MISSISSIPPI
STATE GEOLOGICAL SURVEY

WILLIAM CLIFFORD MORSE, Ph. D.
Director

BULLETIN 33

THE GEOLOGIC HISTORY OF TOMBIGBEE STATE PARK

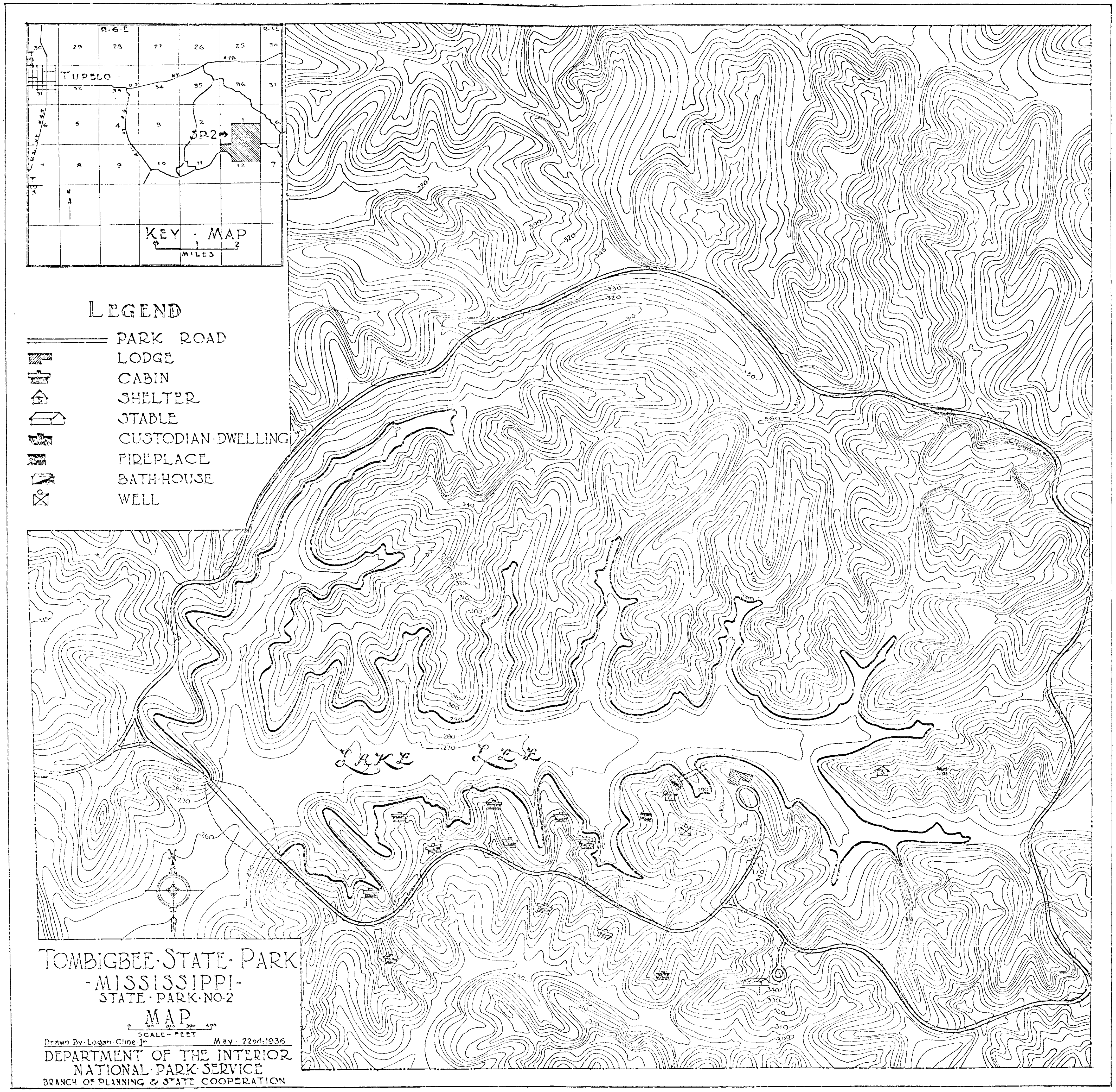
By
WILLIAM CLIFFORD MORSE, Ph. D.
State Geologist

UNIVERSITY, MISSISSIPPI
1 9 3 6

PLEASE DO NOT DESTROY THIS REPORT; RATHER RETURN IT TO THE MISSISSIPPI GEOLOGICAL SURVEY, UNIVERSITY, MISSISSIPPI, AND RECEIVE POSTAGE REFUND.

MISSISSIPPI STATE GEOLOGICAL SURVEY
WILLIAM CLIFFORD MORSE, DIRECTOR

BULLETIN 33
FRONTISPIECE



B. M. ELEVATION ASSUMED

FRONTISPIECE

Topographic map of Tombigbee State Park, a map of contour lines each of which connects all points of the same elevation as does a shore line of a body of standing water.

NOTE

Tombigbee State Park is under the management of the Mississippi Board of Park Supervisors, from whose executive officer, The State Forester, Jackson, information concerning the use and facilities of the park may be obtained.

MISSISSIPPI

STATE GEOLOGICAL SURVEY

WILLIAM CLIFFORD MORSE, Ph. D.
DIRECTOR

BULLETIN 33

THE GEOLOGIC HISTORY OF TOMBIGBEE STATE PARK

By
WILLIAM CLIFFORD MORSE, Ph. D.
STATE GEOLOGIST

UNIVERSITY, MISSISSIPPI
1936

MISSISSIPPI GEOLOGICAL SURVEY

ALFRED BENJAMIN BUTTS, Ph. D., LL. B.
CHANCELLOR OF THE UNIVERSITY OF MISSISSIPPI

STAFF

WILLIAM CLIFFORD MORSE, PH. D.....DIRECTOR

CALVIN S. BROWN, D. SC., PH. D.....ARCHEOLOGIST

HUGH McDONALD MORSE, B. S.....ASSISTANT GEOLOGIST

DOROTHY MAE DEAN.....SECRETARY AND LIBRARIAN

MARY C. NEILL, B. A., M. S.....SECRETARY AND LIBRARIAN

LETTER OF TRANSMITTAL

Office of the State Geological Survey,
University, Mississippi
June 30, 1936

Dr. A. B. Butts, Chancellor
University, Mississippi

Dear Chancellor Butts:

I have the pleasure of transmitting herewith the manuscript of Bulletin 33, entitled The Geologic History of Tombigbee State Park. It is the third report in the educational series of the survey and was prepared at the request of Mr. Fred B. Merrill, State Forester, who has charge of the state parks.

Very sincerely yours,

William Clifford Morse, Director

ACKNOWLEDGMENTS

Much of the credit for the establishment of Tombigbee State Park near Tupelo should go to one of the first citizens of that city, Honorable J. P. Nanney, Mayor; and for the development, to another, the Honorable John M. Rankin, U. S. Representative from that district--to mention only two. To them the author as well as the citizens are under obligation. In the preparation of the report, Mr. L. B. Priester, Jr., Superintendent of the park, and his entire staff have done everything possible to facilitate the study. Mr. Fred B. Merrill, State Forester in charge of the State parks, has offered every encouragement and has requested a report on each park. In writing the Geologic history of Tombigbee State Park the author has attempted to make the history complete, although brief, even though this completeness involves some repetition of the Geologic history of Tishomingo State Park in Bulletin 32 and will involve some repetition in the reports of other State parks.

CONTENTS

LIST OF ILLUSTRATIONS--PLATES

LIST OF ILLUSTRATIONS--FIGURES

THE GEOLOGIC HISTORY OF TOMBIGBEE STATE PARK

BY
WILLIAM CLIFFORD MORSE, PH. D.
STATE GEOLOGIST

INTRODUCTION

The beauty and charm of Tombigbee State Park are the beauty and charm of its youthful V-shaped valleys and the mature sloping topography of the region as a whole--features produced by rain and stream erosion (Frontispiece). These features were taken advantage of by those choice souls having a vision and a desire to give to their fellow man and to preserve for the future generations one of God's beauty spots, by planning the park, especially the artificial lake to be

Figure 1.—Lake Lee, looking southward toward the dam, Tombigbee State Park.---Photographed June 5, 1936.

known henceforth as Lake Lee. Although an artificial lake, everything save the dam seems natural, for the water extends up the main valley and up its tributaries precisely as it would have, had the Gulf level been raised to the height of the dam (Figures 1 and 2). Herein lies its charm, a charm greatly enhanced by natural vegetation (Figure 3), but perhaps the park can be appreciated best after some of the geologic history has been presented.

Figure 2.—Lake Lee, looking eastward up the valley that had reached early maturity in its development before the lake waters filled it, Tombigbee State Park.---Photographed June 5, 1936.

Figure 3.—The head of one of the youthful tributary valleys up which the waters of Lake Lee extend between the beautiful trees of Tombigbee State Park.---Photographed June 5, 1936.

ANCIENT GEOLOGIC HISTORY

Much of Mississippi's ancient geologic history lies buried beneath younger beds of the Coastal Plain deposits, which begin with the Cretaceous rocks of the Mesozoic era--rocks that constitute the foundation of Tombigbee State Park (See Time Scale).

The oldest rocks, the Archeozoic and Proterozoic of the Canadian Shield about Hudson Bay, of the Piedmont district, and of the Rocky Mountain region, have no surface representations whatsoever in Mississippi. Of the sediments that were, in Paleozoic times, swept westward from the old mountainous and plateau area (Appalachia land), standing where the Peidmont Plateau and Atlantic Coastal Plain now are, down into the great Appalachian trough, lying where the mountains now are, like those that were swept eastward from old Cascadia land down into the great Cordilleran (Rocky Mountain) trough, even the Cambrian, Ordovician, and Silurian systems have no surface representation here. Mississippi's oldest rocks, therefore, begin with the Devonian system of the Paleozoic group, whose surface distribution in Mississippi is confined entirely to the valleys of the Tennessee River and of the lower stretches of its tributaries and of Mackeys Creek.

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
            - 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

Mesozoic era
- Cretaceous period
  - Gulf epoch
    - Ripley age
    - Selma age
    - Eutaw age
    - Tuscaloosa age
- Comanchean period
- Jurassic period
- Triassic period

Paleozoic era
- Permian period
- Pennsylvanian period
- Mississippian period
  - Chester epoch
    - Forest Grove age
    - Southward Bridge age
    - Southward Spring age
    - Southward Pond age
    - Allsboro age
    - Alsobrook age
  - "Iowan" epoch
    - Iuka age
    - Carmack age
- Devonian period
  - Upper epoch
    - Whetstone Branch age
  - Oriskanian epoch
    - Island Hill age
  - Helderbergian epoch
    - New Scotland age

Silurian period
Ordovician period
Cambrian period
Proterozoic era
Keweenawan period
Late Huronian period
Middle Huronian period
Early Huronian period
Archeozoic era
Archean period

These Devonian sedimentary rocks and the Mississippian sedimentary beds accumulated in the old Appalachian trough from material partly derived from old Appalachia land, although some of them were derived from calcareous (limy) shells and tests of marine plants and animals. During the Helderbergian and Oriskanian epochs practically no sediments were swept into the Mississippi part of this sea, so that fairly pure limy material from the shells of marine animals was ground up and cemented in the form of the New Scotland and Island Hill limestones of the northeastern part of the state. During the latest Devonian epochs the sea became muddy and sufficiently shallow to permit vegetable material to grow and, along with the finer sediments, to accumulate and to form the overlying black slate-like shales of the Whetstone Branch formation.

During the earliest epoch of the Mississippian period the sea again became clearer, so that limy shells and other tests of marine animals accumulated along with some fine muds to form the impure clayey deposits now known as the Carmack and Iuka limestones. Much material in the form of siliceous (SiO_2) animal tests accumulated at this time which on consolidation formed the flints and cherts of these limestones. Untold ages later the limy material of the surface exposures of these limestones was dissolved and carried away by ground waters, thus setting free the cherty residue which forms such conspicuous surface material today and which formed the chert fragments out of which were fashioned in the past the pebbles that make up the gravel deposits of the Coastal Plain beds. These Coastal Plain deposits constitute the fundamental basis of the geologic history of Tombigbee State Park.

During the latest (Chester) epoch of the Mississippian period the sea transgressed the land of northeastern Mississippi, reached its maximum extension, and then retreated, time and again. During transgression the sea worked over the weathered surface (mantle) rock and deposited this residual material in the form of sand and mud, which on consolidation became sandstone and shale. During the maximum extension the sea received little sedimentary material, so that the limy tests of its dead animals were ground up by the waves, accumulated in a fairly free state, and were later cemented into limestone. On retreating, the sea again worked over these surface materials and deposited them, which materials later on consolidation formed shales and sandstones. Thus were formed in an upward sequence: sandstone and shale; limestone; and shale and sandstone--a sequence that was repeated many times. From all these sandstones and shales, as well as from the chert and other beds, materials for the Coastal Plain deposits of the park area were, in part, derived.

Although not represented at the surface in Mississippi, Pennsylvanian beds encountered in gas wells near the Tombigbee State Park and farther to the north show that the Paleozoic sea withdrew from the Appalachian trough except for brief intervals of time when a few thin layers of marine limestones accumulated. Even though this part of the North American continent stood near sea level, swamps rather than the sea spread far and wide over the area. In these vegetation grew luxuriantly, accumulated in great thicknesses in the swamp waters which preserved it from total decay, and underwent burial and compacting, which through the ages changed it from woody material to peat, then to lignite, and finally to bituminous coal. Thus was formed the greatest high grade coal field in the world, the Appalachian coal field extending 850 miles from northern Pennsylvania to northwestern Georgia and central Alabama.

Farther to the north, too, though in a very small area confined to adjoining parts of Pennsylvania, Maryland, Ohio, and West Virginia, similar swampy conditions continued during part of the Permian period, but sedimentation was not the dominant feature during that period. Rather, throughout most of the Permian the newly formed Paleozoic sediments that had been accumulating for millions of years and to thousands of feet in thickness were subjected from the southeast Atlantic side to a series of lateral thrusts which slowly forced them into an enormous series of upfolds and downfolds, the lofty Appalachian Mountains stretching from maritime Canada through New England, New York, and other states into Georgia, Alabama, and barely reaching northeastern Mississippi. This was the first great Appalachian Mountain system whose grandeur perhaps exceeded that of the present Appalachians and whose roots on disintegration furnished so much of the material for Tombigbee State Park.

Throughout the Triassic, Jurassic, and Comanchean periods of the Mesozoic era no known beds that now lie at the surface in Mississippi or elsewhere along the eastern Gulf Coastal Plain were accumulating, even though such sediments must have been borne by the rivers of that day into the Gulf whatever its limits. Rather, as soon as the series of Appalachian anticlinal folds began to be forced upward in the northeastern tip of Mississippi and elsewhere farther north, the streams began to be quickened, began to erode with renewed energy. Throughout these long periods the streams were, according to the available record, busy eroding the slowly rising Appalachians. Though erosion is so slow that the hills are from everlasting to everlasting so far as the human life span is concerned, nevertheless by Cretaceous times this noble system of mountains had been brought down to a plain (a peneplain) in northeastern Mississippi and in states farther north.

Then began in early Cretaceous time an upward movement of an entirely different type. The whole peneplaned area was gently arched upward so slowly that the master streams of the north continued their flow toward the east and southeast and those of the south, theirs toward the west and southwest. So slow was the rise, that these major streams cut down their valleys as rapidly as the axis of this exceedingly broad fold was raised athwart their courses. The tributary streams, on the contrary, soon found the northeast-southwest parallel belts of highly tilted less resistant rocks into which they cut their valleys, leaving the intervening parallel belts of more resistant rocks standing as the present ridges of the Appalachians. Thus the parallel upfolded anticlinal ridges and the downfolded synclinal valleys of the first Appalachian Mountain System gave way to the present Appalachian Mountains, consisting of parallel ridges of resistant rocks and valleys of less resistant rocks--in short to a mountain system formed by the erosion of parallel belts of highly tilted beds that alternate with one another in the degree of their resistance to erosion.

GEOLOGIC HISTORY OF THE EASTERN GULF COASTAL PLAIN

As the newly formed Appalachian Mountains of Permian age were being planed down nearer and nearer to sea level throughout Triassic, Jurassic, and Comanchean times, the Gulf waters transgressed farther and farther up the peneplaned Appalachian region and farther and farther up the down-warping Mississippi trough until in early Cretaceous times they reached northeastern Mississippi and southern Illinois--the maximum sea transgression of the Mississippi embayment. While the sea was extending itself farther and farther over the peneplaned surface in early Cretaceous times, the oldest of these Cretaceous sediments, the lower part of the Tuscaloosa, was being deposited as gravel, sand, clay, and lignite on flood plains and deltas and in bordering marshes. Later the finer of these materials, the sands and clays, were deposited perhaps in lagoons and perhaps in the sea itself which had now reached the region. All had been derived from the Paleozoic rocks already described and from older rocks of the Piedmont district, the gravels chiefly from the cherts of the Mississippian system. Deposition of later beds has restricted the surface outcrop of these Tuscaloosa beds in Mississippi to a narrow belt along the northeastern margin of the State.

The Eutaw sea quietly succeeded the largely non-marine conditions of Tuscaloosa time and received sand as the chief constituent and mica as a minor constituent, but glauconite became an important part of the sand, imparting to it a green color which has gained for it the name of green sand marl. At first the sea received at intervals small quantities of mud or clay, so that the lower part of 200 or 250 feet contains thin beds of clay interstratified with thicker beds of sand; and later, especially in north-east Mississippi, it received sand in huge amounts which now constitute the massive glauconitic sand of the upper 150 feet, which is known as the Tombigbee sand member. Limy marl and fossil forms show that this late Eutaw sea teemed with invertebrate shell-bearing animals among which were giant clams (Inoceramus) and Cephalopods (Ammonites). At present the Eutaw has a surface belt 15 to 20 miles in width in east-central Mississippi, where it grades upward into the overlying Selma chalk, showing that the Eutaw sea gave way here to a clearer limy sea practically free from sandy material; and at present it has a surface belt 20 to 30 miles in width in northern Mississippi, where the massive Tombigbee sands grade upward into similar sands and laminated clays and sands of the Coffee sand member, showing that the Eutaw sea here was succeeded by another of the same character. The question then is whether this was the Eutaw sea or the later early Selma sea. In any case the sandy Coffee sea was the time equivalent of the Selma limy sea of east-central Mississippi as the more technically-minded will discern. It was, furthermore, the sea that received the sediments that now form the Tombigbee Park area.

The slightly muddy limy Selma sea of east-central Mississippi and the sandy Coffee sea of northern Mississippi succeeded the sandy Eutaw sea of both places. Eventually the Selma sea received so little detrital material that limy material from its teeming shell-fish life accumulated as almost pure unconsolidated limestone or chalk material, which on weathering now gives rise to the black fertile soils that form the Black

Prairie Belt 15 to 20 miles in width, the fertility of which has contributed so much to the wealth of Lee and other counties located in this belt. Later the rather clear Selma sea gave way to a more sandy Ripley sea extending from the present Tennessee line to northern Noxubee County, but still later it became clear again, at least as far north as northern Chickasaw County, so that a thin Oktibbeha tongue of chalk overlies the Ripley sand in this section.

The Ripley sea, although the time equivalent of the late Selma sea, was typically sandy. Consequently the calcareous tests from its abundant shell-fish when mixed with greater quantities of sand formed limy sand rather than limestone or chalk. The presence of this limy material yields, however, a limy sandy soil of surprising fertility. Among the invertebrate animals whose tests formed the limy material of the sand were large oysters (Exogyra) and numerous small and medium sea urchins and a few huge forms. Eventually both the Ripley sea and the late Selma sea withdrew; the region became a higher land mass, and was subjected to prolonged erosion before the new Cenozoic sea came in teeming with more recent life.

The Eocene, Oligocene, Miocene, Pliocene, and Pleistocene seas of the Cenozoic era each in turn came in, furnished the environmental background for its contained life, received its sediments, and then withdrew. Thus were the successively younger and younger beds laid down in parallel belts closer and closer to the present Gulf shore until the whole of the Coastal Plain was completed. Although the beds are exceedingly interesting, they extend beyond the bounds of the Tombigbee Park area and, consequently, beyond the limits of the present discussion.

PHYSIOGRAPHY OF MISSISSIPPI

Although the State of Mississippi lies wholly within the Gulf Coastal Plain, it is not a plains section as its position would seem to imply. In fact a physiographic map of the state shows that more of its area lies within the hill districts than lies within the prairie, alluvial, and coastal meadows sections. Whenever the beds are predominantly sandy, the region is still in hills; wherever they are clayey or limy, the region has been reduced to a plain. Accordingly the Tuscaloosa and Eutaw sands constitute the Tombigbee Hills, practically coextensive with them; the Selma chalk, the Black Prairies; and the Ripley sands, the Pontotoc Hills. Inasmuch as the Tombigbee State Park is underlain by the Coffee sand member of the Eutaw formation, it lies within the Tombigbee Hills district.

MORE DETAILED GEOLOGIC HISTORY OF THE TOMBIGBEE PARK AREA

Untold ages ago after the massive calcareous, glauconitic sands of the Coffee member of the Eutaw formation had been deposited within the sea, the shallow sea bottom was slowly raised above the Gulf waters and was slightly tilted seaward. No sooner had this new land appeared above the surface of the Gulf than rain water began to wear it down, for, as it has been so aptly stated, every drop of rain that falls has for its mission the carrying of a small particle of rock to the sea.

When the rain water reaches the sloping surface and starts to flow seaward as a sheet, sooner or later irregularities in the form of depressions on the land cause a concentration of the water into tiny streams. As these streams flow seaward they are joined by other tiny streams which thus form tributaries to them. In this manner the streams increase in size forming brooks, then creeks, and eventually rivers.

Moving water in the form of streams, waves, and currents; moving ice in the form of slowly creeping glaciers; and moving air in the form of winds, all transport material from one place to another. Being more or less solid substances, glaciers shove material in front of them, drag it along underneath them, and carry it along on top of them, regardless of the size of the particles which may range from the finest rock flour to single blocks weighing hundreds of tons. This is not true of moving water and moving air. Being gaseous or liquid substances, winds or streams, waves, and currents transport material in suspension or by rolling it along the surface beneath them--the size of the individual particles depending directly on the velocity of the transporting agent. In technical language the transporting power of a stream varies directly as the sixth power of its velocity. In other words, if a stream, flowing at a velocity just sufficient to roll along its bottom a pebble weighing one pound, has its velocity doubled, it will then be able to transport a pebble weighing not only twice as much but one weighing 64 times as much (increased velocity to the sixth power being 2x2x2x2x2x2 or 64), for twice as much water in a unit of time will strike it twice as hard. Rather than two the multiple is, therefore, four; and four raised to the cubical power of the solid stone is 64. This enormous increase in transporting power of a stream having its velocity increased only a little accounts for the terrific damages of streams at flood time.

No sooner had these tiny streams developed on this newly formed Coastal Plain area than they began to carry the land particle by particle toward the sea. In doing so at first they formed small gullies. Later through the long ages, they cut these small gullies deeper, wider, and longer, forming small valleys of them. Through still longer ages, they further increased their depth, width, and length, forming larger valleys of them but valleys still in the youthful stage (Figure 4); and so on through still longer ages until the present day.

Thus the streams have formed the present deep steep-sided valleys and tributary valleys, all still in the youthful stage of development except Lake Lee Valley which has been widened by side cutting until

Figure 4.—A youthful valley up which the waters of Lake Lee extend, Tombigbee State Park.---Photographed June 5, 1936.

it is now in early maturity. Thus they have developed a main valley, its tributary valleys, and their tributary valleys, and in turn their tributary valleys almost in an unending sequence (Figure 5)--in short a youthful valley system.

In an area of homogeneous rocks like the Coffee sand of the Eutaw formation in Tombigbee State Park, a stream by cutting a main valley, its tributary valleys, their tributary valleys, and so on, forms a valley system, a map of which is similar to a longitudinal section through the trunk of a tree and its branches, accordingly, a dendritic valley system. Such a valley system, has a stream developed out of Lake Lee Valley, so that on damming, the lake thus formed has an outline or a shore line similar to a tree--beautiful indeed.

As these streams cut numerous deep steep-sided valleys and their numerous tributary valleys, they left behind an equal area and amount of land in the form of a narrow ridge and of tributary spur ridges. They have thus produced master ridges and their tributary spur ridges of great charm, now greatly enhanced in some by the lake water extending up the tributary valleys on each side of them in such a manner as to make of them narrow promontories extending out into the lake--a result not possible in an area of low relief.

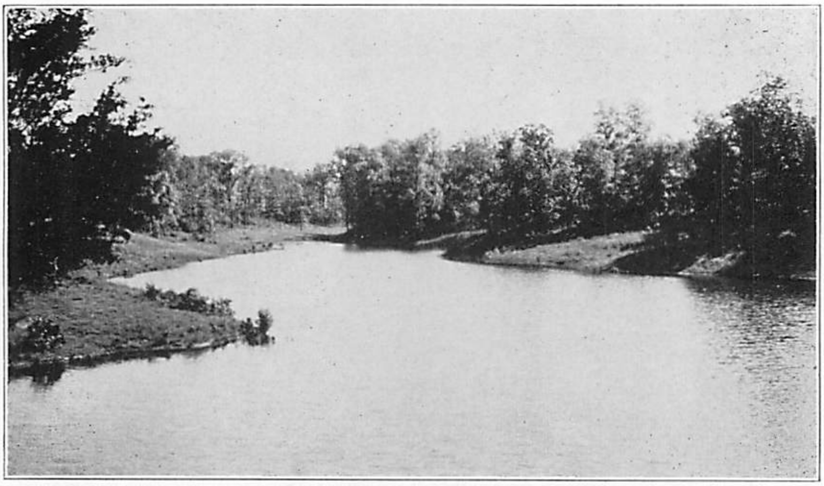


Figure 5.—A youthful valley partly filled with the waters of Lake Lee, Tombigbee State Park.---Photographed June 5, 1936.

In developing the valleys and the tributary valleys just described, the streams have carried seaward particle by particle rock material comparable in amount to that remaining in the main ridges and the spur ridges. They have thus performed half of their task of carrying to the sea the rock material of the Tombigbee Park area. They have accordingly reduced the gently seaward-sloping youthful plain to an area of slopes or to a mature topography (Frontispiece); and in the eons of geologic time to come, they will by side cutting widen their valleys and decrease the side slopes until they form first mature valleys and later, by further widening them and reducing the divide ridges between them, they will produce old age valleys and an old age plain of the area as a whole.

TOPOGRAPHY OF TOMBIGBEE STATE PARK

As just stated, the streams have reduced the original gently seaward sloping Coastal Plain of what is now Tombigbee State Park to an area of slopes or to a region of mature topography, topography being defined as the relief features, such as hills, ridges, valleys, cliffs, and other surface features. The topography of Tombigbee State Park may best be presented by means of a topographic map or a contour map (Frontispiece)--a map constructed of contour lines, each line connecting all points having the same elevation above sea level.

Figure 6.—The Lodge in Tombigbee State Park.---Photographed June 6, 1936.

Such a contour line is similar to a line representing a shore line, the shore line of Lake Lee for example. In fact the contour map could have been constructed by drawing the shore line of successively higher and higher positions. If, for instance, when Lake Lee began to fill, its shore line at 265 feet above sea level had been drawn, this line would represent or would be the 265-foot contour line. If when five feet more water had accumulated the new shore line had been drawn, it would represent the 270-foot shore line; and so at other five foot stages. The contour interval or the vertical distance between two contour lines in this case would be five feet, as it actually is on the contour map.

By examining the present shore line of Lake Lee, the most important features of this contour map may be learned. The shore line or contour line swings around the promontories and extends up the tributary

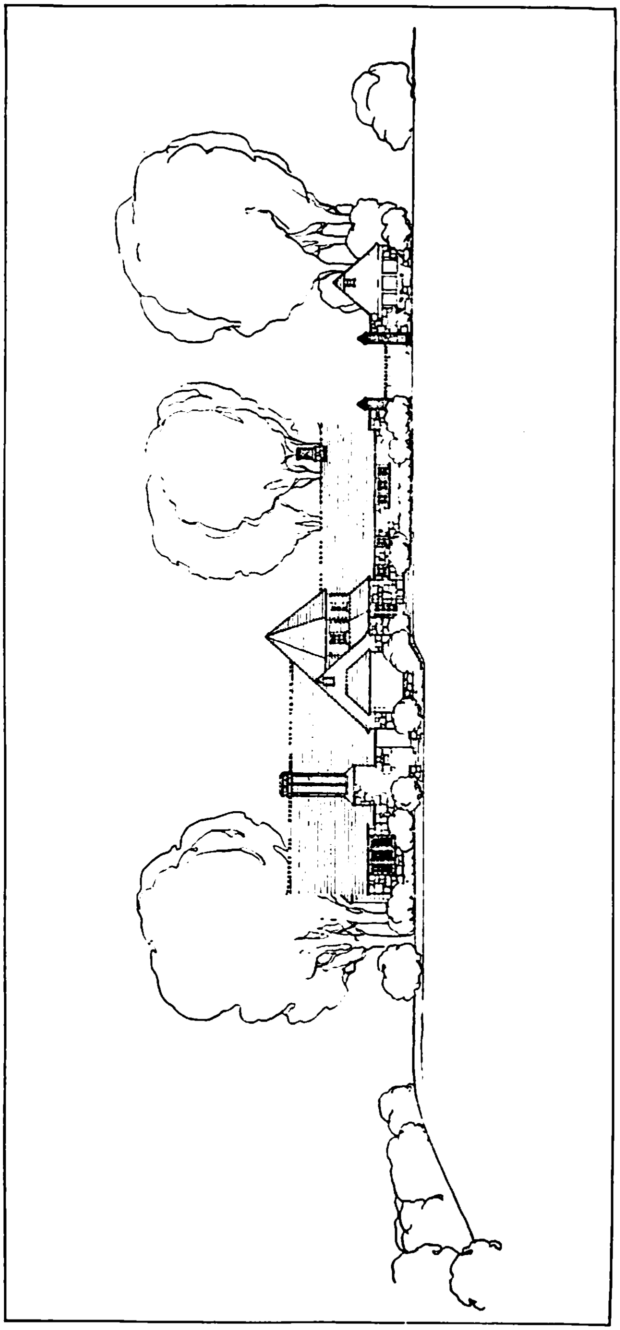


Plate I.—Front elevation of the Lodge in Tombigbee State Park.---Frank Fort, Architect. September 21, 1934.

valleys. Where the land slope is steep, the new shore line or new contour line is close to the old; where the land slope is gentle, the new shore line or contour line is farther from the old. Thus follows the general rule that where contour lines are close together the surface slope is steep; where they are far apart the surface slope is gentle.

Those that visit Tombigbee State Park will wish to study the contour map as a part of the joy in visiting the park; those that have not visited it will, after studying the topographic map (and illustrations), desire to do so.

Figure 7.—Detailed construction of the Lodge in Tombigbee State Park. The lumber came from the trees that were cleared for the lake bed; the dark ferruginous sandstone blocks, from Pontotoc and Itawamba counties; the light colored sandstone, from the Highland Church sandstone of the Forest Grove formation at Bay Springs, Tishomingo County.---Photographed June 5, 1936.

All in all Tombigbee State Park is a topographic park. Its topography enhances its charm. It has not been defaced by man. Rather Lake Lee, the only artificial feature, is so nearly natural that it accentuates its topography and thereby increases its beauty. May the fine spirit that conceived the park preserve it inviolate for the present generation and for the generations to come.

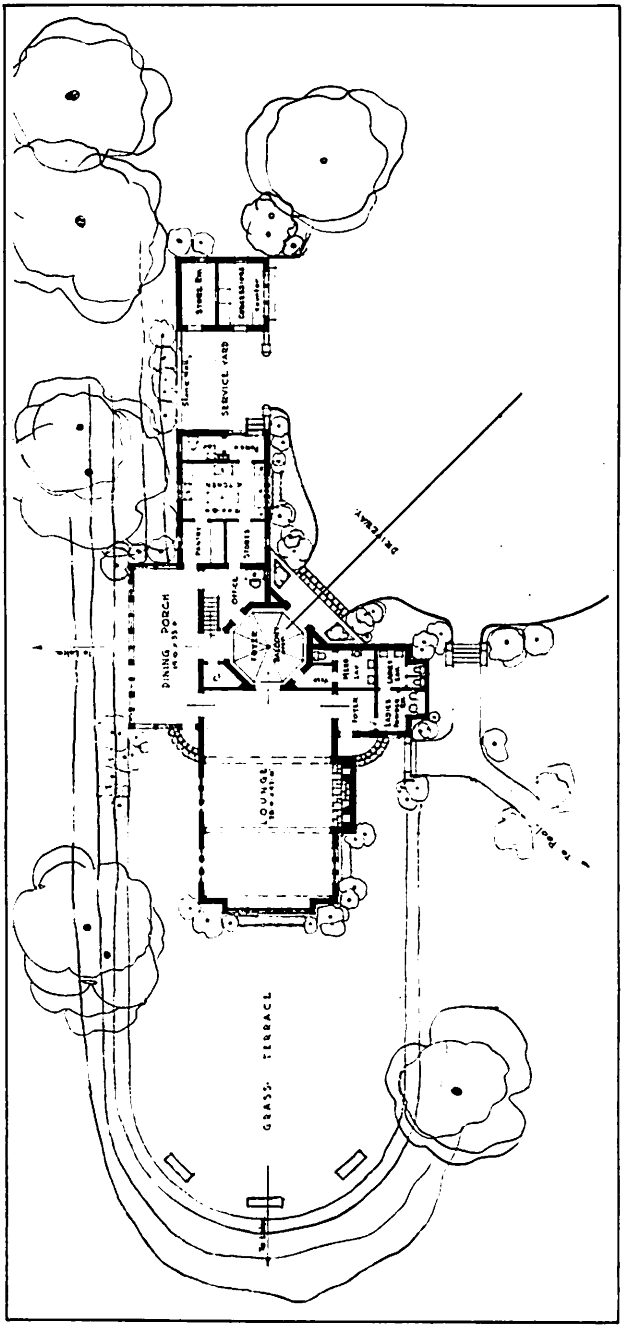


Plate II.—Plan of the Lodge in Tombigbee State Park.---Frank Fort, Architect. July 21, 1934.