Note. For a portion of the data used in the preparation of the contour maps, the author begs to acknowledge the assistance of Mr. E. R. Cumings and Mr. J. W. Beede, Instructors, Department of Geology, Indiana University, and Mr. J. W. Frazier, student, Indiana University.

Wabash River Terraces in Tippecanoe County, Indiana.

William A. McBeth.

General Description.—The Wabash Valley, in Tippecanoe County, Indiana, embraces an area of about eighty square miles. Its average width is about three miles. It is much wider below LaFayette than above, and it is less wide at that place than elsewhere within the county below the mouth of Tippecanoe River. The width of this valley above the city averages at least two miles, while below it is not less than four.

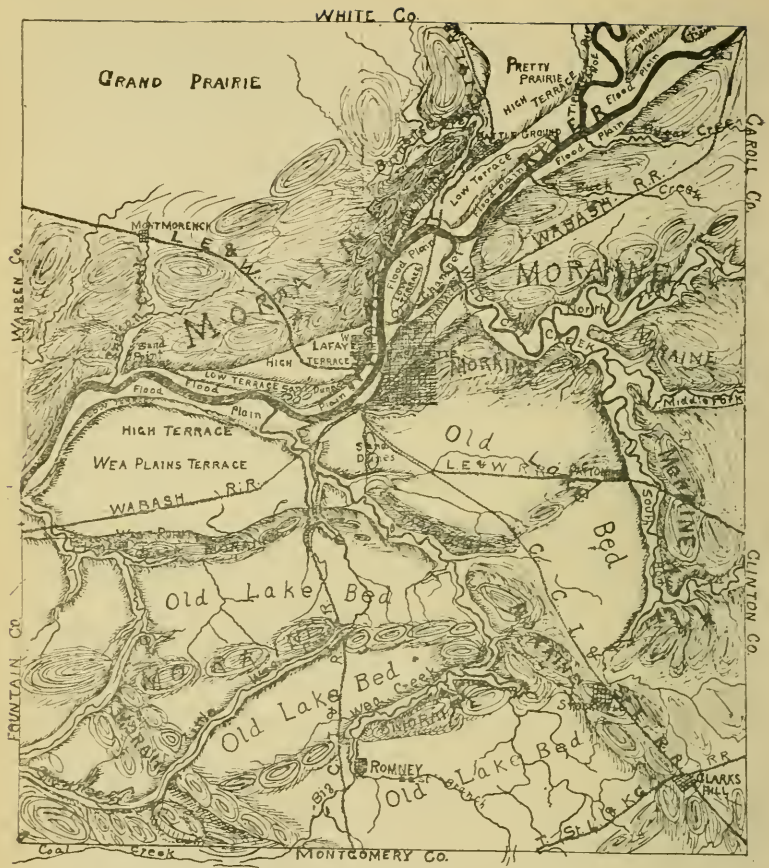
The valley comprises a broad, shallow trench, cut by a deeper and narrower trench, into the bottom of which is carved the river channel.

The general surface is about seven hundred feet above sea-level, and the bottom of the river channel is about two hundred feet below this. The inner valley or flood-plain tract averages about one mile in width and along this rise the terrace fronts from one hundred to one hundred and fifty feet above the stream. The inner valley is quite uniform in width throughout the county, but the terrace areas are much more conspicuous below LaFayette than above.

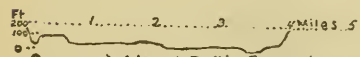
The outer valley is quite straight compared with the inner valley, which meanders from side to side, while the river crossing from side to side of this flood-plain meanders most.

The Terraces.—The terraces begin a few miles below Delphi, on the west side of the river, an island in the Deer Creek Prairie flood-plain comprising the farthest up-stream area so far observed.

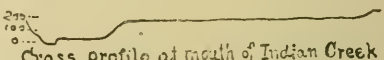
The point between the Tippecanoe and the Wabash, where it rises above the flood-plain near the junction, is of this formation. Below the mouth of the Tippecanoe the terraces become conspicuous. On the west side of the stream the region called Pretty Prairie descends gently from the Grand Prairie and terminates in a bluff front which runs parallel with the Wabash at an average distance of a mile from it.



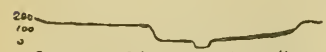
A MAP OF TIPPECANOE COUNTY, INDIANA.
TO SHOW TERRACES, FLOOD-PLAINS, MORAINES & DRAINAGE.
SCALE 1 2 3 4 5 MI. BY W. A. McBETH.



Cross profile at Battle Ground



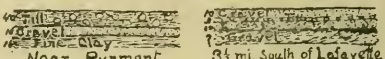
Cross profile at mouth of Indian Creek



Cross profile at Lafayette

Cross profile at Independence.

Cross section at Lafayette. (Ideal.



Sections showing interstratification

This is of terrace structure to an unknown distance back from the river and is not limited on the west by a perceptible bluff. At Battle Ground the level of the prairie is continued south to the point where the river swings across the valley against the foot of the west bluff. This part of the high terrace is nowhere more than one-fourth of a mile wide. The Tippecanoe battle field occupies its entire width of a few rods between the lower terrace on the east and the valley of Burnett's Creek, which separates it from a high bluff on the west.

The low terrace just mentioned averages about one mile in width and its border along the flood-plain takes the form of a distinct ridge, apparently a sand-bar, higher than the general surface of the terrace. This surface is ten to fifteen feet above the flood-plain.

Below the westward bend of the river the flood-plain occupies the full width of the valley separating the terrace tracts below from those above. This flood-plain surrounds a detached section of low terrace which evidently was cut off from that on which LaFayette stands by a former course of the river. This channel was later the lower course of the Wild Cat Creek and still contains a chain of ponds. The creek was by some means deflected and now joins the river several miles farther up stream than formerly.

The LaFayette terrace slopes gently from flood-plain level back one mile to the bluffs. It corresponds in elevation to the detached area in the flood-plain and the low terrace above the bend. It is about four miles long and is slightly higher at the upper end than at the lower.

The West LaFayette terrace is two miles wide in its greatest width and eight miles long. Opposite LaFayette it presents a bold bluff to the river and lies at an elevation of one hundred and twenty to one hundred and fifty feet above it. Two miles below a low terrace begins and extends between the higher terrace and the flood-plain nearly to the mouth of Indian Creek.

The most extensive area is the beautiful region embracing the Wea Plains, southwest of LaFayette. This great terrace begins just below the city and extends ten miles to the west line of the county. Its width averages at least four miles. Its height agrees with that of the West LaFayette terrace, the narrow strip between lower Burnett's Creek and the bluffs and Pretty Prairie. This correspondence in elevation seems to indicate a former continuous surface of these terraces throughout the

valley at a height of one hundred to one hundred and fifty feet above the present river channel.

The Pre-glacial Valley.—As the stream flows on a valley floor of rock at Delphi, eighteen miles above LaFayette, and again at Black Rock, at the west line of the county, fourteen miles below, the nature of the intervening depression, its shape, direction and extent have been and are still matters of interesting speculation. It is probably a section of the valley of the pre-glacial Wabash. This valley bottom is sixty or eighty feet above the bottom of the filled valley at Terre Haute and the two sections possibly are connected by a buried valley somewhere near the present stream line.

There are signs that its former course was north of its present course from the west line of Tippecanoe County into the immense pre-glacial valley of Kickapoo Creek, opening into the Wabash Valley at Attica. Cates' Pond, a traditionally bottomless kettle hole pond or lake, about two miles northwest of Independence, Warren County, is a good link in the evidence of such a former course.

The abrupt drop of two hundred feet from the valley bottom at Delphi to the rock floor beneath LaFayette indicates that the part of the stream above Delphi is not in the old valley. The north fork of Wild Cat Creek perhaps more nearly represents the pre-glacial drainage line. The little creeks between this creek and the Wabash show rock in their channels, while Wild Cat does not cut down to bed-rock at any place in Tippecanoe County, so far as I know, although its valley is one hundred feet or more in depth as far up as the county line.

Rock outcrops in the bed of Indian Creek near Porter's Station, in the bed of Little Wea Creek at the Monon Railway crossing and along Flint Creek for four or five miles above its mouth.

Borings are few and not many are deep. A well driven forty or fifty feet below the bed of the Big Wea Creek, where it is crossed by the moraine about five miles south of LaFayette, passed through gravel hardpan and into quicksand, producing a constant flow of water.

Materials and Structure of the Terraces.—The terraces and the whole valley region are composed of sand, gravel and bowlders with interposed beds of clay. The whole deposit is of great depth, in places as much as three hundred or four hundred feet. The channel of the river at LaFayette is two hundred feet below the general surface of the county and one hundred and fifty feet above the bed-rock, giving total depth of three hundred and fifty feet of deposits.

The material is bedded in layers that lie at a high angle, such as is seen in delta structure; the dip is in a general direction down stream. Ample opportunities for observation occur in gravel pits and stream sections.

The streets in West LaFayette are improved by opening pits in the street lines and afterward filling them with the top-soil and graveling over them. These excavations uniformly show steeply inclined beds. The railroad cuts through the terraces on both sides of the river show this structure. The valley of the Wea through the gravel deposits shows the same thing. In the Wea Valley a layer of conglomerate is a conspicuous

Cates' Pond, a kettle hole two miles northwest of Independence, Ind.

feature, dipping toward the creek on the north side and from it on the south side.

The conglomerate stratum is formed of the sand and gravel of the deposit cemented with carbonate of lime. It lies apparently at a uniform horizon and is of uniform thickness. The cement is so abundant in some places as to fill completely the interstices in the mass of sand and gravel. Indeed, a block left in a yard fronting on State Street in West LaFayette has its upper flat surface completely covered with a layer of pure carbonate of lime a half inch thick.

An interesting feature of these deposits is the occurrence of beds of bowlder clay interstratified with the sand and gravel. This is noticeable

more particularly about the east end of the Wea Plains along ravines opening into the Big Wea Creek. An exposure 3.5 miles south of LaFayette shows a deep layer of false bedded fine sand overlaid by three feet of very dense till, above which is ten feet of sand and gravel. This interstratification of materials appears even more strongly marked along the Wild Cat Creeks. At the bridge across South Fork near Monitor are two beds of clay differing in color and overlaid by twenty feet of sand and gravel. Near Pyrmont, on the north fork, ten feet of dark alluvial clay appears above the waters of the creek, above this ten feet of coarse gravel, and above this forty feet of gray bowlder clay.

Allied Topography.—The topography of the county about the border of the terrace deposits is interesting and suggestive. A moraine ridge containing much gravel, some of it water laid, extends along the entire south side of the Wea Plains. A heavy moraine lies along the north side of the valley from Battle Ground south, bending away from the river just above West LaFayette. Stream sections in the mass of this moraine show compact till as deep as they extend. At the mouth of Indian Creek the upper hundred feet of the bluff is a layer of fine sand resembling the dune sand of Lake Michigan, and the sand ridges of northern Indiana. This may be the source of the sand built into the ridges and dunes a mile further up the valley. The bluffs back of LaFayette are of till and are possibly a section of the moraine west of the river extending east in the direction of Monitor.

Explanation.—An attempt at explanation would revert immediately to the glacial period. The great valley was obstructed somewhere to the west, probably in the region of the great bend, by an ice sheet moving east or south. This may have been a result of one of the earlier ice invasions. The obstructed valley forming a lake has been filled by the deltas of streams flowing into it. The high angle of the layers indicate this. The layers of till represent movements of the ice sheet over the delta plain. These may have been minor advances and recessions of the same ice sheet. The material has been assorted out of the drift sheet overlying the basins of the streams traversing the region. The lime cement in the conglomerate is easily explained as being derived from the Niagara limestone region lying immediately to the east.

The problems in detail are of such complexity that any attempt at explanation is made with extreme diffidence. There are good reasons for believing that the valley was over-ridden by ice from the east and also

from the north at various times during the accumulation of the deposits. The sheets of till found at different depths in the terrace gravels indicate this. The moraine extending along the south side of the Wea Plains as far east as the Little Wea Creek is composed of hills and ridges of gravel, while farther east it becomes a ridge of till.

This may indicate that after the valley had been filled nearly to its present level the ice swept over it from the north, transporting the gravel from the valley and depositing it in the moraine.

The arrangement of the moraines on either side of the river at LaFayette, together with the narrowness of the valley at that point, may indicate that the front of the ice sheet lay across the valley while the moraines were deposited.

The terminal drainage may have spread gravel deposits over the surface of the Wea Plains much as the Yahtse River is building its delta below its outlet from the Malaspina Glacier in Alaska. This may have been a line of interlobate drainage between lobes from the Lake Erie and Lake Michigan basins, and much of the material may have been furnished by the slow, but long-continued creep of the glacier toward the stream line.

The height of the terraces was determined by the height of the rock surface crossed by the river between the west line of the county and Attica. The terraced arrangement is continued here, but the upper valley has been made by the removal of the drift from the surface of the rock, while the inner valley has been cut through the rock (mainly shales) since the gravel was deposited above. The excavation of the inner valley through Tippecanoe County proceeded as the channel through the rock sill below was cut down. The stream that did this work carried the waters of the melting sheet of ice as it retreated slowly to the north and east. Its width probably corresponded to that of the inner valley.

The Tippecanoe River and Wild Cat Creek were streams of great volume as the size of their valleys show, and this volume was doubtless maintained through a long period of time.

The sand dunes southwest of LaFayette along the eastern edge of the Wea Plains Terrace, those on the terrace edge on the north side of the river opposite the mouth of Wea Creek, and the deep deposit on the crest of the bluff above the mouth of Indian Creek were probably gathered and piled up from the surface of the Wea Plains by the southwest winds, while, after the recession of the ice, the surface remained bare.