MISSISSIPPI
STATE GEOLOGICAL SURVEY

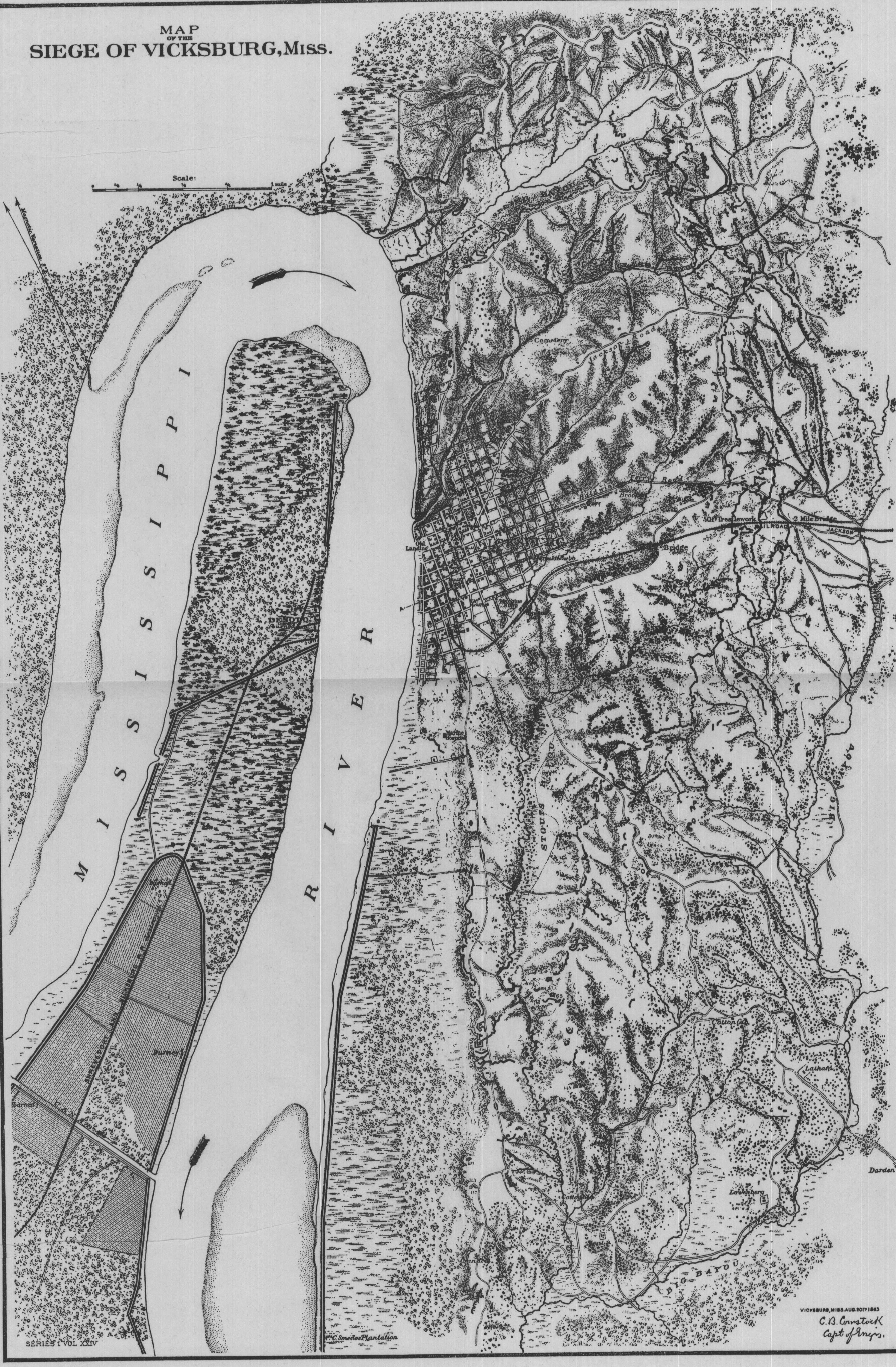
WILLIAM CLIFFORD MORSE, Ph. D.
Director

BULLETIN 28

THE GEOLOGIC HISTORY OF THE VICKSBURG NATIONAL MILITARY PARK AREA

By
WILLIAM CLIFFORD MORSE, Ph. D.

1935

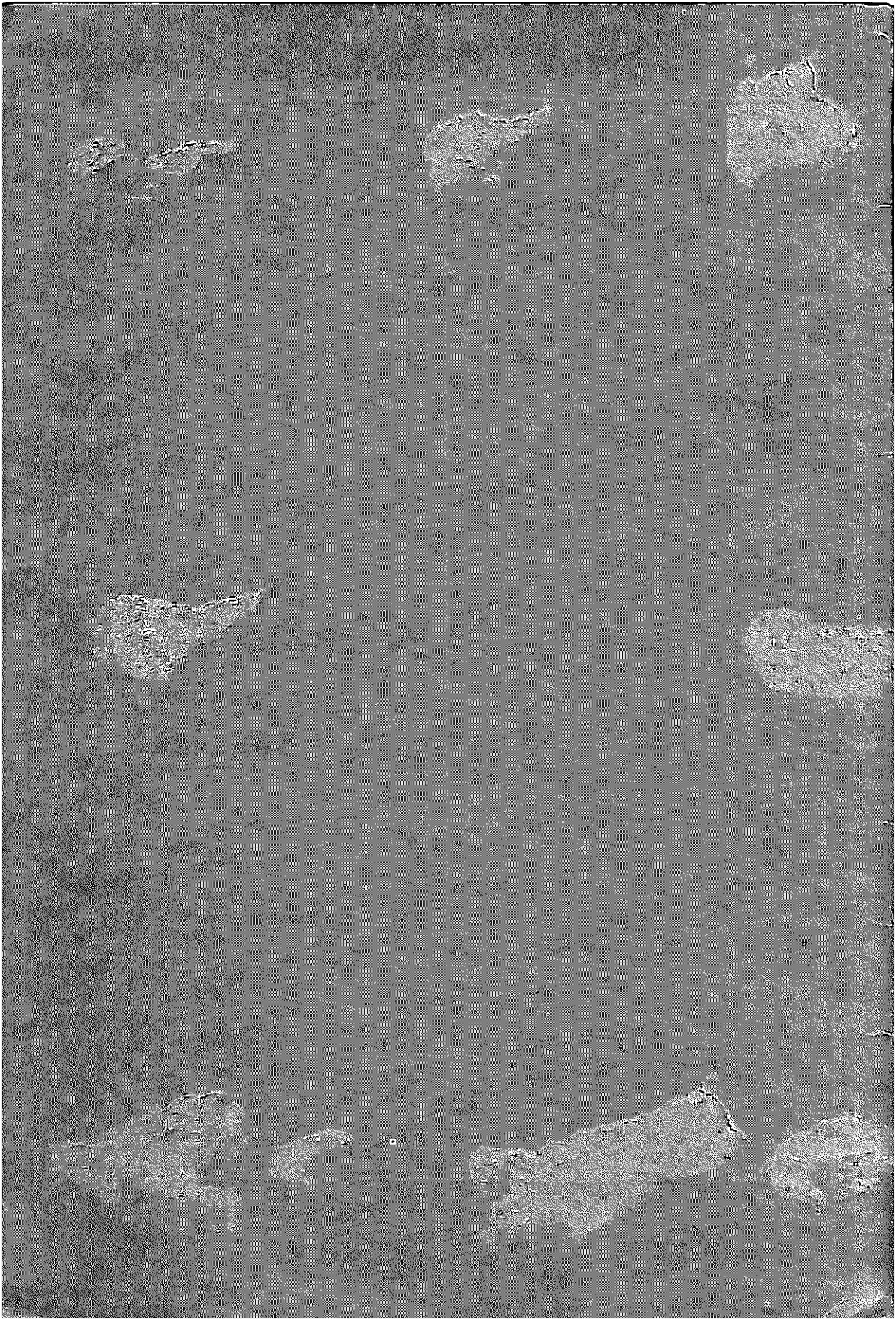


Frontispiece

The Vicksburg region as it was depicted on a map of 1863 when the Mississippi River flowed past the city twice, first north and then south. Since that date the river has cut across the long narrow neck of low land, leaving the city behind on the old meander. To keep this cut-off meander open as a navigation channel from the city wharf to the river, which now strikes the bluff near the southern corporate limits, it has been necessary to cut a diversion canal from the banks of the Yazoo River near its mouth to the abrupt curve of the meander.

Although the Confederate and Federal trenches have not been differentiated in this reproduction of the old map, the two lines can, for the most part, readily be distinguished. Aside from the Confederate line of trenches along the bluff of the Mississippi River, the Confederate trenches are the inner line, almost continuous from bluff to bluff about the city; the Federal trenches, the outer arc and approaches.

Reproduced with only minor changes from a "Map of the Siege of Vicksburg, Miss." bearing the date of August 20, 1863, and the signature of C. B. Comstock, Captain of Engineers.



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MISSISSIPPI GEOLOGICAL SURVEY

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FRANCES HARTWELL WALTHALL

After 20 years of faithful service, Miss Frances Hartwell Walthall has voluntarily laid down the duties of Secretary and Librarian to the Mississippi Geological Survey to take up a more noble work. Beginning on July 5, 1915, with a table and two cracker boxes of books, she has, in cooperation with the director, quietly, slowly, but persistently built up the library until it now has 10,000 volumes and pamphlets---a monument to her efforts. Besides this she did all the secretarial work of her Chief, the late beloved Director, Dr. E. N. Lowe, whom she served so loyally. But the Mississippi Geological Survey Library was the just pride of her endeavors. Jealous to a militant degree, the young little lady, dressed in gray hair and a smile, guarded the child of her creation to such an extent that neither director dared transgress the limits of her domain.

And now she takes up one of the more noble things of life so characteristic of many at the University of Mississippi---those finer things of life not written in text books, yet they are text books plus, text books, age, and experience plus, plus those intangible, indescribable qualities that made, as one example, the Commencement Exercises of last June (1934) an occasion of simple dignity worthy of any educational institution of the land. She is to aid the widow of one of those who quietly through the years helped to make the University of Mississippi a finer place---a more noble institution, an institution that is training citizens as well as students. She is to help edit the diaries and quaint sayings of her former Chief, Dr. E. N. Lowe. May the Heavens spare her for this noble task of devotion.---William Clifford Morse, The Oxford Eagle, April 4, 1935.

LETTER OF TRANSMITTAL

Office of the Mississippi Geological Survey,
University, Mississippi, June 20, 1935

Dr. Alfred Hume, Chancellor
University, Mississippi

Dear Chancellor Hume:

I am transmitting herewith in final form for the printer the manuscript for Bulletin 28, long since approved by you in general outline, as it was written during the Christmas vacation. Like the material for Bulletins 26 and 27, it is based on a number of years of study, the subject having been presented to my classes in geology for more than fifteen years. It is the Geologic History of the Vicksburg National Military Park area, still another subject illustrating the absolute dependency of human affairs on geologic environment. It was written to acquaint the general reader with this most interesting fact and constitutes the first of a series of educational bulletins.

Very sincerely yours,

WILLIAM CLIFFORD MORSE, Director

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THE GEOLOGIC HISTORY OF THE VICKSBURG NATIONAL MILITARY PARK AREA

BY

WILLIAM CLIFFORD MORSE, PH. D.

STATE GEOLOGIST

INTRODUCTION

Notwithstanding the minor distribution of the Confederate and Federal armies at Vicksburg by Pemberton and Grant during the siege of the City from May 18 to July 4, 1863, the fact, nevertheless, remains that the major disposition of the forces was determined untold ages before by the Creator working through the agency of one of the Continental Glaciers in Canada and northern United States. This particular glacier, in passing over the bed rock of the region, ground some of it, as well as some of the rock material the ice was transporting, into a fine rock flour, which the flood waters from the melting glacier carried down the Mississippi and deposited as flood plain material. The westerly winds picked up this rock flour, after it had dried, carried it on to the east bluffs and uplands, and deposited it as a mantle rock that forms steep-sided valleys where streams cut into it. These valleys were the controlling factors in the distribution of the armies.

But this is beginning far along in the geologic history of the Vicksburg National Military Park region; in fact, near the closing stages of its history. Although this geologic history of the area does not stretch back to the most ancient eras of geologic time, it does reach millions of years into the past.

Perhaps this can best be demonstrated by giving all the major divisions of the geologic time scale:

Geologic time scale

Cenozoic era
- Recent period
- Pleistocene period
- Pliocene period
- Miocene period
- Oligocene period
- Eocene period

Mesozoic era
- Cretaceous period
- Comanchean period
- Jurassic period
- Triassic period

Paleozoic era
- Permian period
- Pennsylvanian period
- Mississippian period
- Devonian period
- Silurian period
- Ordovician period
- Cambrian period

Proterozoic era
- Keweenawan period
- Late Huronian period
- Middle Huronian period
- Early Huronian period

Archeozoic era
- Archean period

Beginning with the Comanchean in late-Mesozoic, much of the subsequent material was laid down along the Atlantic and Gulf coastal plains, and is, for that reason, known as the Coastal Plains deposits. Save for some Paleozoic rocks along the stream courses in Tishomingo County, in the northeastern corner of the state, the geologic history of the beds at the surface begins in late Mesozoic time with the Cretaceous.

This was the time of the so-called Mississippi embayment, when an arm of the Gulf spread broadly over the southern part of the United States and reached as far north as the mouth of the Ohio River at Cairo, Illinois, or even slightly farther north. In this sea the thicker sediments were laid down along the old shore line which at the begin-

ning extended almost north and south across the northeast corner of the state. As time elapsed and as the embayment became more and more filled with sediment the old shore line shifted farther toward the south and to a more nearly east and west position in the vicinity of Vicksburg. Here begins the detailed history of the Vicksburg area, but it calls for a more detailed time scale of later geologic time.

Later geologic time scale

Cenozoic era
- Recent period
- Pleistocene period
  - Loess age
  - Terrace age
- Pliocene period
  - Citronelle age
- Miocene period
  - Pascagoula age
  - Hattiesburg age
  - Catahoula age
- Oligocene period
  - Vicksburg epoch[1]
    - Byram age
    - Glendon age
    - Mint Spring age
    - Forest Hill age
- Eocene period
  - Jackson age
  - Claiborne epoch
    - Yegua age
    - Lisbon age
    - Tallahatta age
  - Wilcox epoch
    - Grenada age
    - Holly Springs age
    - Ackerman age
  - Midway epoch
    - Porters Creek age
    - Clayton age

[1]The term Vicksburg was first applied to the rocks of this region by T. A. Conrad, Acad. Nat. Sci. Phila., Proc. 3, pp. 280-299, 1847.

DESCRIPTIVE GEOLOGY

In the lower part of Mint Spring Bayou, in reality a valley, at northern edge of the City of Vicksburg, the stream has uncovered nine or more feet of gray marl which is a slightly indurated or consolidated mass of marine shell fragments. It has been named the Mint Spring marl by C. Wythe Cook[1].

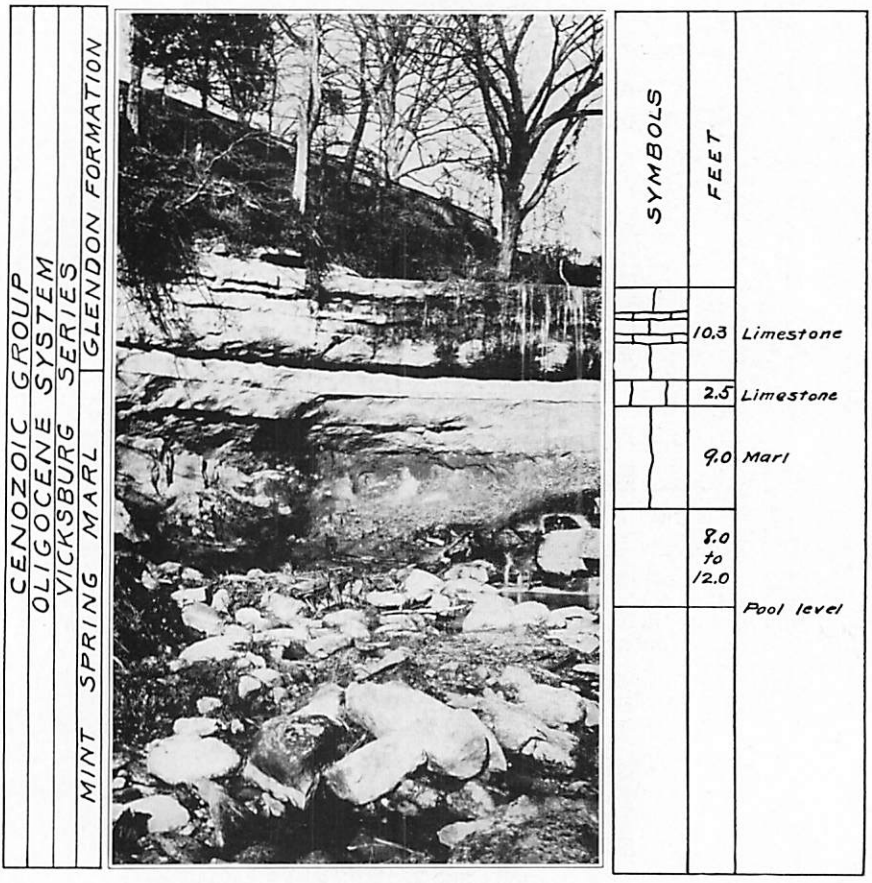

Figure 1.—Falls in Mint Spring Bayou at the National Cemetery, Vicksburg. The rocks are correlated on the left and described on the right.---Photographed January 9, 1935.

Directly overlying the Mint Spring marl is an interval of 12.8 feet of limestone extending to the brink of the falls. It, too, is a gray

[1]Washington Acad. Sci. Jour., vol. 8, No. 7, p. 195, 1918.

marl not fully indurated, but possibly sufficiently so to be called a limestone. It belongs to the basal part of the Glendon formation.

Section of the waterfalls in Mint Spring Bayou

	Feet	Feet
Glendon formation		12.8
Limestone, gray, or marl, indurated, forming the most nearly vertical part of the rock beneath the falls	10.3	
Limestone, gray, or marl, indurated, forming also a part of the nearly vertical portion of the falls	2.5	
Mint Spring marl		9.0
Marl, gray, only slightly indurated	9.0	
Base of exposure is 8 or 12 feet above water level in pool.		

These layers of limestone in the basal part of the Glendon formation are harder than the other beds of the Glendon or of the other formations of this vicinity. Consequently, they stand out in the steep parts of the valleys, whereas the less indurated beds are commonly covered with mantle rock. For this reason the limestone is exposed in the bluffs of the old Mississippi, north of the business section of the city.

Perhaps the most readily accessible section of fairly well exposed beds in the Vicksburg region is along the side of the roadway extending from Waltersville southward up the hill past the north wall of the National Cemetery. It is given in detail in the following section.

Section of the beds along the Waltersville-National Cemetery Road

Loess		21.0
Loess, grayish-buff, contains Gastropod shells and breaks into vertical columns	21.0	
Citronelle (provisionally referred to this formation)		14.0
Clay, pinkish-gray, tenaceous, which has sand and gravel in its upper inch. Both its upper and lower contacts are irregular, and, hence, its thickness is not uniform. Top surface has slickensides	3.0	
Gravel and sand mixed in the most confusing way, after the manner of the Citronelle, to which it is provisionally referred. Both upper and lower contacts are irregular, and, consequently, its thickness is not uniform	11.0	

	Feet	Feet
Catahoula formation		26.0
Sand and clay in rather indefinite layers. Some of the clay is light in color, and some of it, especially in the basal parts, contains dark films of lignite or lignitic clay. It is slightly covered at the base	26.0	
Byram marl		44.5
Marl, gray, certain beds of which are extremely fossiliferous, especially in the lower part of the interval	37.5	
Marl, bluish-gray. The top and basal intervals, each of 1.5 feet, are exposed, the median interval of 4.0 feet is covered	7.0	
Glendon formation		17.0
Limestone at top, which forms the small falls along the roadway. The lower part is marl	3.5	
Interval, covered	5.5	
Limestone at top, which forms the small falls in the small gulley opposite the roadway bridge. The rest is fossiliferous marl	8.0	
Undetermined		3.0
Interval, covered to Washington Street and Illinois Central Railroad tracks	3.0	

Although neither the Mint Spring falls section nor the Waltersville-National Cemetery road section extends down to clearly exposed beds of the Forest Hill formation of the Vicksburg series of rocks, exposures elsewhere show the Forest Hill formation to consist of cross-bedded siliceous sand and some clay. It also contains lenses of lignite and lignitic clay.

INTERPRETATION OF THE GEOLOGIC HISTORY

From the two detailed sections, it is determinable that the Vicksburg epoch of the Oligocene period began, after the Forest Hill age of shallow sandy and clayey waters, with a shallow sea in which marine invertebrate life abounded. Many of these forms secreted a calcareous test, which the waves ground into fragments, as they beat against the shore, and which marine or ground water subsequently cemented into partly indurated limestone or shell marl.

The Mint Spring sea seems to have passed quietly into the Glendon sea without definite crustal disturbances. The Glendon

sea was likewise shallow and likewise filled with invertebrate animals, whose calcareous tests were washed up the beach by the incoming waves and down the beach by the undertow until nearly all of the larger forms of these shells were reduced to mere fragments---the matrix of the present limestone. At times slightly stronger currents brought to the area some clay, and at others even stronger currents brought sand, for both are mixed with the limestone and marl at certain elevations in the stratigraphic section.

The Byram sea followed the Glendon sea. In it thrived corals, snails, and clam-like forms, besides many other species having calcareous tests---all whose fossilized shells and those of the other beds of the Vicksburg series have made this collecting area famous throughout the world. Crustal deformation, filling-up of adjoining tracts, or some other change, brought the Byram sea to an end.

The mantle rock, forming the covered interval between the Byram marl below and the sand provisionally referred to the Catahoula above, conceals the history of the change from Byram to Catahoula times. Whatever the details, the Byram sea gave way to some type of water body in which sand rather than calcareous tests accumulated. At times, too, the currents were less swift, for some clay was dropped here instead of being swept farther from the shore.

The next two ages of geologic time are less definitely known, for the clays of both the Hattiesburg and Pascagoula formations are absent. If either bed were deposited, it has been swept away by erosion; or even if both formations were laid down, both have suffered a like fate. The position which these two beds should occupy, therefore, represents an unconformity---a break in depositional sequence.

The history of the next or Pliocene period is one of the most controversial of any period of geologic time. If the yellow sand and gravel of the next interval of 14 feet really belong to the Citronelle, to which they are provisionally referred, rather than to the Coastal Terrace deposits, then there is a local basis for the discussion of some of the history of this period. Here, as over a broad belt in southern Mississippi, these sands and gravels are mixed together, are partly stratified and partly interstratified in such a manner as to mask the identity of the agent which produced them. No agent other than the glaciers habitually deposits at one and the same time both coarse and fine material---but the glaciers fell far short of reaching this region.

While loam, sand, gravel, and clay were being deposited in a broad belt along the Gulf of Mexico in the southern part of the State,

conditions quite different obtained in the northern part of the North American continent, roughly north of the Ohio and Missouri rivers. This was the time of the great Pleistocene glaciers, when glaciers of continental extent moved outward in all directions from a center in the peninsula east of Hudson Bay, from a center west of the bay, and from a center in the Canadian Rockies. During each of the five ages of the Pleistocene; namely, during the Nebraskan, Kansan, Illinoian, Iowan, and Wisconsin, a glacier slowly formed and gradually pushed itself out from each of these centers, and just as slowly it gradually melted back from its position of maximum extension. Again it reformed, pushed out, melted, and retreated, only to repeat the sequence time and again.

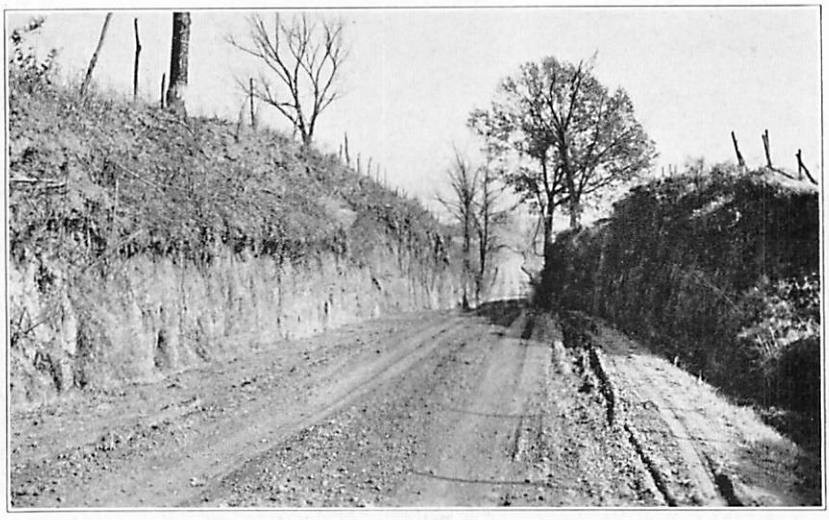

Figure 2.—Old Jackson Road cut into the Loess east of the Vicksburg National Military Park.---Photographed December 24, 1934.

It was during the advance of the Iowan that the ice ground up so much of the bed rock over which it pushed its rock-shod base, and ground up so much of the boulders it carried in transit, as it rubbed these against one another, that it had an abundance of this fine material to deliver to the streams flooded by the waters from its melting edge. This fine rock flour was carried southward by all outflowing streams and particularly by the Mississippi and its tributaries and deposited far and wide as alluvium or flood plain deposits. When the glacier melted so far back that the floods of its waters did not reach so far south, then this alluvial material was picked up by the wind and wafted

over the bluffs of the Mississippi and over the uplands. As the wind's velocity was first checked at the bluffs, here most of the material was deposited, and here, consequently, are the thickest beds of Loess.

This Loess, whose particles are intermediate between sand and clay, has the peculiar physical property of standing in vertical cliffs---even though the material is so loosely consolidated as to be readily crushed in the hand (Figures 2 and 3). This loess is the material that played such an important role in the investment of Vicksburg. Inasmuch as it tends to stand in vertical or even overhanging cliffs, valleys cut into it by the streams of any region are almost all deep and steep-sided. To this rule there seems to be no striking exception[1].

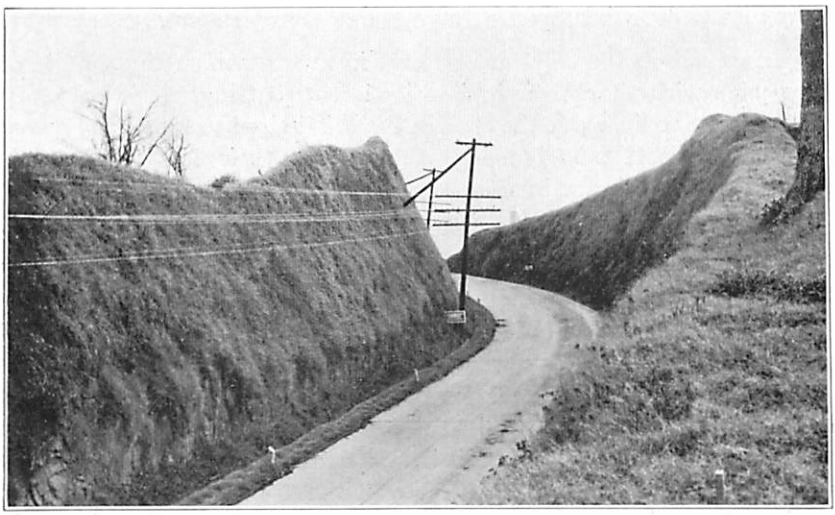

Figure 3.—Old Jackson Road cut into the Loess at the line of the Confederate trenches in the Vicksburg National Military Park. Although the verticality of the walls of the cut has been modified by recent improvement, nevertheless, the depth of the cut and the steepness of the walls are shown in this photograph of December 24, 1934.

Preceding, during, and subsequent to the time of deposition of the Loess, the waters of the Mississippi River were busy carving out

[1]As a matter of general information, it might be added that Loess, formed by mechanical disintegration rather than by chemical decomposition, has practically all of its soluble plant food intact. Consequently, it forms one of the richest soils of the state, the nation, and the world.

of the previously accumulated sediments of the Vicksburg National Military Park area the great valley of the river. And at least some of the tributary streams in at least the lower stretches of their courses were performing a similar task. Previous to the investment, the Mississippi River flowed northward in an enormous bend and struck the east bluff of the valley at the northern edge of the city where Fort Hill is located (Frontispiece).

As is always the case on the outside of such curves, the river undercut the cliffs, forcing them farther and farther outward; in this instance, eastward. By the Mississippi thus pushing its sides farther and farther into the belt previously occupied by the lowest stretches of its tributary streams, it reduced the length of these tributaries, particularly of Mint Spring Bayou and Glass Bayou.

Inasmuch as the tributary streams in their down cutting could not keep pace with the Mississippi in its lateral cutting, these tributary valleys came to lie above the level of the Mississippi Valley. They were thus transformed into hanging valleys. At their lower end, their streams had to plunge in falls to reach the Mississippi.

Geologically, subsequent time has been so short that these tributary streams have been able to push their falls back only to their present positions (Figure 1). But even so, this lowering of their immediate outlet, has enabled them to deepen and make more rugged the lower stretch of their present valleys.

Obviously, the flood waters of the Mississippi River could not lay down as flood plain deposits the Iowan rock flour without a valley flood plain upon which to deposit it. And just as obviously the Mississippi River could not have a valley without the tributary streams having valleys. For these reasons, when the winds later picked up this dry rock flour and wafted it over the valley walls and upland, they deposited a part of it upon the side of the Mississippi Valley, a part upon the surface of the tributary valleys, and a part upon the upland as well. Subsequent erosion has, accordingly, deepened and steepened the valley coated portions, and has later formed deep and steep headward portions in the upland. Such, briefly, were the conditions at the time of the investment.

GEOLOGIC CONTROL OF THE ARMIES

Fortifications at Fort Hill and at South Fort, as well as at intermediate places along the Mississippi bluff within the city limits, were so well nigh impregnable that a direct attack was not considered practicable by the Federals. By descending the Mississippi to the mouth

of the Yazoo at that time, and by ascending this tributary to a point nearest the bluff (Haynes Bluff), the Federals hoped to penetrate the swamps and bayous and to reach dry land, but were severely repulsed. Later the Federals attempted to cut a canal and thus form a cut-off, leaving Vicksburg on a large meander curve, much as the river has subsequently done of its own accord. Failing in this attempt, the Federals marched their forces from Millikin Bend to the vicinity of Grand Gulf, allowing their boats to attempt the feat of drifting by the Confederate batteries under cover of darkness. Most of the boats succeeded in running the forts, and later picked up the Federal army, landing it at Bruinsburg. From this position the Federal forces marched north to attack Jackson and then Vicksburg from the rear.

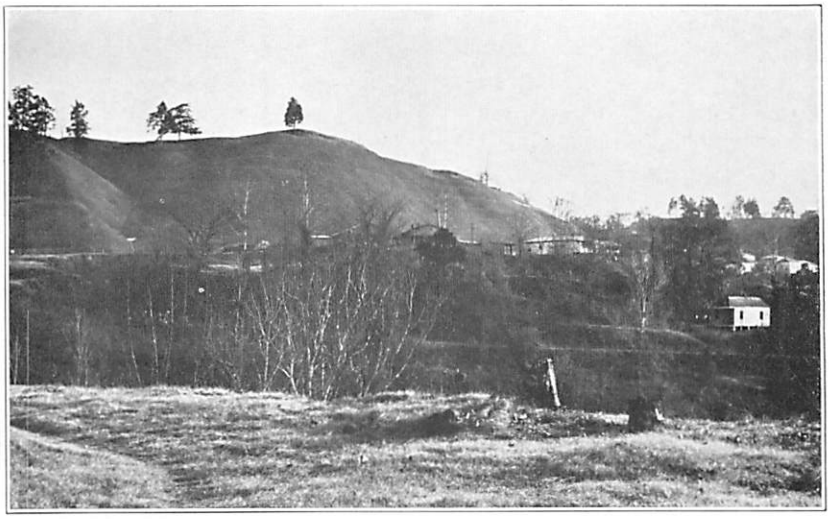

Figure 4.—Fort Hill across Mint Spring Falls from the National Cemetery.---This photograph of December 24, 1934 was taken shortly after the extremely steep bluff had been terraced and sodded.

And now comes into action the geologic forces which played such an important part in the investment.

Near and at the northern edge of the city. as the maps show, are two streams, Glass Bayou and Mint Spring Bayou, which flow in a westerly direction more or less parallel with each other. For their length and for the volume of their waters, both have cut enormous valleys of great depth and steep walls.

Along the ridge constituting the southern or left valley wall of the more northern of these two valleys, Mint Spring, the Confederates took up their position and entrenched in the Loess, the most ideal of mantle rock for rapidity in excavation and for stability of vertical walls. From the head of Mint Spring valley, they extended their line southward along the ridge constituting the west or right wall of one of the tributary valleys of Glass Bayou. From Fort Hill on the Mississippi bluff, their line extended east and thence south unbroken topographically to the crossing of the main valley of Glass Bayou near the old Jackson Road. On the side of the valley opposite these various positions of the Confederates, the Federals took up their position and likewise entrenched in the Loess. Between these parallel lines was no

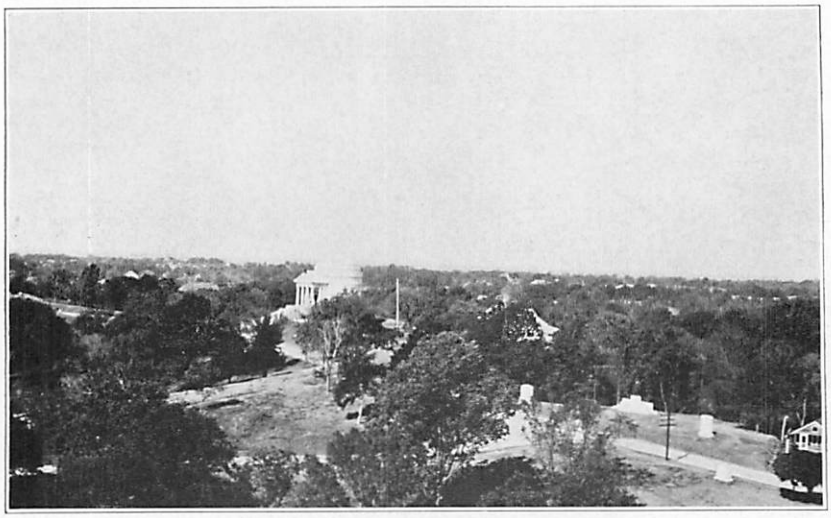

Figure 5.—General view of the Vicksburg National Military Park from Observation Tower No. 2, past the Illinois Monument on the Old Jackson Road between the Confederate and Federal trenches, westward toward Fort Hill, November 4, 1934. Unfortunately for this article, the trees conceal the deep rugged valleys.

level way of approach other than the narrow transverse ridge forming the divide between the headwaters of Mint Spring Bayou and Glass Bayou. This transverse ridge is a part of the Graveyard Road and was actually used as the Ewing approach.

Just south of the point of crossing of Glass Bayou valley by the Confederate line is the old Jackson Road (Figure 3) extending along

a ridge, which connects the two lines of trenches. Along this road is a second place, where either side could assault the other along a somewhat level ridge.

From Jackson Road the valley of Stouts Bayou drains south by southwestward almost to the Mississippi at the southern edge of the city. The left or east wall of this valley forms a ridge extending unbroken likewise almost to the very bluff of the Mississippi. Along this ridge the Confederates entrenched, thus encircling the city from bluff almost to bluff with a topographically unbroken trench, save for the crossing of Glass Bayou at Jackson Road.

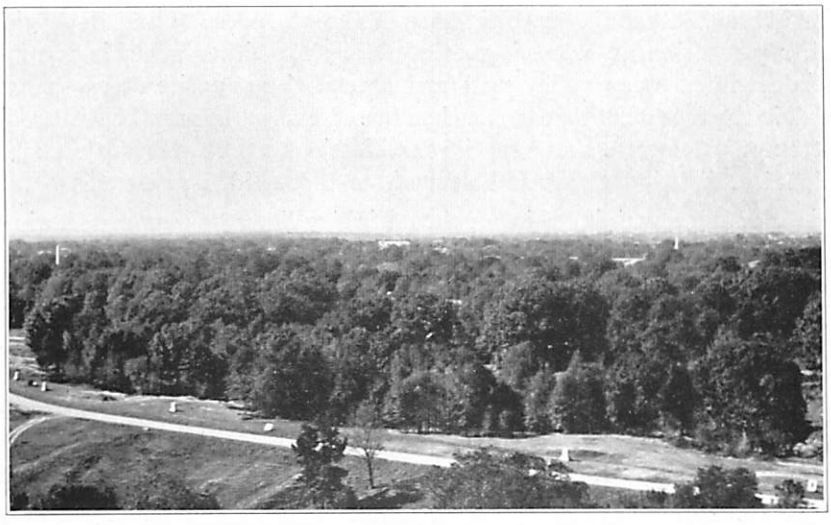

Figure 6.—General view of the Vicksburg National Military Park from Observation Tower No. 2, southwestward toward South Fort.---Photographed November 4, 1934. Unfortunately for this article, the trees almost completely conceal the deep, steep-sided valleys cut into the Loess.

For nearly half of the distance from the Jackson Road ridge southwestward toward the Mississippi bluff, a number of successively lower and lower tributaries of Big Bayou (Durden Creek) head upward toward the ridge, bearing the Confederate trenches, in such a manner as to form along their headwater stretches a succession of headwater valleys, the whole being a linear composite valley parallel with the ridge on which the Confederates were entrenched. On the side of this valley opposite the Confederates, the Federal forces took up their

position and entrenched in a parallel line of trenches. Between the two opposing trenches was only one ridge approach; namely, the Baldwin Ferry Road through the Hebrew Cemetery near the Alabama and Vicksburg Railroad.

For approximately two-thirds of the length of the line of defense trenches, therefore, the Federal line was on the side of a deep valley opposite to, and parallel with, the Confederate line. Throughout this entire distance only three transverse ridges, the Graveyard Road ridge, the Jackson Road ridge, and the Baldwin Ferry Road ridge, connected the two opposing lines of trenches. Consequently, it was necessary that the Confederate trenches be heavily fortified at these three places, for at most other places, even though the steepness of the slope did offer protection at some, it was necessary for either attacking army to descend a steep valley wall and ascend the opposite steep valley wall in the face of a brave entrenched foe. Needless to say, the Federals' attempt to capture these special fortifications led to the hardest and bloodiest fighting along and near these three ridge approaches.

For the remaining third of the encircling line, the outward flowing tributaries head upward toward the ridge of the Confederate trenches at right angles to it, thus forming short spur ridges between them. Save for a short distance south of Kentucky Avenue, the Federal trenches were, consequently, not dug in a parallel position. Rather they were dug as a series of zig-zag trenches along the crest of some of these spur ridges and as a series of short crescent-shaped trenches across others.

Needless to say, these separate positions of the Federals in their separate trenches and along their separate ridges of approach called for an entirely different strategy of warfare than did the continuous parallel trench position. Obviously, therefore, for all these reasons, the angularity of the valleys in the loess-covered region absolutely controlled the disposition of these two great armies.

Notwithstanding the fact that before the actual siege began, the Confederates had withdrawn to a shorter arc about the city, the other fact remains that both the outer and inner positions were determined by the topography of the region. And the nature of the topography, in turn, was determined largely by the type of the material out of which it was carved. And the type of the material, in turn, was determined in this instance, largely by the work of the ancient glacier. Accordingly, as stated in the beginning, the positions of the great armies of Pemberton and Grant were determined untold ages ago primarily by the work of this ancient glacier.