SOIL SURVEY OF TIPPECANOE COUNTY, INDIANA.

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LOCATION AND BOUNDARIES OF THE AREA.

Tippecanoe County is situated in the west central part of Indiana. It is bounded on the north by White and Carroll counties; on the east by Carroll and Clinton counties; on the south by Montgomery County, and on the west by Fountain, Warren, and Benton counties. The county comprises approximately 320,000 acres, or 500 square miles.

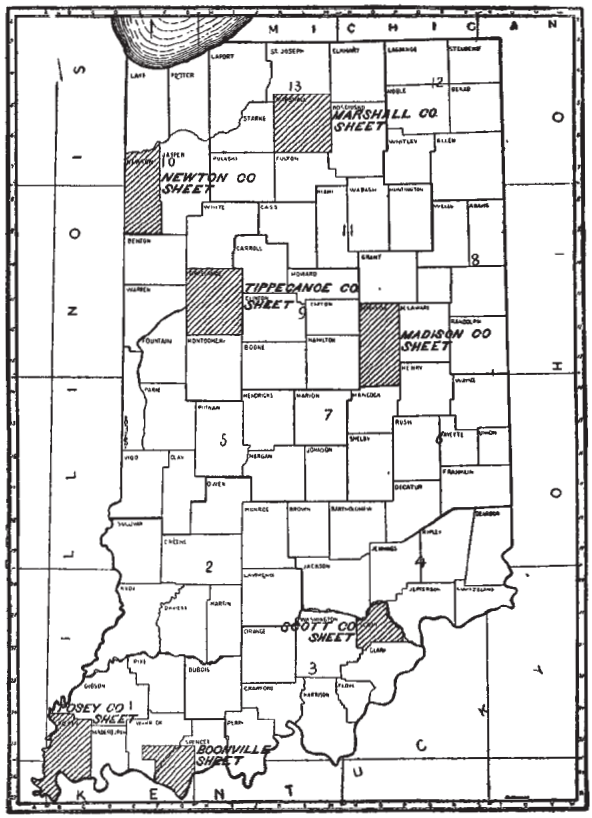

FIG. 33.—Sketch map showing location of the Tippecanoe County area, Indiana.

It is nearly square in shape, its width east and west being 21 miles and its length north and south about 24 miles. Lafayette, the county seat, which is quite centrally located, is the principal town and has a population of about 20,000. Purdue University and the Indiana State experiment station are located at this place.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

A little over three-quarters of a century ago Tippecanoe County was inhabited by hostile Indian tribes belonging to the great Algonquian family. The defeat of the Indians in 1811 by General Harrison at the battle of Tippecanoe broke their power and rendered the country available for settlement. By an act of the general assembly of the State of Indiana Tippecanoe County was formed out of Wabash County in 1826, the latter then embracing all of the territory lying north of Montgomery County as far as Lake Michigan. Lafayette was chosen as the county seat.

In the latter part of 1822 or early in 1823 Peter Weaver settled in the lower end of Wea Plains, on the south side of the Wabash River. Other pioneers settled around him, and early settlements were also made near Clarks Point, in the neighborhood of Westpoint and on Little Wea Creek. The early settlers came principally from eastern and southern Indiana, the majority of them being natives of Ohio, Virginia, Kentucky, and Pennsylvania. In later years, as the county became better developed, immigrants came from Illinois, New York, Maryland, and West Virginia.

In taking up the new land the settlers generally selected timbered areas. The open prairie lands, which were considered poor and unproductive, were swampy and poorly drained, and were covered with a tough, thick sod which could not be broken with the tools possessed by the settlers. The timbered areas, when cleared of their forest growth, offered little resistance to cultivation and possessed good natural drainage. In course of time, when newcomers were unable to locate claims, except on the prairie lands, a heavy sod plow was invented with which the tough sod could be broken. While it was a crude, poorly constructed implement, requiring several yoke of oxen to draw it, it nevertheless served its purpose, and the farmers were well repaid for the labor expended in breaking up the prairie soils. They were found to be more productive than the timbered areas, yielding larger and better crops on the well-drained areas.

Corn and potatoes were the first crops planted on the newly cleared timbered lands, while corn was generally the first crop grown on the virgin prairie soils. In planting corn on the prairie soils it was the practice the first year to drop the grain in the furrow as the sod was being turned under. This was called "sod corn" and was not worked during the growing season, it being impossible to cultivate the crop without tearing up the sod and pulling out considerable of the corn. The corn thus produced was generally of poor quality. In the fall the land was plowed and put in wheat, which was sown broadcast. Wheat was generally the second crop grown on the new soil, but in some cases corn was grown for two or three years before the land was

sown to wheat. The wheat was at first cut with a sickle and later the cradle came into use. It was either thrashed out with a flail or spread on the barn floor and trampled by horses until the grain was separated from the straw. Reapers and thrashing machines did not come into use until some time during the sixties. The early settlers also raised some flax and wool, from which they made their clothing.

Little progress was made in agriculture prior to the completion of the Erie and Wabash Canal in 1840. Most of the grain produced had to be consumed at home. Occasionally a load of grain or other produce would be taken west to Chicago or east to Louisville or Cincinnati and salt and other provisions brought back. It took several weeks to make the trip, and only small loads could be hauled, because of the bad roads. Produce of all kinds was very cheap at this time. Some traffic between Lafayette and other small cities to the south and east was carried on by steamboats and other smaller craft on the Wabash River. While navigation of this character figured quite extensively in the earlier growth of the county, it was not until the completion of the Erie and Wabash Canal, which furnished direct communication with the Ohio River, that more rapid progress was made in the agricultural development of the county. With these increased shipping facilities produce of all kinds could be sent to the south and east, where it was more in demand and brought higher prices.

Following the introduction of canal navigation the county began to develop rapidly. Large areas of timber lands were cleared and put under cultivation. Soon afterwards large tracts of prairie land were broken and converted into productive fields. Many improvements rapidly followed. The settlers began draining their land, open drains being most commonly used. A great deal of fencing was done, Osage orange hedges being used generally. In later years these hedge fences have been largely replaced by wire.

Late in the fifties the first railroad was built in the county and aided greatly in its development. Other railroads were soon afterwards constructed, and as they afforded better and more rapid transportation facilities they secured most of the shipping trade, finally forcing the abandonment of both the canal and the river as means of transportation.

CLIMATE.

There are no marked peculiarities in the climatic conditions of the area. The climate is humid and is about the same as that of the Middle States lying in the same latitude. Extreme temperatures seldom occur during either the summer or winter months, and the rainfall is well distributed throughout the year. The following table, compiled from the records of the Weather Bureau station

at Lafayette, shows the normal monthly and annual temperature and precipitation:

Normal monthly and annual temperature and precipitation.

Month.	Lafayette.		Month.	Lafayette.	
	Temperature.	Precipitation.		Temperature.	Precipitation.
	°F.	*Inches.*		°F.	*Inches.*
January	25.1	2.15	August	72.7	3.16
February	27.7	2.78	September	65.9	2.66
March	36.9	3.01	October	53.0	2.45
April	51.0	3.20	November	38.9	3.24
May	61.2	4.59	December	30.1	2.49
June	71.2	4.50			
July	74.8	3.52	Total	50.7	37.79

As appears from the foregoing table, the average annual precipitation is about 38 inches. The greatest amount of rainfall occurs during May, June, and July, and the lowest precipitation comes during the month of January. The average annual temperature is about 51° F. The growing season comprises about six months of the year, during which time crops are safe from frosts. It is seldom that crops are injured by frosts on the uplands, but occasionally those grown on the bottoms are injured if sown late in the spring.

The following table shows the dates of first and last killing frosts for the past seven years:

Dates of first and last killing frosts.

Year.	Lafayette.		Year.	Lafayette.	
	Last in spring.	First in fall.		Last in spring.	First in fall.
1898	Apr. 6	Oct. 15	1902	Apr. 5	Sept. 14
1899	Apr. 16	Sept. 27	1903	May 1	Sept. 18
1900	May 10	Oct. 17	1904	Apr. 21	Oct. 23
1901	Apr. 21	Oct. 5	Average	Apr. 20	Oct. 4

PHYSIOGRAPHY AND GEOLOGY.

Tippecanoe County lies wholly within the drainage basin of the Wabash. North of this river the general fall is toward the south, while south of it the fall is toward the north and west. The smaller streams flowing into the Wabash have cut channels from 10 to over 175 feet deep, which as a rule carry off the surface water quickly and afford excellent outlets for artificial drains. The Wabash River enters the county at the northeast corner, flows in a general southwesterly direction, and leaves the county about the center of the western boundary line.

The Tippecanoe River enters the area about 4 miles west of the northeast corner, flows in a southerly direction, and empties into the Wabash about 3 miles south of the northern boundary line. This stream drains only a small proportion of the northeastern part of the county. Pine Creek, Indian Creek, Burnett Creek, and their tributaries drain that part of the county north and west of the Wabash River, the eastern half of the area south of the Wabash is drained by Sugar Creek, Buck Creek, and Wildcat Creek and its tributaries, while the southwestern section of the area is drained by Big and Little Wea creeks and Flint Creek.

The general altitude of Tippecanoe County is about 750 feet above sea level. The high bluff lines about 4 miles north of Lafayette and the uplands between Wildcat and Sugar creeks have an elevation of a little over 800 feet. It is quite probable that these are the highest points in the area.[a]

Along the margin of the Wabash River and its principal tributaries the surface is generally broken and hilly, while back from these streams the topography of the county is slightly undulating and rolling, gradually extending into plains or level tracts. In the northwestern part the surface varies from level to slightly undulating, but eastward the surface becomes more or less undulating and rolling in character, and in the northeastern part, where Burnett Creek, the Tippecanoe River, and the Wabash River approach one another, it is quite uneven and somewhat broken. That part of the uplands east of Tippecanoe River and north of the Wabash is level or only slightly rolling.

In the western part of the county, north of the Wabash River and extending east to Lafayette, the surface is slightly undulating. Pine Creek has formed only a small, shallow valley in this section, but near the margins of the valley formed by Indian Creek, particularly along the southern half of its course, the surface is more or less broken. The valley formed by this stream is narrow and is marked by rather steep bluff lines.

The valley of the Wabash is quite narrow, considering the size of the stream. The valley floor varies in width from a few rods near Lafayette to perhaps a mile at other points and is generally marked by prominent bluff lines. In some cases the bluffs have been worn into well-rounded contours or gently sloping descents, while in other cases, particularly near Lafayette and in the northeastern part of the county, they are precipitous and from 50 to 100 feet or more above the level of the valley floor. The surface of the low bottoms of the Wabash varies but little along its course, and its height above the low-water mark is between 10 and 20 feet. These bottoms are subject to overflow during periods of high water.

[a] Fifteenth Report, Indiana State Geologist.

West of Lafayette, on the south side of the river, a second terrace is developed. This has an elevation of from 40 to 80 feet above the bottom lands and extends back from 2 to 5 miles from the river. This comparatively level tract, known as Wea Plains, was originally a prairie, and is composed of a mass of sand and gravel from 125 to 200 feet in depth, covered by a mantle of soil of varying thickness.

South of Wea Plains the surface becomes more rolling and is crossed by a number of ridges of varying height which have a general trend from east to west.

On the opposite side of the river from Wea Plains a gravelly terrace is developed, with about the same elevation as the plains. This is really a third terrace, as a lower or second terrace occurs from 25 to 30 feet above the bottoms. About 4 miles below Lafayette this second terrace is well developed, but it gradually merges into the higher or third terrace as the city is approached. This second terrace varies in width from a few rods to over 1 mile.

The surface of the uplands of the eastern half of the county south of the Wabash River varies from level to slightly rolling. Near the stream courses the surface becomes more or less broken and hilly. The valley formed by Wildcat Creek is marked by steep, precipitous bluffs ranging in height from 50 to 100 feet or more. The bluff lines are most prominently developed near the point where the South Fork enters the main stream, but as the source of the stream is approached the bluff lines become more rounded and possess more gentle slopes. The bluffs along the South Fork are not so prominently developed. The valleys formed by these streams are narrow and the surface irregular, being broken by low hills and ridges, old stream channels, sloughs, and swampy depressions. Second bottoms, generally quite narrow, are developed along certain parts of these stream courses.

North of Wildcat Creek the uplands are broken by the deep, narrow valleys formed by Buck and Sugar creeks.

The entire region is covered with glacial débris, the thickness of which varies greatly in different parts of the county. The greatest depth of this drift, so far as is known, is about 150 feet, but it is thought that careful measurements in some parts of the county would show it to be deeper, possibly from 200 to 250 feet.[a]

Prior to the deposition of the glacial material a great depression or basin was formed in the central part of the county by erosion. Immediately following this period of erosion the basin was filled with glacial drift. Subsequent to the deposition of the glacial material a large proportion of the county was covered with loess. The loess varies in thickness from a few inches to 3 feet or more and has resulted in the formation of the most extensive soil types in the area. Generally a

[a] Fifteenth Report, Indiana State Geologist.

few feet below the surface the soils grade into bowlder till consisting of clay, sand, and gravel mingled together in varying proportions. In some cases the underlying material consists of yellow or blue clay, which extends to an undetermined depth, while in other cases it consists chiefly of sand and gravel.

SOILS.

Seventeen soil types were recognized and mapped in the area surveyed. Of these, 8 occur as upland types, 5 as alluvial or river bottom types, and 4 as second bottom or terrace types. The various soils are quite distinct in their typical formations, each possessing its own physical peculiarities. Although each soil type is easily recognized when typically developed, yet in some parts of the county the transition from one to the other is often so gradual that it is difficult to draw accurate boundaries between them. This is especially so in the case of the lighter areas of the Marshall silt loam and the darker areas of the Miami silt loam, and also of the Marshall loam and the Marshall silt loam. Although frequently occurring in limited areas, the bottom land types are generally quite easily distinguished.

The following table shows the extent of the different types of soil found in Tippecanoe County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Marshall silt loam	140,166	43.9	Wabash sandy loam	2,624	.8
Marshall loam	72,320	22.6	Miami loam	1,920	.6
Miami silt loam	44,288	13.9	Muck	1,664	.5
Wabash fine sandy loam	11,712	3.7	Miami gravelly sandy loam	1,024	.3
Marshall fine sandy loam	11,584	3.6	Sioux loam	896	.3
Wabash silt loam	9,408	2.9	Riverwash	832	.2
Sioux sandy loam	9,216	2.8	Sioux silt loam	570	.2
Miami fine sandy loam	4,608	1.6			
Miami black clay loam	3,840	1.2	Total	319,488	.....
Miami fine sand	2,816	.9			

MARSHALL SILT LOAM.

The Marshall silt loam is the most important and extensive soil found in the area. It consists generally of a dark-brown to almost black silt loam in which the percentage of silt is extremely high. In some cases the color is much lighter, varying from light brown to dark gray. On the more rolling areas the depth of the soil is about 12 inches, while on the more level tracts and in some of the shallow depressions it is much deeper, occasionally extending to 20 inches. Over the prairie regions occupied by this type the depth is fairly uniform, averaging from 16 to 18 inches. The percentage of organic matter in the soil is generally quite large, giving the type its prevailingly

dark color. The color of the soil generally becomes much lighter with depth. As the depth increases the soil gradually becomes heavier, and below 16 or 18 inches it grades into a heavy silt loam subsoil having some of the properties of a clay. This material generally extends to a depth of 3 or 4 feet, but in some cases it grades into a clay loam or clay at a depth of from 28 to 30 inches. Sometimes this clay loam subsoil lies directly beneath the soil. The color of the subsoil is yellow, sometimes slightly mottled or streaked with red or yellow iron stains in the lower sections. Generally below 3 or 4 feet the subsoil consists of a yellow sticky sandy clay, which grades into bowlder till at lower depths. As the Wabash River is approached the underlying material contains more sand and gravel, and near this stream it is composed largely of coarse sand and gravel more or less stratified. An occasional bowlder or small pebble occurs on the surface, particularly upon the morainic ridges.

The following table shows the results of mechanical analyses of a typical sample of Marshall silt loam:

Mechanical analyses of Marshall silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13991	Soil	0.2	1.1	1.3	3.9	5.7	67.2	20.0
13992	Subsoil	.3	.9	1.1	2.9	4.5	64.8	25.6

The Marshall silt loam is most typically developed southeast of Lafayette, and is the chief type, occupying the uplands on both sides of the Wabash River. The type occurs in every part of the county, but is not extensively developed north of township line 24 north, nor is it found to any great extent in the southwestern part of the area.

The surface of the greater part of this type is level, although in certain localities it is slightly undulating and rolling. Near the streams and along the morainic ridges which cross the county in a general east and west direction the surface is somewhat broken. The topographic features of the greater part of this type afford good natural drainage. In the swales and local depressions and over some parts of the more level areas the natural drainage is poor, and artificial drainage is necessary to successful crop production.

This soil has been formed by the deposition of loess over glacial drift. To this have been added large quantities of organic matter from the growth and decay of grasses and other prairie vegetation. The type embraces a part of the typical prairie lands of the county. Some areas, however, especially near the streams, were originally timbered, the forest growth consisting chiefly of oak, ash, walnut, hickory, and maple.

Corn, oats, wheat, and clover are the principal crops produced on this soil. Of these corn is by far the most important. The crop yields vary with the seasons and methods of cultivation, but are always larger than those secured on typical areas of the Miami silt loam. On the well-managed farms corn yields from 50 to 60 bushels per acre, but the average for the type will probably not exceed 40 bushels. The average yield of oats is estimated at 50 bushels and of wheat from 20 to 30 bushels per acre. Clover when cut for hay will average about 2 tons per acre, and when cut for seed from 1 to 1½ bushels per acre. The Marshall silt loam is well adapted to the crops at present grown upon it. It is generally recognized that wheat does better on the lighter than on the heavier phases of this soil. The best results from corn are generally secured on the heavier and darker-colored areas.

In order to study the manurial requirements of this soil, a large sample was collected from the southeast corner of sec. 22, T. 23 N., R. 4 W., and an examination made by the paraffined wire-pot method. The soil at this place is a black or dark-brown silt loam, containing a large percentage of organic matter.

The land from which the sample was taken was originally timbered, but has been under cultivation for the last thirty years. During the last seven years it has been cropped continuously to corn, the average yield being about 45 bushels per acre. It has never been sown to clover, neither have fertilizers of any kind ever been applied. Of the various fertilizer ingredients applied to this soil, none produced any appreciable increase in the growth of the plants. The plants grown on the untreated soil were of good size, thus indicating that thorough cultivation rather than fertilizers is needed on this soil.

In these tests wheat plants were used as an indicator, and the results are held to be applicable only to this crop and to the particular field from which the sample was taken, but in a general way they are believed to apply to a large part of this soil throughout the area, and in this agree with the common farm practice.

MIAMI SILT LOAM.

The soil of the Miami silt loam consists of a light-brown or dark-gray to almost white silt loam with an average depth of about 16 inches. In some localities it is streaked with red or yellow iron stains. Iron concretions are frequently found on the surface and through the soil, and in a few cases some small gravel is found, but the amount is too small to have any appreciable effect upon the texture or agricultural value of the soil. The soil has a loose, flour-like feel, and the amount of organic matter it contains is generally very small. On the ridges and slopes of the bluffs the soil is somewhat more sandy than in the typically developed areas.

There is no sharp line of demarcation between the soil and subsoil. At a depth of 16 inches the soil generally grades into a heavy silt loam subsoil, which gradually becomes heavier with depth. The color varies from gray to yellow and is often streaked with red and yellow iron stains. Below 30 inches the subsoil generally grades into a yellow clay loam, which extends to a depth of 3 or 4 feet. Below this the underlying material consists of a sandy silt or clay, in which the percentage of sand increases with depth. This material is underlain by bowlder till, consisting of clay, sand, and gravel in varying proportions, but in some localities, especially near the Wabash River and a few of its principal tributaries, this underlying material is composed largely of sand and gravel. Over that portion of the type underlain by sand and gravel the soil grades at a depth of about 18 inches into a yellow or mottled yellow, sticky, sandy clay in which the percentage of coarse sand and fine gravel increases with depth, grading eventually into sand and gravel.

This soil type resembles the Marshall silt loam to a marked degree in texture, but is easily distinguished from that type by its lighter color, more hilly surface, and lower crop value. The following table gives the result of the mechanical analyses of a typical sample of this soil type:

Mechanical analyses of Miami silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
14003.....	Soil.....	0.4	1.8	1.0	2.2	7.3	68.4	18.9
14004.....	Subsoil.....	Trace.	.9	.7	1.6	6.5	73.6	16.2

The Miami silt loam is most typically developed over a portion of the uplands bordering the valleys formed by the Wabash River and its principal tributaries. It occupies the best-drained areas of the county. It is found in a long, narrow strip north and west of the Wabash River, widening out into broader areas along the lower courses of Indian and Burnett creeks. Another large area occurs east of the Wabash, from Wildcat Creek northeast to the county line. Between the Middle and North forks of Wildcat Creek is a third area of Miami silt loam. The only other area of any considerable size lies in the southwestern part of the county, in the vicinity of Flint Creek.

A few areas of this type are level, but the greater proportion is rolling, and near the streams it is quite hilly. In many places deep V-shaped gullies have been cut in the steeper slopes by erosion. Owing to the rolling and hilly topography, which characterizes the most of this type, the rainfall runs off readily, and artificial drainage is seldom necessary. The more level tracts, however, could be improved by tile drains.

This type owes its origin to the deposition of loess over glacial material. Because of the good natural drainage, the moisture conditions have been unfavorable to the growth and preservation of a heavy vegetation, and as a consequence a soil has been formed in which the amount of organic matter is extremely low. For this reason the type is less loamy and less productive than other soils of the area in which considerable organic matter has been incorporated through the growth and decay of grasses and other vegetation. This type embraces the greater part of the original timbered areas of the county, and at present considerable timber, consisting chiefly of oak, ash, hickory, walnut, and maple, is found growing upon it, especially in the more hilly and nonagricultural sections.

The Miami silt loam is devoted to about the same crops as the Marshall silt loam, but the yields are generally much smaller. The yields are largest during wet seasons, as the crops grown on the more rolling and hilly areas are frequently injured by drought. Corn and oats average from 35 to 40 bushels per acre, wheat from 15 to 20 bushels, and clover from three-fourths to 1 ton. This soil type is not well adapted to corn, although a considerable proportion of the cultivable tracts is devoted to this crop. Oats do fairly well, and moderate yields of wheat and clover are secured. It is an excellent soil for pasture, and a large proportion of the type, particularly in the hilly sections, is used for this purpose. Some fruit is grown, chiefly apples, pears, and peaches, but the yields are generally light and the fruit is not of the best quality.

The manurial requirements of this soil were studied, using a large sample collected near the center of sec. 23, T. 23 N., R. 3 W. The field from which the sample was taken has been in cultivation for about twenty years, having been planted to corn a larger part of the time, and although no manure or fertilizer of any kind has been used the average yield has been about 30 or 35 bushels per acre.

The results obtained with plants grown in wire baskets indicate that an excellent increase in productiveness may be obtained by the use of stable manure; that nitrate of soda with either sulphate of potash or acid phosphate will give a large increase, and that cowpeas and lime, acid phosphate alone, or nitrate of soda alone will give a fair increase. Sulphate of potash or lime gave only a small increase.

In these tests wheat plants were used as an indicator, and the results are not held to be applicable to other and unrelated crops or to fields which have received treatments essentially different from that from which the sample was taken.

MIAMI BLACK CLAY LOAM.

The Miami black clay loam is the heaviest soil type in the county. The soil consists of a heavy loam or clay loam with an average depth of about 14 inches, the depth varying in different parts of the same area, generally being deeper near the center of the area than near its outer margins. The soil contains a very high percentage of organic matter, and to this is due the characteristic black or dark-brown color. As the depth of the soil increases the percentage of organic matter proportionately decreases, and the color becomes much lighter, generally becoming bluish or grayish at from 10 to 20 inches below the surface. The soil is very cohesive, with a tendency to puddle, and if stirred when too wet or too dry it breaks up into large clods which are difficult to pulverize. If allowed to dry without cultivating, it cracks badly, often forming cracks 1 or 2 inches wide and several inches deep.

The soil gradually becomes heavier with depth, and below 14 or 16 inches grades into a silty clay, the clay content increasing with depth. Below 20 or 24 inches the subsoil generally consists of a heavy, tenacious, impervious silty clay. The color of the upper section of the subsoil varies from light to dark gray, depending upon the depth to which the organic matter extends. It rapidly becomes lighter with depth, finally grading into light-gray or mottled yellow.

While the surface soil is fairly uniform throughout the area, the subsoil varies somewhat in different parts of the county, especially where the type occurs along stream courses. In such localities the subsoil consists of a yellow heavy silty clay grading at a depth of about 30 inches into a heavy sandy clay containing some fine gravel. Occasionally some fine gravel is found on the surface, but the amount is generally small.

The following table gives the results of mechanical analyses of this type of soil:

Mechanical analyses of Miami black clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13600	Soil	0.3	1.3	1.9	5.1	6.2	59.1	25.3
13601	Subsoil	.1	1.1	.5	1.9	5.1	71.1	19.7

The Miami black clay loam occupies only a small proportion of the area surveyed. It occurs as small isolated bodies over the county, and is found most typically developed south and east of Lafayette. It occupies shallow, basinlike depressions on the uplands and is occasionally found along some of the smaller streams. The soil has resulted from the washing of the finer material from the higher levels into these poorly drained depressions, where through the growth and decay of rank grasses and other kinds of vegetation much organic

matter has accumulated. The surface is practically level, with only a slight fall toward the main drainage lines. In some cases it is slightly broken by old sloughs and swampy depressions. On account of the level surface and the heavy impervious subsoil the type is poorly drained. To produce good crops artificial drainage is necessary over all this type, except in the small areas occurring along the streams. Some of these lands have already been supplied with tile drains. The soil is rich and productive, and when well drained and properly managed it is capable of producing large crops of corn, oats, grass, and other products.

The Miami black clay loam is one of the best corn and grass soils in the area. Good crops of oats have been produced, but there is danger of the grain lodging, because of the rank growth of straw induced by the high organic matter content of the soil. The average yield of corn is from 50 to 60 bushels, while that of oats in good years is about 35 bushels per acre. The yield of hay varies from 1 to 2 tons per acre. Some clover is grown on this type, mostly for pasture and green manure. When grown for hay, it yields about 1½ tons per acre. It is sometimes allowed to ripen and is cut for seed, 1 bushel per acre being the average yield. Trouble is frequently experienced in growing this crop on account of its heaving from the freezing and thawing of the soil. This can be largely overcome by a more thorough system of drainage.

MARSHALL LOAM.

The surface soil of the Marshall loam, as typically developed, consists of a black or dark-brown loam with an average depth of 8 or 10 inches. Below this the soil grades into a somewhat heavier-textured and lighter-colored loam, which extends to an average depth of 14 inches. The soil contains a small amount of sand, which is most apparent on the surface after beating rains. The type in some localities, although of a loamy appearance, when examined closely is seen to have the characteristics of a silt loam, and in some cases it is difficult to separate this type from the darker-colored Marshall silt loam. Organic matter occurs in this soil in large quantities, and to this is due the prevailing dark-brown or black color. As the depth of the soil increases the percentage of organic matter decreases, and the color becomes correspondingly lighter.

The depth of the soil varies considerably in different parts of the area, depending largely upon the topographic position occupied by the type. On the crest of the low knolls and ridges it varies from 8 to 10 inches and is generally more sandy than the typical soil. On the more level areas and in the local depressions the soil is generally much deeper, averaging 16 or 18 inches. The organic matter content of the soil in these areas is generally much larger than in the more uneven or elevated areas, and the texture is also somewhat heavier.

The line of separation between the soil and subsoil is generally well defined. At a depth of from 14 to 16 inches the soil grades into a yellow clay loam subsoil, in which the percentage of clay increases with depth. In some sections the clay loam extends to a depth of over 36 inches, but generally at about 24 inches the subsoil grades into a yellow heavy sandy clay. In some cases a depth of 30 or 33 inches is reached before this coarse sandy material appears. Below these depths, however, the subsoil becomes lighter, the sand content increasing, and below 36 to 40 inches the subsoil is a light sandy clay. Occasionally at a depth of 36 inches a thin layer of medium to coarse sand is encountered. The type is underlain by bowlder till. A small amount of gravel and a few large bowlders occur on the surface. In some areas the bowlders are so plentiful as to interfere with cultivation, but in most cases they have been removed from the fields.

The average results of mechanical analyses of typical samples of this soil are shown in the following table:

Mechanical analyses of Marshall loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13594, 13979.....	Soil.....	0.2	1.2	1.1	3.4	7.1	66.2	20.5
13595, 13980.....	Subsoil.....	.2	1.0	.8	1.9	4.4	70.0	21.5

The Marshall loam occupies a part of the prairie lands of the county. It occurs as a large, irregular-shaped area in the northwestern corner of the county, extending eastward along the northern boundary line nearly three-fourths the width of the area. A second large area is found between Flint Creek and the Wabash River, northeast of Westpoint. In the southwestern part of the county are other large areas of Marshall loam. A smaller area of this soil occurs in the southeastern corner of the county, near Clarkshill.

The surface of the Marshall loam is nearly level or only slightly undulating. The surface is sometimes broken by small, shallow valleys, formed by streams flowing across the type and by a number of low sand and sandy loam ridges, which seldom exceed an elevation of more than 6 or 8 feet above the level of the surrounding country. Owing to the practically level surface of the greater part of this type, the natural drainage is poor and artificial drainage has to be employed in order to insure good crops. When this land was first put under cultivation open drains were mostly used, but in later years these have been largely replaced by tile drains.

The Marshall loam is of glacial origin. Directly associated with the type are large massive bowlders, consisting chiefly of granite, which are found most abundantly in the southern part of the county. In addition to the material deposited by glaciers, there has been

added to the soil a large quantity of organic matter from the growth and decay of prairie vegetation.

This soil is well adapted to the production of corn and oats, which are the principal crops grown on it. Clover does fairly well, but considerable difficulty is sometimes experienced in getting a good stand. It is generally sown with oats, and if the season is dry the clover may die after the nurse crop is removed. The average yield of corn is about 40 bushels, while that of oats varies from 35 to 45 bushels per acre. Clover will yield during successful years from 1 to 2 tons of hay and from three-fourths to 1½ bushels of seed per acre. Fruit and vegetables are grown only for home use. Of the large fruits, apples and pears are most extensively produced, but the yields are light and the fruit is not of the best quality. Irish potatoes and some of the early vegetables can be successfully produced, but up to the present time they have been grown only for home use.

MIAMI LOAM.

The soil of the Miami loam, to an average depth of 16 inches, is a light-colored loam, in which the percentage of silt is relatively high. When wet or newly plowed it has a light-brown color, which on drying out becomes light or dark gray, and in some cases almost white. In general the soil resembles the Miami silt loam, but upon careful examination it is found to contain considerable medium to coarse sand. When thoroughly moistened, the soil is quite sticky and the presence of sand and small iron concretions gives it a gritty character. The soil is loose and light and is easily tilled, but is very deficient in organic matter.

The subsoil is a heavy, sticky loam, the upper section of which has a mottled yellow color, changing to deep yellow at lower depths. Some iron concretions occur in the first 6 or 8 inches of the subsoil, but below this depth they are not generally found. In some localities the soil at a depth of 14 inches grades into a sticky, gravelly subsoil, which resembles that of the Miami gravelly sandy loam. The gravel, however, is generally much smaller, and as a rule does not occur so abundantly as in the case of the Miami gravelly sandy loam subsoil.

There is usually found a slight quantity of small pebbles or gravel on the surface of this soil, and occasionally a few small bowlders, but not in sufficient quantity to interfere with cultivation.

The Miami loam covers only a small percentage of the area surveyed. It occurs as one continuous body on the uplands southwest of Lafayette, in the vicinity of Elston. The surface of the type is comparatively level, with but a slight fall toward the drainage channels. In some parts of the area the surface is slightly undulating, but the low knolls and ridges seldom exceed an elevation of 5 or 7 feet above the mean level of the type. Near the streams the surface is more broken

and the boundary between this type and the valleys is often marked by a steep scarp from 80 to 100 feet high.

The natural drainage features of the type are poor, except on the more undulating areas and over that portion underlain by a gravelly loam at a depth of from 14 to 20 inches. Originally the soil was cold and wet, but this condition has been greatly improved by artificial drainage. A few low, wet areas needing drainage are still to be found.

The Miami loam is of glacial origin It is composed of the weathered products of a mass of ground-up rocks deposited upon the surface during Glacial times.

Corn is the principal crop grown upon this soil Wheat and oats are also grown to a limited extent, and some areas are devoted to pasture. The yields vary considerably, according to the seasons and the drainage conditions of the soil. Corn will average from 35 to 45 bushels, oats about 40 bushels, and wheat about 20 bushels per acre The type is well adapted to the crops at present grown upon it. It is quite probable that tobacco would do well, since this crop is successfully grown on soils of similar character in other sections, particularly in Ohio.

The following table gives the average results of mechanical analyses of typical samples of this soil:

Mechanical analyses of Miami loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13618,13977.....	Soil.....	0.8	12.1	8.1	5.8	3.6	52.5	16.9
13619,13978.....	Subsoil.....	.9	10.0	8.8	13.1	8.9	34.3	23.2

MIAMI FINE SAND.

The soil of the Miami fine sand consists of a loose, incoherent, medium to fine sand, in which the percentage of fine sand is extremely large. The color of the soil varies from light-brown to yellow, depending upon the amount of organic matter present, which is generally very small. The color usually becomes lighter with depth, and below 10 or 12 inches the soil grades into a light-yellow or gray subsoil having about the same texture as the soil. In the lower section of the subsoil the color is often mottled with brown and yellow, and in some cases pockets of gray sand are found.

There is a small area of the type northeast of Battleground in which the soil contains a larger percentage of organic matter than is generally the case, and the color is consequently somewhat darker, varying from light to dark brown. It rapidly becomes lighter with depth, and below 12 or 14 inches grades into a subsoil similar in character to that underlying the typical areas.

The following table gives the results of mechanical analyses of a sample of this type:

Mechanical analyses of Miami fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13624.....	Soil.....	0.0	2.9	13.3	52.0	11.5	13.8	6.4
13625.....	Subsoil.....	.0	3.0	13.3	49.6	13.4	13.5	7.1

The Miami fine sand is found bordering the Wabash River and as well-defined ridges on the uplands some distance back from this stream. The largest body is found south of Battleground, occupying a part of the second bottoms on the north side of the river. One or two small areas are also found along Wildcat Creek and its principal tributary.

The Miami fine sand has a topography similar to sand dunes, consisting of well-rounded hills and ridges varying from 5 to over 20 feet in height. Owing to the uneven surface and the open, porous nature of the soil, the drainage is generally excessive and crops are frequently injured by lack of sufficient moisture in the soil.

This type has resulted from the drifting of sand from the valley of the Wabash and its principal tributaries and its deposition in its present location by the action of winds.

Corn, melons, and sweet potatoes are the principal crops grown. The yield of melons and potatoes is generally good, but that of corn depends upon climatic conditions entirely. A few areas are covered with timber, consisting chiefly of oak, hickory, and walnut. It is a good truck soil and is also well adapted to small fruits.

MIAMI FINE SANDY LOAM.

The soil of the Miami fine sandy loam consists of a light to dark brown fine sandy loam, averaging about 4 inches in depth. The sand content varies in texture from fine to medium, with the finer material occurring in the upper part of the soil. The soil generally becomes slightly sandier and somewhat coarser with depth. Below 14 or 16 inches the soil grades into a medium sandy loam, which extends to an average depth of 30 inches. This section of the subsoil is very compact, the clay content being sufficient to give it a sticky character when wet. The color varies from light-brown to yellow. At a depth of 30 inches the subsoil grades into a brown coarse sandy loam containing considerable fine gravel and extending to an undetermined depth. Outcrops of the underlying material along road cuts and stream bluffs show this fine gravelly, sandy loam subsoil extending to a depth of from 4 to 6 feet, underlain by alternating layers of coarse sand and gravel. As the distance back from the streams increases, particularly near the Miami silt loam areas, the soil becomes heavier,

in some cases approaching a loam, and the subsoil varies somewhat from that described above. In such localities the subsoil generally becomes heavier with depth, grading into a heavy fine sandy loam or light loam in which the silt content is high. The color is also somewhat lighter, varying from light gray to mottled yellow. This phase of the type is usually underlain by material similar in character to that underlying the typical Miami silt loam, although a few areas occur in which the subsoil grades at a depth of 3 feet into a layer of fine sand.

On some of the higher elevations and near the bluff lines the soil is sandier and the sand is somewhat coarser than is the case where the soil exists in its typical formation. The color of the soil, however, remains practically the same. This type, like the Miami silt loam, is markedly deficient in organic matter.

The following table gives the average results of mechanical analyses of typical samples of this soil:

Mechanical analyses of Miami fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13693, 13999, 14001.	Soil.....	0.6	6.1	8.1	22.0	8.5	40.6	13.5
13694, 14000, 14002.	Subsoil	1.2	7.5	8.0	23.1	7.9	31.1	21.0

The Miami fine sandy loam is confined exclusively to the northeastern part of the county, north of the Wabash River. The largest body occurs north and northeast of Battleground. Another area occupies that part of the upland between the Wabash and the Tippecanoe rivers.

Near the streams the surface of the type is somewhat broken and hilly, but farther back on the uplands it is rolling or slightly undulating. A few level areas occur, but these are generally quite small. The natural drainage of the Miami fine sandy loam is good, and in only a few cases has it been necessary to construct artificial drains. Over a considerable proportion of the type the drainage is excessive and crops frequently fail to mature on account of an insufficient moisture supply in the soil. The type has probably been formed by the deposition of loess, to which has been added the fine sand which has drifted upon the uplands from the valley of the Tippecanoe River.

The Miami fine sandy loam is well adapted to the crops grown in the county, with the exception of timothy, which requires a greater amount of moisture than this soil can retain during a dry season. Corn, oats, wheat, and some clover are the principal crops. Ordinarily corn will average 45 bushels per acre. The yield of wheat is about 20 bushels and of oats from 25 to 35 bushels per acre, depending upon the moisture supply. The yield of clover averages three-fourths of a ton per acre. Potatoes do well on this type, but it is difficult to estimate the

yield, inasmuch as they are grown only in small patches for home use. Apples and peaches are grown to some extent, and some small fruits also, but the quantity produced is seldom sufficient for home use. The soil is well adapted to truck crops.

MARSHALL FINE SANDY LOAM.

In its typical formation the soil of the Marshall fine sandy loam to an average depth of 18 inches consists of a medium to fine sandy loam. It generally contains a large percentage of organic matter, and to this is due its prevailing black or dark-brown color. The soil usually becomes heavier as the depth increases, and at 16 or 18 inches below the surface it grades into a light-brown, sticky, sandy loam extending to a depth of about 30 inches. The subsoil generally becomes lighter in the lower section, grading into a light-brown medium sand extending to a depth of over 3 feet. In some cases this sandy layer is only a few inches thick and is underlain by bowlder till, while in others it is totally absent, the type resting directly upon glacial debris. The depth of the soil varies in different localities, depending largely upon its topographic position. On the slopes and crests of some of the ridges it has an average depth of about 10 or 12 inches, and the soil is of a more sandy nature and the sand is coarser, while at the base of the ridges, on the more level areas, and in the depressions it is much deeper, occasionally exceeding 22 inches. The soil in the depressions is generally heavier than the typical soil, approaching a loam in some cases. In some areas, especially on the crests of the ridges, fine gravel is found, but the amount is generally too small to have any effect upon the agricultural value of the soil. Occasionally a few large bowlders are found.

The following table gives the average results of mechanical analyses of this soil type:

Mechanical analyses of Marshall fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13622,13985.....	Soil.....	0.1	7.1	18.1	22.4	10.4	23.3	18.7
13623,13986.....	Subsoil.....	.6	17.2	17.6	23.1	8.3	16.8	16.0

The largest body of Marshall fine sandy loam occurs in the western part of the county, immediately south of the Wabash River. A smaller area occurs northeast of Battleground, and a few areas are found in the northwestern part of the sheet. Other small, isolated areas occur in the county, principally in the southern and western parts.

The surface of the greater part of the type is slightly rolling. In some parts of the county the type occurs as low knolls and ridges,

running approximately parallel with the Wabash River. The natural drainage of the Marshall fine sandy loam is excellent. Owing to the uneven surface of the greater part of the type water runs off quickly, and artificial drainage is seldom necessary except on the more level tracts and in local depressions. On the lighter areas, particularly those underlain by a light subsoil, the drainage may be excessive, but in most cases the soil withstands drought well.

This soil type is for the most part of glacial origin. A few small areas have been formed by the mixing together of the Miami fine sand and the Marshall loam, forming a transitional zone between the two types. There have been added to this soil large quantities of organic matter through the growth and decay of prairie vegetation.

Corn, wheat, oats, and clover are the principal crops grown on the type. During wet seasons those areas of the soil underlain by sand produce better crops than those having a heavy subsoil. The latter, however, give better results than the former during a dry season, being better able to withstand drought. Corn averages about 40 bushels, wheat 20 bushels, and oats from 35 to 45 bushels per acre. Clover yields about 1½ tons when cut for hay and from three-fourths to 1 bushel per acre when grown for seed. Potatoes do well on this type, but are at present grown only for home use. Some fruit is raised, but is not of good quality and the yields are small.

RIVERWASH.

The Riverwash consists chiefly of coarse sand and waterworn gravel. It occurs as narrow strips, seldom exceeding one-quarter of a mile in width, along the Wabash River and its principal tributaries. It has been formed by the deposition of material along stream courses during periods of high water. The surface is low and flat and occasionally broken by old stream channels. It is generally dry during the summer months, and during wet periods it is covered with water. Owing to the small amount of fine material in this soil it is unproductive and has no agricultural value. Cottonwoods and willows, with some water-loving shrubs, are about the only vegetation found on this type.

WABASH SANDY LOAM.

The soil of the Wabash sandy loam consists of a sandy loam in which the percentage of coarse sand is extremely high. The average depth of the soil is about 12 inches, but this varies in different localities, the soil being deeper as well as slightly heavier in the depressions. On the ridges the soil is of a more sandy nature and is frequently covered with considerable fine gravel. The gravel is generally less than 1 inch in diameter and is more or less irregularly distributed throughout the soil profile. The prevailing color of the soil is dark brown, but it is sometimes slightly reddish, becoming lighter colored with depth.

At about 12 inches the soil grades into a coarse, slightly sticky, loamy sand subsoil which extends to a depth of over 3 feet. Small gravel is also found in the subsoil. The color varies from yellow in the upper part of the subsoil to pale yellow at lower depths.

The following table gives the average results of mechanical analyses of typical samples of this soil:

Mechanical analyses of Wabash sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13604,14021.....	Soil	5.2	27.5	14.9	25.6	8.9	12.0	5.4
13605,14022.....	Subsoil	3.7	25.0	15.5	28.9	9.4	12.1	4.6

The following sample contained more than one-half1 of per cent of calcium carbonate ($CaCO_3$): No. 14022, 1.3 per cent.

The Wabash sandy loam occurs only in limited areas along the Wabash River and its principal tributaries. It usually borders the bluff lines where typical second bottoms have not developed. The type has resulted from the washing of material from the uplands and coarse sand and gravel from the exposed bluff lines, together with material deposited by streams, its formation being due entirely to stream action.

The surface is generally uneven, consisting of low knolls and ridges and shallow depressions. A few level areas occur, but these are not very extensive. Owing to the open, porous structure of the soil the drainage in most cases is excessive, but this depends upon the relative position of the soil with respect to the streams. While not occupying the flood plain proper, it is nevertheless partly overflowed during excessively wet seasons. During the growing season the streams are generally low and the crops are seldom injured by floods.

Corn and melons are the principal crops grown on this soil. The yield of melons is generally good, but that of corn depends largely upon the quantity of rainfall during the growing season. In favorable seasons the average yield of corn is about 30 or 40 bushels per acre.

WABASH FINE SANDY LOAM.

The Wabash fine sandy loam varies to a marked degree in different parts of the area. Where typically developed, the soil consists of a fine sandy loam having an average depth of 16 inches. The fine sand content is quite large and generally increases with depth. The color varies from light to dark brown, the latter predominating. As the depth increases the soil becomes lighter both in color and texture, grading at about 18 inches into a light-brown fine sandy loam or loamy fine sand. The loamy material gradually decreases with depth, and at about 30 inches a gray fine sand is encountered which

extends to a depth of more than 36 inches. Very frequently at this and lower depths the fine sand grades into gray coarse river sand and finally into gravel. In some localities the type, particularly the subsoil, is stratified. The soil in such cases is a light fine sandy loam, of a light to dark brown color, to a depth of about 14 inches. This is underlain by a fine gray sand, with an average thickness of 4 or 5 inches, which in turn is underlain by a brown fine sandy loam containing considerable silty material. This layer is about 5 inches thick, and beneath it is a medium gray sand extending to a depth of over 3 feet and becoming coarser with depth. In the depressions or over areas where the velocity of the stream was greatly retarded, thus permitting the deposition of the finer material carried by the streams, the type is much heavier, consisting in some areas of a light loam and in others of a silty loam. The color of the soil throughout these variations is the same as where the soil is typically developed. The organic matter content is generally small, but a few areas are found where considerable organic matter has been added to the soil. In such areas the color is a very dark brown and in some cases almost black. Some fine gravel is occasionally found on the surface, but the quantity is too small to have any effect upon the agricultural value of the soil.

The following table shows the average results of mechanical analyses of typical samples of this soil type:

Mechanical analyses of Wabash fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13606,14023.....	Soil.....	Trace.	0.5	2.2	19.9	24.4	44.6	8.3
13607,14024.....	Subsoil	0.1	1.1	2.1	20.3	26.5	40.3	8.9

The following samples contained more than one-half of 1 per cent of calcium carbonate ($CaCO_3$): No. 13606, 7.8 per cent; No. 14024, 1.5 per cent.

A few small areas of this type are found along the Wabash River in the western part of the county. It is most typically developed along the more important tributaries of the Wabash, especially along Wildcat Creek, Sugar Creek, and Tippecanoe River. It occupies the first bottoms or flood plains of these water courses and has a width seldom exceeding three-fourths of a mile.

The surface of this soil is fairly level, with a gentle slope toward the main stream channels. A few low sandy and gravelly knolls and ridges occur, but they seldom exceed an elevation of 3 or 4 feet above the mean level of the type. The surface is also broken by sloughs, swampy depressions, and old stream channels.

The Wabash fine sandy loam is of alluvial origin, having been deposited in recent times by the streams which it borders. Because of its low-lying position the type is frequently flooded, but the sandy tex-

ture of the soil allows the water to drain off quickly, so that it is possible to plant crops quite early in the spring. Occasionally crops are injured by late floods and have to be replanted; but as a general rule crops on this soil are earlier than on the uplands.

Corn is about the only crop grown on this soil, and the average yield in favorable seasons is 45 bushels per acre. Some clover is grown, particularly on the higher and better drained areas, and yields fairly well. During dry seasons, especially when the streams are very low, the crops suffer from drought and the yield is very small. This soil is well adapted to truck crops.

WABASH SILT LOAM.

The soil of the Wabash silt loam consists of a heavy silt loam or clay loam, with an average depth of 18 inches. It contains only a small percentage of decayed organic matter, and the characteristic color is light or dark brown. The soil is quite sticky when wet. If allowed to dry without stirring, it has a tendency to bake and crack, and if plowed when too wet or too dry it forms clods which are difficult to pulverize unless moistened by rain.

The Wabash silt loam is remarkably uniform in character over most of the area. Where found along the smaller stream courses, the color of the soil is generally much darker, the amount of organic matter is larger, and more fine gravel occurs on the surface than is the case where the soil is typically developed. These areas resemble somewhat the Miami black clay loam, but the color of the soil is generally much lighter.

As the depth of the soil increases the percentage of clay also increases, and below 18 or 20 inches it grades into a heavy silt loam subsoil, which gradually becomes heavier, grading in turn into a silty clay, which extends to a depth of over 3 feet. Over the greater part of the type the color of the subsoil is much like that of the soil, but in some localities it is slightly mottled. There is no distinct line of separation between the soil and subsoil, and the change from one to the other is marked only by the gradually increasing clay content.

The following table gives the results of mechanical analyses of a of a typical sample of this soil type:

Mechanical analyses of Wabash silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13626.....	Soil.....	0.0	Trace.	0.3	27	2.1	66.1	28.4
13627.....	Subsoil.....	.0	0.0	.2	27	3.2	62.2	31.9

The Wabash silt loam occupies the first bottoms or flood plains along the Wabash River. A few small areas are also found along its

principal tributaries. The surface is fairly level, with gentle slope toward the stream beds. The elevation of the type varies in different parts of the valley, in some places rising gradually from the streams to the bluff line, while in other localities it occurs in the form of broad, flat terraces or steps. Often as many as three of these step-like elevations occur between the river and the bluff line, each having a rise of from 2 to 3 feet. In some parts of these bottoms the surface of this type is cut by old stream channels, sloughs, and swampy depressions. In general the natural drainage of the type is poor. During wet seasons in the spring the greater part of the bottoms is flooded, and it not infrequently happens that early-sown crops are destroyed. As a rule, however, the bottom lands are late in drying out in the spring, so that by the time crops are planted the danger of floods is past. It is seldom that a crop is destroyed during the growing season.

This soil type owes its origin to the deposition of material brought down by the river during periods of high water. Corn is about the only crop grown, and the type is admirably adapted to this crop, yielding in favorable seasons from 50 to 60 bushels per acre. Occasionally, if the crop has been late in getting started, it is injured by early frosts. Clover does well on the higher and better-drained areas, yielding from 1 to 2 tons of hay per acre.

MUCK.

Muck consists of more or less thoroughly decomposed vegetable mold mixed with varying amounts of mineral matter. Over most of the Muck areas in this county the vegetable matter is thoroughly decayed, but in a few areas it is only slightly decomposed. These latter areas could be more properly classed as Peat, but on account of the small extent of the type a separation was not made. The peaty areas consist of coarse, raw, fibrous matter in which the vegetable tissue has been only slightly decomposed. Over these areas the soil is light and chaffy, contains some fragments of shells, and gives a slight effervescence when tested with hydrochloric acid. The color of the soil varies from dark-brown to black, being darker in those areas where the vegetable matter has been more thoroughly decomposed. The depth of the soil varies from 2 to several feet. The subsoil of those areas occurring along the streams consists of all grades of light-colored sand and gravel, while that underlying the type on the uplands is composed largely of dark-gray to mottled yellow clay loam or clay, the color here depending upon the depth to which the organic matter extends.

This soil type is not extensively developed in Tippecanoe County, and occurs as small, isolated areas, mostly in the southern and southwestern parts of the county. Along some of the streams the type

marks abandoned channels that have passed the lagoon stage, where the soil has been formed by the long-continued growth and decay of aquatic vegetation. Some of the areas occur at a considerable elevation above the present stream channels, so that it is probable that the moisture necessary to the growth of muck-forming vegetation was supplied by seepage from the bluffs.

The natural drainage is poor. When artificially drained the type is adapted to the production of corn, potatoes, onions, and celery. It is also well suited to rape and timothy and other grasses. Corn is the principal crop grown. On some areas of the type good yields are secured, but on those areas where the soil is light and chaffy, resembling Peat rather than Muck, the crop is poor both in yield and quality and very frequently fails to mature. Oats and other small grains can not be successfully produced, because the large organic-matter content forces the growth of straw at the expense of the grain, and the crops lodge badly.

MIAMI GRAVELLY SANDY LOAM.

The soil of the Miami gravelly sandy loam to a depth of 12 or 14 inches consists of a sticky, heavy coarse gravelly sandy loam. The color varies from light to dark brown, and in some cases is a reddish-brown. The surface is generally covered with considerable gravel, which is seldom more than 1 or 2 inches in diameter. Gravel also occurs distributed through the soil, and as a rule increases in quantity with depth. The greatest quantity is found on the crests of hills and ridges and gradually decreases on the lower slopes.

The soil grades at about 14 inches into a light-brown heavy sandy loam in which there is considerable coarse sand and fine gravel. Small gravel is also found in the subsoil, the size and quantity generally increasing with depth. From 30 to 36 inches below the surface a layer of gravel is encountered which extends to an undetermined depth. Very frequently pockets of coarse sand and gravel occur in the hills and ridges, but these are seldom over a few rods across. On such areas the soil consists of a dark-brown coarse sandy loam to a depth of 10 or 12 inches, below which it grades into sand and small gravel. Below this material the subsoil is composed of alternating layers of sand and gravel, with the gravel gradually increasing in size with depth. Near the base of ridges and along the foot of terrace lines the soil generally becomes sandy and less gravel is found. The sand is also much finer.

The average results of mechanical analyses of fine earth of this type are given in the following table:

Mechanical analyses of Miami gravelly sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13598,14013.....	Soil.....	4 0	22.4	15.1	18.3	7.4	19.9	12.3
13599,14014.....	Subsoil	2.7	20.9	12.6	16.7	9.2	20.0	17.7

The Miami gravelly sandy loam is found on the uplands, principally in the southwestern part of the county, and on well-developed terrace lines along the streams. While occupying different topographic positions, there is little variation in the texture or the crop value of the soil, so far as could be observed in the field.

This soil is of glacial origin. The low hills and ridges which occur to a limited extent were probably formed by the action of ice and probably were at one time covered with loess, which has since been removed by erosion. The soil of the terrace lines is composed of glacial material which has been slightly modified and reworked by stream action. The surface of the type on the terraces is level or gently rolling, while on the uplands occur low, well-rounded hills and ridges. The type in general possesses good natural drainage. In some cases, especially on the more elevated areas, the drainage is excessive and crops do not do well unless there is an abundance of rainfall. The soil has, however, the power of retaining moisture exceptionally well, considering its coarse, gravelly texture. The crops produced do not as a rule suffer from drought as much as those grown on the Sioux sandy loam.

Corn, clover, oats, and wheat are the principal crops. The yields are generally best when the rainfall is quite evenly distributed throughout the growing season. The yield of corn is about 30 bushels, oats 25 bushels, and wheat from 10 to 15 bushels per acre. Clover will yield from 1 to 1½ tons of hay and from three-fourths to 1 bushel of seed per acre.

SIOUX SANDY LOAM.

The surface soil of the Sioux sandy loam consists of a medium to coarse sandy loam with an average depth of about 16 inches. The sand content is quite high and usually increases with depth. The color varies from light to dark brown and in some areas where the soil contains more organic matter the color is somewhat darker. Fine gravel is found on the surface and through the soil. There is no sharp line of demarcation between the soil and subsoil, but the change from one into the other is gradual. At a depth of from 14 to 18 inches the soil grades into a sticky coarse sandy loam or sandy clay

subsoil containing considerable coarse sand and gravel. The gravel content generally increases with depth, and at a depth of 33 to 36 inches a bed of coarse gravel is encountered which extends to an undetermined depth. The color of the subsoil is brown, but it has more of a reddish tinge than the soil. Northeast of Lafayette the soil varies somewhat from its typical formation, containing a smaller amount of gravel and the gravel being finer than is generally the case.

The following table gives the average results of mechanical analyses of samples of this type:

Mechanical analyses of Sioux sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13602,14019.....	Soil.....	2.2	9.8	10.2	28.5	10.3	27.1	11.2
13603,14020.....	Subsoil	3.5	11.5	10.2	30.4	11.6	18.8	13.4

The Sioux sandy loam is an old alluvial soil and is found only where second and third bottoms are developed along the streams. It is most typically developed along the Wabash River and Wildcat Creek and their tributaries. The soil owes its origin to stream action. The coarse material which forms the subsoil was deposited at times when the streams had sufficient velocity to transport coarse sand and gravel. Following the deposition of this coarse material the finer and more loamy material was deposited as the velocity of the streams diminished, thus forming a sandy loam. The surface varies from level to slightly undulating. The level areas generally occur along the border of the terraces and uplands, while near the outer margins of the areas the surface becomes more uneven. In some areas the surface is broken by shallow abandoned stream channels and by streams flowing from the uplands.

Owing to the topographic position of the soil, its open, porous texture, and the fact that it is underlain by sand and gravel, the natural drainage conditions are good. In most cases it is even excessive, and except during seasons of unusually heavy rainfall crops suffer from lack of moisture. The type is never overflowed.

Corn, wheat, oats, and clover are the principal crops grown on this soil. The crop yields are heaviest during wet seasons. The average yield of corn is about 35 bushels, oats about 30 bushels, wheat 12 or 20 bushels, and clover about 1½ tons per acre when raised for hay and 1 bushel when raised for seed. The Sioux sandy loam is well adapted to these crops and is generally recognized as one of the best wheat soils in the county.

SIOUX LOAM.

The soil of the Sioux loam consists of a dark-brown to black loam about 15 inches deep, containing a large percentage of silt, some coarse sand, and a few pebbles or fine gravel. The dark color is due to the large amount of organic matter present. The subsoil is a brown or reddish-brown loam of about the same texture as the soil and is underlain at an average depth of 2 feet by a bed of gravel many feet in depth, which constitutes the chief material of the river terraces. In some places this gravel comes to the surface, and these small areas are of low agricultural value.

The only area of this type occurs upon the high terrace immediately southwest of West Lafayette. The State University farm is located upon it. The surface is nearly level, but the underlying gravel bed gives thorough underdrainage. In fact, the lower subsoil is so open and porous that water readily passes through it, causing crops to suffer quickly from drought. The large amount of organic matter present in the soil assists greatly in the retention of moisture, thus diminishing the damage from this cause.

This soil type consists of glacial material reworked by the swollen streams at the close of the Glacial epoch. The sand and gravel were laid down by swift currents, but when the water began to subside finer material was deposited, giving rise to the thin layer of loam over the coarser sand and gravel.

The yields upon this type depend very largely upon the rainfall and the depth to the underlying gravel. Where the layer of loam is 2 feet or more deep large yields are secured in seasons of abundant rainfall. A drought at the critical period in the growth of a crop causes a very decided decrease in the yield.

A sample of this soil taken from the university farm, 20 rods south of the experiment station building, was studied by the paraffined wire-pot method to learn something of its manurial requirements. The soil is a dark-brown or black loam. It contains some coarse sand, and a few pebbles and fine gravel are found on the surface, while the subsoil is of a gravelly nature. The field from which the sample was taken has been in corn continuously for the last twenty-five years without the use of manure or other fertilizer.

The results obtained indicate that a large increase in production may be obtained by the use of stable manure; that nitrate of soda and sulphate of potash will give a small increase; while only a very small increase may be obtained by the use of any other form of fertilizer tried. Lime alone or with cowpeas or acid phosphate slightly diminished the yield.

In these tests wheat plants were used as an indicator, and the results are held to be applicable only to this crop and to the particular field from which the sample was taken, but they are believed to apply in a general way to this soil throughout a large part of the area.

SIOUX SILT LOAM.

The soil of the Sioux silt loam consists of a dark-brown or black friable silt loam with an average depth of 15 inches. It contains a very large percentage of organic matter which gives the dark color. The subsoil consists of a yellowish heavy silt loam or clayey silt, containing brown iron stains and some iron concretions. At a depth of from 3 to 6 feet the silty deposit is underlain by coarse sand and gravel, which extends to a depth of many feet.

The Sioux silt loam occupies only a small percentage of the area, the only occurrence being found upon the high terraces along the Wabash River and is covered almost entirely by West Lafayette. The surface features of the type are gently rolling or undulating. The underlying gravel bed insures good drainage.

The soil was probably formed at the same time that the loess or silt was deposited upon the uplands. The underlying gravel beds were laid down by the swollen streams at the close of the glacial period.

The Sioux silt loam is a strong, fertile soil, easily cultivated and capable of large yields of general farm crops. The greater part of the type, however, is covered by West Lafayette, and very little therefore is under cultivation.

AGRICULTURAL METHODS.

The cultural methods generally practiced in the county apply almost exclusively to the production of corn, oats, and wheat. On many farms, particularly those on the Marshall loam areas, no wheat is grown, and corn, oats, and some clover are the principal crops.

In the preparation of the land for corn about 5 inches is the usual depth for both spring and fall plowing. In some cases, especially if the land has been in corn the preceding season, the disk harrow is used to stir up the ground, after which the peg-tooth harrow is used for pulverizing and leveling the soil. Some farmers drill their corn, but the general practice is to plant with a check rower and cultivate both ways. Shallow cultivation is the general rule, although deeper cultivation is frequently necessary in wet seasons when weeds are especially troublesome. On a few farms a part of the corn crop is cut for ensilage, while on a larger number it is cut, usually with a corn binder, shocked, and husked by hand. These methods are not widely practiced, however, as probably more than 90 per cent of the corn is husked from the standing stalks.

Oats are generally sown broadcast over the corn land and a disk harrow used to loosen the surface and cover the seed. In some cases the land is harrowed after disking. When the oats mature they are cut with self-binders and thrashed from the shock.

Winter wheat is a somewhat uncertain crop in regard both to yield and quality. Many farmers, particularly those located on the light-

colored soils, continue to grow this grain, because it alternates easily with either corn or oats and clover, making an excellent nurse crop for clover and affording a needed change in the crop series. Some farmers drill their wheat in the cornfield between the rows of stalks, using a one-horse drill for this purpose. This method is satisfactory if the ground is free from weeds and the seeding is done somewhat earlier than if sown on open land. A large proportion of the wheat grown is sown on land that has been in oats the previous season. Soon after the oat crop has been removed the stubble land is plowed to a depth of 4 or 5 inches and well harrowed. The seed is drilled in, usually during the last two weeks in September. It has been observed that the best fall growth is obtained when the seed bed is prepared as early as practicable. This is probably due to the fact that the soil moisture is thus conserved, usually a very necessary factor at this season of the year.

Timothy and clover are quite extensively grown for hay. On the typical prairie soils, particularly the Marshall loam, clover is sown with oats, as wheat can not be grown on this soil; but on the lighter soils wheat is preferable with clover, because it draws less upon both the moisture content and the available plant food of the soil, and consequently there is less danger of the clover doing poorly after the nurse crop has been removed. The first crop of clover is cut for hay, but if the second crop promises a good yield of seed it is allowed to ripen and is thrashed.

There are practically no farms upon which a systematic rotation of crops is practiced. In certain parts of the county, however, it has been found unprofitable to grow the same crop continuously for any considerable length of time upon one field. In such cases the rotation considered by the farmers as best adapted to the soil is one or possibly two years of corn and one year of oats or wheat. If oats are grown, they are followed by wheat, used as a nurse crop for clover. In some cases the oat crop is omitted and the rotation practiced is one year of corn, one year of wheat, and one year of clover. On the heavier soils corn and oats, with an occasional crop of clover, is the rotation generally practiced. Many farmers grow corn as long as possible, the land being planted to this grain for three or four seasons, and then one crop of oats is raised. In some cases the farmers alternate corn and oats from year to year. In either case clover is generally introduced once in four or five years. The limited quantity of barnyard manure on hand is usually applied to land intended for corn. Commercial fertilizers have been tried in some parts of the county, but their use is not becoming general.

AGRICULTURAL CONDITIONS.

During the last five years there has been a marked increase in the valuation of farms in the county. This is due in part to the advance in the average price of agricultural products and the comparatively high rents which good lands readily command. The valuation of farm lands and implements according to the census of 1900 was $16,023,930. The majority of the land owners are in prosperous circumstances, but as much can not be said of the tenant class, who enjoy a comfortable living, but are not, as a rule, acquiring much property other than their teams, farming implements, and a limited number of cows and hogs. In the last fifteen years many of the farmers have moved to town and now live upon the rent received from their land. In every neighborhood the number of tenant farmers is increasing. A good many men who own and live upon large farms rent most of their tillable land, and thus avoid the employment of hired help and the details of farm management. More than one-half of the individual farms and a large proportion of the cultivated lands are operated by tenants. According to the census of 1900 only 44.6 per cent of the farms of the county were operated by owners.

The usual rent paid is one-half the crop, and in most cases the tenants deliver the grain at the elevators. Some landlords also exact a fixed cash payment for the use of the house and other buildings. The cash rent for good land varies from $4 to $5 an acre. The average size of farms for the county is 118.7 acres. In those parts of the county which were formerly timbered the farms are generally smaller than on the prairies. There are a few large holdings of 1,000 acres or more, but these consist of separately managed farms.

How to secure necessary farm labor is a very serious problem with the farmers of Tippecanoe County, and the difficulty of solving it is largely responsible for so many of them renting their lands and moving to town to live. About $270,500 is paid out annually for labor. A farm hand receives from $22 to $25 a month, with board for himself and a horse if he wishes to keep one. Three cents a bushel is paid for husking corn, and wages for other kinds of work are seldom less than $1.50 a day.

There is considerable difference in the agricultural value of the different soil types. The Marshall loam and the Marshall silt loam are the best corn soils and are worth from $90 to $125 an acre. The level areas of the Marshall fine sandy loam approach these heavier soils in value, but some of the sandy phases of this type and those which have a gravelly subsoil are rated somewhat lower on account of their susceptibility to drought.

The topography of the Miami silt loam usually determines its agricultural value. Broken areas along streams are commonly used for

pasture, and some areas are in timber. The level areas have a market value somewhat lower than similarly improved farms of the Marshall loam and Marshall silt loam.

On the Miami fine sand and the Wabash fine sandy loam melons, small fruits, and early truck are successfully grown for the home market. Some of the Miami gravelly sandy loam and much of the Miami silt loam is adapted to apples, pears, and peaches. The poorer quality and lower yields of these fruits, compared with those reported a few decades ago, are doubtless due to causes other than those which may be attributed to the soil. The orchards are usually located without regard to the slope of the land or protection from wind, while the study of varieties adapted to this locality and the necessary care of the trees are almost wholly disregarded.

The variety of soils in the county affords opportunity for a diversity of products, but the tendency toward the exclusive production of grain is shown by the fact that the annual acreage of corn—approximately 100,000 acres—is 30 per cent greater than it was twenty years ago. The area now devoted to oats is about 50,000 acres, or nearly five times as much as it was two decades ago. The acreage of wheat varies from year to year, but is steadily decreasing.

With the exception of wheat, which often fails to mature well, the quality of the grain is generally good. Much of it, however, fails to grade well on the market on account of being damaged before leaving the farm. Oats and wheat usually remain in the shock until they are thrashed, and a great deal of corn, especially on the rented farms, is carelessly cribbed.

All of the wheat and nearly all of the oats are shipped out of the county. Of the 3,250,000 bushels of corn annually produced, about 65 per cent is sold at the elevators.

The comparative ease with which these cereals can be grown and harvested with the aid of machinery and the sure returns they afford commend them to both the landowners and the tenants. This system of farming is recognized as exhaustive of the soil, but clover is considered an easily introduced restorative. Too much dependence, however, is being placed upon this legume. Generally the first crop is cut for hay and the second is harvested for the seed, so that most of the vegetable matter above ground is removed from the field. While the nitrogen supply is reasonably well maintained, very little humus is added to the soil. The physical condition of all the upland types, excepting recently drained areas, is not so good as formerly. More labor and better methods are required to keep the soils in good condition during the growing season.

On the average farm the amount of manure produced is small as compared with the acreage of land cultivated. This is due to the small number of cattle usually kept. Cattle feeding has greatly

declined of recent years, and dairying has not been developed to any extent except in the neighborhood of Lafayette. The number of cows a tenant can keep is restricted by the high rate of rent for pasture, while the farmers living on their own land usually sell most of the young stock. This limits the acreage of clover, which can be utilized profitably for pasture. The total acreage of this crop in the county has decreased during the last ten years. Since there is a good market at Lafayette for oat straw, a great deal of this roughage is sold direct from the farms.

Under present conditions there is an increasing tendency to adopt methods of farming which make slight returns to the soil. The results are already apparent in the case of many rented farms. The most of the farmers living on their own land would adopt more diversified lines of farming, especially dairying and stock raising, were it not for the high cost and unreliable nature of most of the hired labor which can be secured. This is a serious difficulty, with apparently no prospect of immediate improvement.

Stock raising is a profitable business wherever the owner gives it his personal attention. Most of the corn now consumed in the county is fed to hogs. On most of the farms the income from this source is greater than that received from the sales of all other kinds of live stock. There are a number of farmers who devote much attention to stock breeding. Some well-bred herds of cattle and flocks of sheep are to be seen, and some excellent horses are raised.

Lafayette furnishes a good market for most of the produce grown in the county. The Wabash, the Lake Erie and Western, the Chicago, Indianapolis and Louisville, and the Cleveland, Cincinnati, Chicago and St. Louis railroads pass through the county and afford good shipping facilities to Chicago, St. Louis, and the East. The Toledo, St. Louis and Western Railroad crosses the southeastern corner of the county. There are 17 elevators in the county, located at various points on these lines. There are also two interurban electric railroads now in operation. The county roads are excellent. All of them are well graded, and more than 1,000 miles of roadway have been surfaced with gravel.

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