETURN AS STATE GEOLOGIST

In 1868, Eugene A. Smith (1841–1927), from Alabama, was named assistant geologist under Little, but he resigned the position to return to Alabama in 1871. Meanwhile, in 1870, Hilgard was elected chair of Economic and Agricultural Chemistry and Special Geology and Agriculture at the University of Mississippi, and by default of this position, he again became the state geologist with Little named to a professorship of general geology and natural history (Lowe, 1963). Hilgard effectively served as state geologist twice.

Robert Hills Loughridge (1843–1917) of Texas replaced Smith as assistant geologist. Unfortunately, survey appropriations were withheld by the state auditor of public accounts in 1872, and the survey's activity was suspended for the remainder of the 19th century (Bograd, 1988). Hilgard subsequently resigned in 1872 to accept a position at the University of Michigan, and, in 1875, he accepted a professorship of agricultural chemistry at the University of California at Berkeley. With no appropriations by the state, the Mississippi Geological Survey's later work of the 19th century was never fully published. The survey would not resume its work until 1903 as the short-lived Geological and Industrial Survey of Mississippi under William N. Logan, and subsequently a "geological, economic and topographical survey of the state of Mississippi" in 1906 (Bograd, 1988: 250).

DISCUSSION

The founding of the Mississippi Geological Survey preceded the U.S. Geological Survey by two decades. The first investigations of the state sought mineral commodities, especially in northeastern Mississippi, but focused on agriculture when geological investigations did not uncover any extractable resources. Mississippi's first state geologists, professors at the University of Mississippi in Oxford, did not conduct fieldwork, but relied heavily on their competent assistant geologists – Oscar Lieber, Benjamin Wailes, and Eugene Hilgard – to ensure quality surveys of the state. Not only did early state geologists misuse the assistant state geologists' reports, the early assistant geologists were not rewarded for their efforts and were passed over for promotion. Lieber resigned when Millington did not credit him for his analysis; Wailes resigned when he was not promoted and Harper was named the third state geologist. Not until Eugene Hilgard was promoted to state geologist, after Lewis Harper's tumultuous tenure, did the Mississippi Geological Survey have an effective, and competent, state geologist at its helm.

How does the Mississippi Geological Survey compare with other surveys established at the same time, in that early directors were figureheads with little geological training? Seven US state geological surveys were established within the decade before, and the decade following, Mississippi's geological survey: Vermont (1845), Alabama (1848), Illinois (1851), Missouri (1853), Iowa (1855), Arkansas (1857–1860), and California (1860). Two of these states, Alabama and Arkansas, also seceded with southern US states during the American Civil War.

When examining the histories of these contemporary geological surveys, similarities, and differences, with the Mississippi Geological Survey emerge. One of the recurring themes was the difficulty that state geological surveys encountered with state legislative money appropriations. Often, state surveys were not contiguous in their service but were inactivated following survey reports and/or legislative decisions to withhold funding. Missouri's governors proposed a state geological survey in 1836, 1846, and 1851, but it was not until 24 February 1853 that the general assembly passed the act that created the Missouri Geological Survey (Missouri Department of Natural Resources, 1988). When Albert Hager served as Vermont's State Geologist (1864–1870), the legislature provided no compensation. Likewise, California's geological survey history was budget-dependent; an 'honorary state geologist' was chosen a year after the state was admitted to the union. The origin of California's geological survey dates to 1860, but with the first reports not focused on the economic resources of the state, the legislature

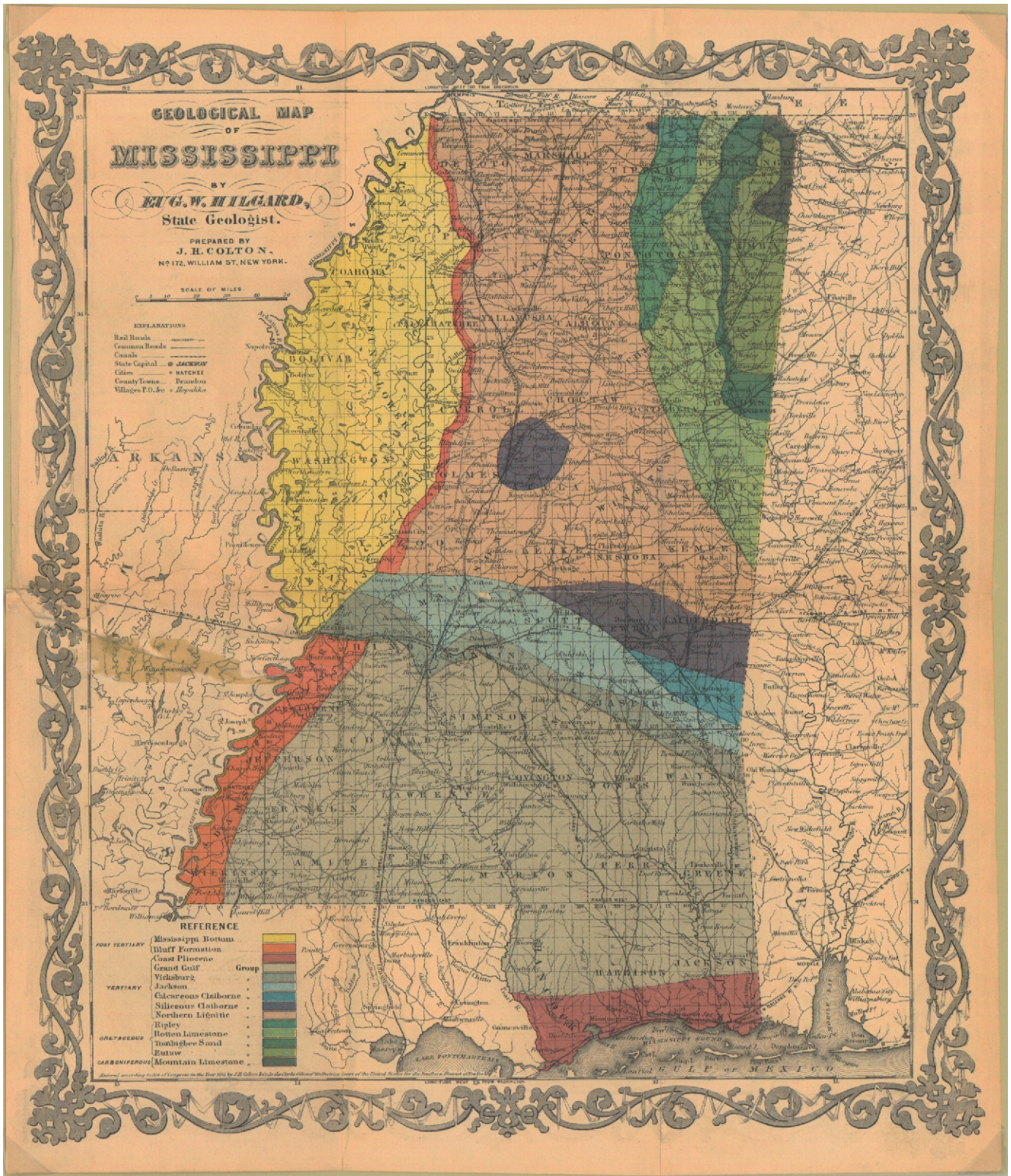


Fig. 7. Eugene Hilgard's (1855) Geological Map of Mississippi corrected the inaccuracies of Lewis Harper's map and more completely delineated the geology of the state

was not satisfied, and the survey was abolished in 1874 (California Division of Mines and Geology, 1988). The California State Mining Bureau later would be founded in 1880.

However, the histories of Mississippi's contemporary state surveys do not indicate that other directors were appointed as figureheads. Several state surveys hired well-known scientists, even from outside the state, to serve as state geologists. Vermont's first report was completed by Edward Hitchcock and his

sons in 1861; their report brought an end to the Vermont state survey. David Dale Owen of New Harmony, Indiana, conducted Arkansas' state survey from 1857 through 1858; it is known as the First Survey, or Owen's Survey (Arkansas Geological Commission, 1988). Owen also served as the first state geologist for Indiana and Kentucky; he surveyed parts of Iowa before their first state geologist was named.

When Iowa's state survey was created in 1855, James Hall was appointed as state geologist, with Josiah Whitney of Massachusetts as an assistant in paleontology (Prior, 1988). Their 2-part volume was published in 1858, and with the report complete, the survey was not reactivated until 1866. Whitney was later appointed head of the California Geological Survey in 1860, and in 1865 he became a professor at Harvard University (California Division of Mines and Geology, 1988). One of David Dale Owen's colleagues, medical doctor Joseph G. Norwood, became the first state geologist in Illinois. Some directors also assembled larger, competent teams; their workforce had the skills required to complete a state survey. Missouri's George C. Swallow hired five assistants (two medical doctors, a civil engineer, a chemist, and a draftsman/geologist) to assist in the survey work (Missouri Department of Natural Resources, 1988).

When survey activities were continuous, and a talented assistant was part of the team, the assistant was not passed over for a state position as had occurred in Mississippi. Illinois' Amos Worthen, Norwood's assistant, became the second state geologist in 1858. Only in Alabama was the state geologist's assistant not promoted. The 1857 death of Alabama's first state geologist, Michael Tuomey, meant the second survey report was delayed; Tuomey's assistant, Dr. John William Mallet, oversaw the printing of the report in 1858. During the American Civil War, Mallet's knowledge of explosives led to Alabama to be known as the 'Arsenal of the Confederacy'. William Mallet was not promoted to state geologist because the survey was without funding and ceased to exist (Sartwell, 1988).

Another notable difference between the Mississippi Geological Survey and its contemporary southern state surveys was that the Mississippi Geological Survey continued, in a rudimentary form, uninterrupted throughout the American Civil War. The Arkansas Geological Survey and Alabama Geological Survey suspended their activities; Arkansas' published survey in 1861 ended the survey activities which did not resume

until 1871, after the Civil War and the reconstruction period. Alabama's state survey was suspended during the war, and their second state geologist would not be named until 1873 (Sartwell, 1988). And while not a Confederate state, Missouri's geological survey activities would be suspended in 1861 during the war, not to resume until 1870. Likewise, Iowa's survey concluded its activities in 1858 with the publication of its 2-part volume; it would not be reactivated until 1866. Although documentation of Mississippi's survey during the Civil War is sparse, the state archives indicate that Hilgard continued as the director, requesting and presumably receiving payment as state geologist.

CONCLUSION

The service of the early assistant state geologists, Lieber, Wailes, and Hilgard, ensured quality work that provided a foundation for the young Mississippi Geological Survey. The survey could not retain Lieber and Wailes, though, since the skilled assistant geologists quickly resigned when their reports were mishandled by their superiors, and they were not promoted. However, Hilgard was able to secure a promotion to state geologist after the disastrous tenure of Lewis Harper. With Hilgard, the Mississippi Geological Survey benefitted from a director with geological skills who had risen from an assistant geologist position. Even though survey work was suspended during the American Civil War, Hilgard managed to quickly re-establish the survey's work shortly after the war ended – in direct contrast to other southern state surveys that were suspended for much longer. Hilgard's survey report served as the definitive source for Mississippi's geology for half a century, and he would also develop an international reputation as the "Father of Soil Science".

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