

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE STATE OF INDIANA DEPARTMENT OF
GEOLOGY, EDWARD BARRETT, STATE GEOLOGIST.

SOIL SURVEY OF BENTON COUNTY, INDIANA.

BY

GROVE B. JONES, OF THE U. S. DEPARTMENT OF AGRICULTURE,
IN CHARGE, AND J. BAYARD BRILL, OF THE
INDIANA DEPARTMENT OF GEOLOGY.

W. E. McLENDON, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1916.]



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS,

Washington, D. C., April 11, 1917.

SIR: Field operations of the Bureau of Soils for 1916 included a soil survey of Benton County, Ind., undertaken in cooperation with the State of Indiana Department of Geology. The selection of Benton County was made after conference with State officials.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1916, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Benton County sheet, Indiana.

SOIL SURVEY OF BENTON COUNTY, INDIANA.

By GROVE B. JONES, of the U. S. Department of Agriculture, In Charge, and J. BAYARD BRILL, of the Indiana Department of Geology.—Area Inspected by W. E. McLENDON.

DESCRIPTION OF THE AREA.

Benton County, Ind., is the third county south of Lake Michigan. It is bounded on the north by Newton and Jasper Counties, on the east by White and Tippecanoe Counties, on the south by Warren County, and on the west by the State of Illinois. It is rectangular in shape, 23 miles long, east and west, and 18 miles wide, and has an area of 408 square miles, or 261,120 acres.

The surface is gently rolling. Gravel Hill, near Fowler, is the highest point in the county, having an elevation of 857 feet above sea level, while the lowest land is along the eastern, southern, and western borders, where the altitude ranges from about 700 to 765 feet above sea level. The slopes are long and gentle, expanding into broad stretches of undulating prairie.

The natural drainage of the county is through small streams which have their headwaters within its boundaries. Pine Creek, the largest stream, drains the eastern part, Sugar Creek the northern, Mud Pine Creek the southern, and Mud Creek the western. The natural drainage is immature, and overflow or bottom lands are of small extent. The natural drainage has been supplemented by ditches which have been constructed throughout the county. The largest of these are from 4 to 8 feet deep and 7 to 12 feet wide, giving an adequate outlet to the smaller ditches and underground drains of the individual farms.

The first settlements in Benton County were made about 1830, and the county was organized in 1840. The population of the county is small, being reported in the 1910 census as 12,688. All the population is classed as rural. The average density is 31.1 per square mile.



FIG. 1.—Sketch map showing location of the Benton County area, Indiana.

In the western and northwestern parts of the county the land is held in large tracts. In the southern and eastern parts it is divided into smaller farms, and these sections are more thickly settled. Fowler, situated near the center of the county, is the largest town and the county seat. It has a population, according to the census of 1910, of about 1,500. Other towns are Oxford, Boswell, Otterbein, Ambia, Talbot, and Swanington in the southern part and Earl Park, Freeland Park, Raub, and Wadena in the northwestern and northern parts of the county. These, with many smaller towns and railroad stations, are commercial centers for their respective localities. In the northeastern part of the county there are no towns or villages, and trading is carried on through Remington and Goodland to the north.

All parts of the county except the northeastern section are well supplied with transportation facilities. The Cleveland, Cincinnati, Chicago & St. Louis (main line of the Big Four) crosses the county diagonally southeast and northwest. The Chicago & Eastern Illinois crosses the center of the county, and the Danville Branch of the New York Central the western part, both in a north-and-south direction. These three railroads furnish direct transportation to Chicago. A branch of the Chicago & Eastern Illinois connects Freeland Park with Milford, Ill. The Lake Erie and Western extends east and west through the southern part of the county, about 2 miles north of the Warren County line. Benton County has no electric lines. Chicago, Indianapolis, and Lafayette are the principal markets.

Good roads cover all parts of the county. There are over 425 miles of road surfaced with crushed limestone and gravel, and further improvement is made each year.

The county is well supplied with schools. The towns and villages have good high schools, and the schools of some of the rural districts have been combined and are known as union schools. Telephone service and rural mail routes reach all parts of the county.

CLIMATE.

Wide variations in temperature are characteristic of the climate of Benton County. The precipitation is fairly well distributed throughout the year, but droughts sometimes injure crops, unless care is taken to employ proper methods of cultivation. The mean annual precipitation is about 39 inches, and the mean annual snowfall about 23 inches. The annual temperature averages about 51° F. The average date of the last killing frost in the spring is April 26, and of the first in the fall October 8, which gives a growing season of 165 days. The latest date of killing frost recorded at Lafayette is May 27, and the earliest September 14.

The data in the following table, compiled from the records of the Weather Bureau station at Lafayette, Tippecanoe County, are representative of the general climatic conditions in Benton County:

Normal monthly, seasonal, and annual temperature and precipitation at Lafayette, Tippecanoe County.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1914).	Total amount for the wettest year (1909).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	29.3	69	-17	2.58	2.54	3.06	3.5
January.....	25.4	70	-33	2.47	2.30	2.69	7.0
February.....	26.7	69	-26	2.79	2.17	4.70	6.3
Winter.....	27.1	70	-33	7.84	7.01	10.45	16.8
March.....	38.3	87	- 5	3.09	1.57	2.33	4.4
April.....	50.4	89	10	3.37	2.82	6.66	.4
May.....	61.2	97	25	4.41	2.30	4.88	T.
Spring.....	50.0	97	- 5	10.87	6.69	13.87	4.8
June.....	70.7	100	33	4.47	1.60	7.34	0
July.....	74.5	105	42	3.79	.28	3.80	0
August.....	72.6	102	39	3.32	4.87	6.77	0
Summer.....	72.6	105	33	11.58	6.75	17.91	0
September.....	66.0	101	29	2.87	1.90	3.67	0
October.....	53.3	92	16	2.37	1.61	2.90	T.
November.....	39.7	95	- 1	3.06	1.09	4.28	1.2
Fall.....	53.0	101	- 1	8.30	4.60	10.85	1.2
Year.....	50.7	105	-33	38.59	25.05	53.08	22.8

AGRICULTURE.

Almost all Benton County consists of productive soil, the only areas unsuited to agriculture being the narrow strips of overflow land along the larger streams.

Settlement was first made in this region about 1830 along Pine Creek. Later settlement spread to other forested sections. Small fields were planted to corn and potatoes, and a little later wheat and broom corn were introduced. Cattle raising early became the principal industry, the vast stretches of prairie affording excellent pasturage. About 1845 settlement began to encroach upon the higher parts of the prairie sections, the settlers making use of small open and "mole" ditches for drainage, but it was not until about 1875 that tile

drainage was resorted to and the reclamation of the wettest lands was begun.

At present the predominant type of agriculture is grain farming. Corn and oats have always been the leading crops. The following table shows the acreage in the principal crops as given in the census reports for 1880, 1890, 1900, and 1910:

Year.	Corn.	Oats.	Wheat.
	<i>Acres.</i>	<i>Acres.</i>	<i>Acres.</i>
1879	98,455	12,962	3,528
1889	84,305	52,400	717
1899	110,057	73,343	67
1909	109,864	83,897	681

Corn and oats are the chief money crops, and in 1910 these two grains occupied about 75 per cent of the total acreage in crops in the county. Grain dealers give 6,000,000 bushels as a conservative estimate of the amount of these grains delivered at the elevators annually. To this must be added the amount fed on the farms, giving a large total production. All the soils are very productive and grow these grains profitably. Some farmers state that corn yields are heavier on the darker soils, but that the quality is better on the lighter Miami soil. The average yield throughout the county is about 37 bushels per acre, though the yields range from about 20 to 75 bushels.

Benton County grows more oats than any other county in Indiana, and produces one-fourteenth of the total oat crop of the State. In 1915 about 5,000,000 bushels were produced on 87,385 acres. The yield was unusually high, averaging 60 bushels per acre over the entire county, largely because of the wet season. From year to year the yields range from 20 to 60 bushels per acre, with an average of about 33 bushels.

While it is possible to grow wheat on the better drained soils of the county, its production has declined until very little is grown.

Few attempts are made to grow wheat on the prairie soils because of the loss through winter-killing by heaving.

The growing of clover is increasing. The best stand is obtained where the ground is carefully prepared and the clover sown alone in July or August. This method is not extensively followed, however, the general practice being to sow or drill the clover with oats and to let it stand a year before again planting the land to corn. Where grown for seed the average yield is about 1 bushel per acre. A few farmers grow Mammoth clover for plowing under to enrich the land.

Little rye is grown. Millet is often sown where the corn has been drowned out, and is cut for feed. Rape is sometimes sown with oats for pasturage.

Alfalfa was first grown in the county about 10 years ago, but it is only within the last 3 or 4 years that much interest has been shown in this crop. As little live stock is raised, alfalfa is not greatly needed as feed.

To grow alfalfa successfully most of the soils in the county require applications of barnyard manure, and about 2 tons of crushed limestone per acre to correct their acidity. The land is plowed in the early spring and worked down to a good seed bed, and the seed is sown about the middle of July or the first of August. If the weeds are carefully kept out three cuttings may be obtained the second year with a total yield of 4 to 5 tons per acre. It is recognized that the growing of this crop is beneficial to the soils.

Hay is an unimportant crop. In 1909, 12,191 acres were devoted to tame and cultivated grasses, producing a little over 1 ton to the acre. This is fed on the farm, but is not sufficient to supply the local demand. Many farmers supplement the hay with oat straw.

Potatoes and other vegetables are grown for home use, but not commercially. Nearly every farm has a small orchard of apple and a few pear, peach, and cherry trees.

In the cultivation of corn, where it follows clover or oats, the prevailing method is to plow the field in the fall, but if it follows corn, the plowing is left until spring. The ground is then worked down with disk and spike-tooth harrows until the seed bed is in a firm but mellow condition. If the season permits, corn planting is begun the first of May, and the crop is given from 3 to 6 or more cultivations, with the common corn cultivator. Most of the corn is husked from the standing stalk, shelled, and hauled to the elevators. Very little is cut and shocked, and consequently the stover is lost. If more live stock were raised and the stover used as feed, this loss could largely be eliminated. During the last few years there has been an increase in the number of silos and in the proportion of the corn cut for ensilage. Modern methods are followed, and where formerly the corn was put into the silos while still green, it is now allowed to ripen until the kernels are rather hard and the husks partially dry. Soy beans are often sown with the corn, making the ensilage a more balanced ration. A good practice sometimes followed is to hog down the crop. Turning hogs into the corn not only enriches the soil but also saves the labor of husking. Soy beans planted with the corn make good feed and increase the productiveness of the soil. Reids Yellow Dent, Leaming, and Boone County White are the leading varieties of corn planted.

Various methods are used in the cultivation of the oat crop. Some disk the stubble land once, sow the oats broadcast with an end-gate seeder at the rate of 3 to 3½ bushels per acre, and then disk again, following this with the spike-tooth harrow. Others sow the oats

and then double disk, but this has proved inadvisable, as some of the seed is too deeply covered. The best method seems to be to double disk the stubble land, then harrow, and drill in the oats, using about $2\frac{1}{2}$ bushels of clean seed to the acre. In 1915 smut reduced the yield of oats about 11 per cent, but farmers now commonly treat the seed with formaldehyde and loss from this disease is decreasing.

The rotation commonly practiced in the county is corn and oats, with clover sometimes sown with the oats and allowed to stand a year, making a three-year rotation. Very little commercial fertilizer is used, probably not more than 15 carloads a year in the entire county. All the manure available is applied to the land, but because of the large acreage under cultivation and the scarcity of stock, especially on rented farms, the supply falls far short of the need. The lighter colored soils or "clay" lands are greatly benefited by the application of a fertilizer containing 1 per cent nitrogen, and 10 to 12 per cent phosphoric acid, and the black prairie soils by the use of fertilizer containing as much as 8 per cent potash and 10 to 16 per cent phosphoric acid. When used on corn about 75 to 150 pounds per acre of these mixtures is applied. Where the growing of alfalfa is attempted it is advisable to use 2 tons of crushed limestone per acre, and also barnyard manure. The growing of clover, soy beans, and other legumes as green manuring crops should be extended.

Hog raising is the most important branch of live-stock farming, and the industry is increasing. Oak Grove Township leads in the number raised, and in 1915 reported 4,075 hogs. The entire county produces between 35,000 and 37,000 each year.

Cattle raising formerly was the main industry of the county, but is now relatively unimportant. A few farmers buy feeders at Chicago or Kansas City in the early fall and place them on the market in the spring or following fall.

There are three small commercial dairies in the county, which supply products for the larger towns. Some cream is shipped out of the county, but dairying is relatively unimportant, and there are no creameries.

Some sheep are shipped in from the Northwest and fattened for market. On the large land holdings, which are farmed by tenants, there is little live stock of any kind. The breeding of purebred cattle, mainly Herefords and Shorthorns, has been undertaken by a few farmers. In general the class of stock is improving. The county has produced some valuable race horses, including Dan Patch.

The following table, compiled from the 1910 census, gives the value of all farm products of Benton County, arranged by classes:

Cereals.....	\$3, 550, 061
Other grains and seeds.....	461
Hay and forage.....	146, 986

Vegetables.....	\$51,053
Fruits and nuts.....	21,269
All other crops.....	6,891
Live stock and products:	
Animals sold and slaughtered.....	1,014,856
Dairy products, excluding home use.....	68,756
Poultry and eggs.....	157,550
Wool, mohair, and goat hair.....	2,932
Total value.....	5,020,806

The following table gives the number of domestic animals sold or slaughtered, as reported in the 1910 census:

Total value.....	\$5,020,806
Other cattle sold or slaughtered.....	5,523
Horses and mules sold.....	1,580
Swine sold or slaughtered.....	27,382
Sheep and goats sold or slaughtered.....	7,713

The 1910 census reports the average size of farms as 198.4 acres. There are several estates of 1,000 to 6,000 acres or more. Of the total area of the county, 96.6 per cent is reported in farms, and of the farm land 97.3 per cent is reported improved.

The 1910 census reports 53.7 per cent of the farms operated by tenants. The land is rented mainly on the share basis, the owner receiving one-half the grain, delivered at the elevators. Cash rent varies from \$5 to \$12 an acre, about \$8 being the average.

There is a marked contrast between the buildings on farms operated by the owners and those on farms operated by tenants. On the latter there are few buildings, usually only a house and barn, and these are very small. Throughout the county there is a lack of adequate storage space for hay.

Modern farm machinery is in common use. A number of tractors are used.

Farm labor, which is mainly American, is scarce and generally inexperienced. Monthly wages vary from \$25 to \$30, with board, for single men, and from \$30 to \$40, with the use of a house, for married men. For corn husking laborers are paid by the bushel, single men receiving 3 to 3½ cents, with board, and the laborers with families 1 cent more per bushel without board.

Land values are high. Farms on the Miami soil sell for about \$150 an acre, while the price of prairie land ranges from about \$200 to \$250 or more.

SOILS.

The soils of Benton County are derived from glacial drift and from water-laid deposits of glacial and more recent age. The drift material, which consists of an unassorted mixture of sand, gravel, clay, and bowlders, was deposited by the late Wisconsin ice sheet upon

the uneven surface of the bedrock, and it ranges in depth from a few feet to 260 feet or more. The deposits of greater depth, as shown by well borings, are found along the eastern boundary of the county in an area following approximately the present course of Pine Creek to within 3 miles of the southern boundary and crossing to the southwestern corner of the county. This evidently was at one time a deeply eroded valley, now filled with glacial *débris* to the level of the surrounding country.

According to the Indiana Geological Survey, the rock formation underlying the glacial drift consists of shale and sandstone, with some limestone. The New Albany shale, of Devonian age, occurs beneath the till in the northeastern corner of the county and is the oldest of the underlying rock formations. Above this is the Knobstone shale of the Lower Carboniferous, which underlies a large part of the eastern half of the county. The only rock exposure in the county is found along the dredged channel of Pine Creek, in sec. 24, Pine Township, and is of this formation. The rocks underlying the western half of the county belong to the Coal Measures and consist mainly of the Meron sandstone with a little Coking coal and Mansfield sandstone in the southwestern corner.

These various rock formations, however, are in general so deeply covered by the unconsolidated glacial drift as to have no direct influence upon the soils. The surface soil throughout the county is of silty texture and with the exception of small alluvial areas along the streams is the result of the weathering of the underlying till. The different kinds of soils recognized are due mainly to the different conditions under which this till has been weathered.

A large part of the county was formerly treeless and the soils developed, therefore, under prairie conditions giving rise to extensive areas of dark-colored soils. Parts of the area were also poorly drained. Light-colored forest soils occur only along the natural drainage ways. Even the ridges throughout the prairie lands, which have the external appearance of moraines, have dark surface soils.

The Carrington soils are the result of the weathering of the glacial till under prairie conditions. The surface soils are dark brown to black, and the subsoils are of lighter color, usually light brown to yellowish. The topography is nearly level to rolling. The silt loam is the only member of the series mapped in Benton County.

The surface soils of the types included in the Brookston series are dark brown or dark brownish gray, and the subsoils mottled yellow and gray, the yellow predominating. The upper subsoil may be dull gray in color, but as a rule the color brightens with depth, and at 18 to 24 inches is almost a solid yellow or yellowish brown. Partially weathered, very friable and loose calcareous till is encountered at a depth of 27 to 36 inches. The topography is level to very gently

undulating, and the natural drainage is imperfect. These soils have resulted from the weathering of till under prairie conditions where the drainage is less perfect than in the areas of the Carrington soil.

The types of the Miami series have brown, light-brown, or grayish soils, and heavier textured subsoils of yellowish-brown color, sometimes streaked with iron stains and slightly mottled with gray. The topography is gently undulating to rolling, and the drainage usually is good. The soils are derived through weathering of glacial till of a generally calcareous nature. The silt loam is the only type of this series encountered in Benton County.

The Clyde series includes types characterized by dark-brown to black surface soils and gray, drab, or mottled gray and yellow subsoils. They have been formed in depressed areas where very poor drainage conditions have prevailed, resulting in the accumulation of considerable quantities of organic matter. The series is represented in Benton County by a single type, the silty clay loam.

The types included in the Wabash series have dark-brown to black soils, containing a high percentage of organic matter, and drab to gray subsoils. This series is typically developed in the first bottoms of streams of the Central Prairie States, and the material is derived mainly from the associated soils of the uplands. It is not extensive in Benton County, and is represented only by the silt loam type.

Muck includes areas, originally or at present poorly drained, in which accumulations of vegetable remains have produced a soil in large part organic.

The following table gives the name and actual and relative extent of each soil type mapped in Benton County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Brookston silt loam.....	168,704	64.6	Wabash silt loam.....	2,560	1.0
Carrington silt loam.....	70,016	26.8	Muck.....	704	.3
Clyde silty clay loam.....	11,264	4.3			
Miami silt loam.....	7,872	3.0	Total.....	261,120

CARRINGTON SILT LOAM.

The surface soil of the Carrington silt loam is a brown or dark-brown, mellow silt loam, 10 to 15 inches deep. The subsoil is a brown silt loam, passing at about 16 to 20 inches into a yellowish-brown heavier silt loam. This in turn is underlain by a yellowish-brown silty clay loam, which is gritty below about 30 inches. Below the 3-foot section boulder till containing sand and gravel is encountered. This material is friable and moderately calcareous.

The variations in shade of the brown and yellow of both the soil and subsoil are due to differences in elevation and natural drainage. On the crests of the higher ridges the organic-matter content is lower than in the typical soil, and the color approaches that of the Miami types. These areas, however, as well as a few forested areas are included with the Carrington silt loam because the organic-matter content is higher than the average for the Miami soils. This condition obtains chiefly in the vicinity of Oxford and in sections 34, 35, and 36, Parish Grove Township. In a few small areas, notably in the northern part of the county, the surface soil is more sandy or loamy than usual, but on account of their small extent such areas can not satisfactorily be shown separately on the soil map. A few large boulders were originally scattered over the surface of the type, but most of these have been removed.

The topography varies from undulating to moderately rolling. The drainage conditions vary in different localities, depending largely upon the topographic features. In the more rolling areas natural drainage is fairly well established. It is not perfect, however, and tile drains are found to be highly beneficial. Over the more nearly level areas artificial drainage is necessary for the production of good crops.

Practically all the Carrington silt loam is under cultivation. A small part is in farm woodlots, and a few natural groves are used as pastures.

This type is well suited to the production of corn and oats, and has been devoted almost exclusively to these crops for a number of years. The yields vary considerably, but the average for each is about 40 bushels per acre. Over much of the type these two grains have been grown continuously, and the yields at present are said to be lower than formerly.

Clover and timothy are grown to some extent, and their acreage is being extended, especially on farms where the number of live stock is increasing. Clover commonly is sown with oats, though it is said that a better and more certain stand is obtained where seeded alone, in July or August.

Alfalfa is grown successfully, but the acreage in this crop is small. Three cuttings are obtained each season, giving a total yield of 4 to 5 tons per acre. The application of burnt lime or crushed limestone and careful preparation of the seed bed, especially with a view to eliminating weeds, are essential in obtaining a good stand.

Soy beans and sweet clover do well on this soil. Wheat and rye are rarely grown. Potatoes do well, but this crop, as well as other vegetables and fruit, is grown only for home use.

Commercial fertilizer is not commonly used. It is sometimes applied to corn, with increased yields. All the available stable manure is applied to the soil, but the supply is usually inadequate.

The rotation most commonly practiced consists of corn one year and oats one year, sometimes followed by clover one year. Land values on this type range from \$200 to \$250 or more an acre.

The organic-matter content of this type should be maintained, preferably by the addition of manure. The same object may be attained by growing clover, soy beans, and alfalfa, and occasionally turning a crop under. The use of these crops will also increase the nitrogen content of the soil. More live stock could be raised to advantage.

BROOKSTON SILT LOAM.

The surface soil of the Brookston silt loam consists of a very dark brown silt loam, having an average depth of about 14 inches. The subsoil, to a depth of about 28 inches, is a grayish-brown silty clay loam. It shows faint mottlings of yellow, which become more pronounced with depth. The remainder of the 3-foot section is a mottled brown, gray, and yellow friable silty clay loam or clay loam, which is decidedly gritty below about 30 inches. The substratum is a moderately calcareous till, which extends to an undetermined depth. Small partially decomposed iron concretions occur throughout the subsoil. Small areas of both the Carrington silt loam and the Clyde silty clay loam are included with this type.

The topography is flat to gently undulating. On this account and also because of the dense nature of the subsoil, the natural drainage is not well developed. Tile drains and open ditches are common.

This is the most extensive soil in Benton County, covering nearly 65 per cent of its area. Practically all the type is under cultivation, being devoted almost entirely to the growing of corn and oats. The yields of these crops are nearly the same, averaging about 40 bushels per acre. Clover does well, and where the water table is at least $2\frac{1}{2}$ feet below the surface alfalfa succeeds. Many of the larger farms of the county are situated on this type, and it is not uncommon to see fields of corn or oats covering several hundred acres.

Fall plowing is extensively practiced where oat stubble is prepared for corn. The average depth of plowing is about 6 inches. Commercial fertilizers are not in general use. In a few instances 75 to 100 pounds of a mixture containing phosphoric acid and potash in varying proportions is applied to corn land. Owing to the present high price, very little potash is used.

A few farmers grow soy beans with corn for ensilage and also for fattening hogs. The acreage in soy beans is increasing gradually. Some rape is sown with oats for sheep pasturage.

Legumes should be grown and manure used more extensively in order to maintain the organic-matter supply of this soil. Ground

limestone applied at the rate of 3 to 5 tons per acre has proved highly beneficial to land of this character in other sections, and it is believed that liming would prove beneficial in Benton County.

Land values range from \$200 to \$250 an acre, but at present very little land of this type of soil is on the market. In 1915 one farm near Fowler sold for \$266 an acre.

MIAMI SILT LOAM.

The surface soil of the Miami silt loam, to a depth of 6 to 10 inches, is a gray or brownish-gray, friable silt loam. The soil usually is free from stone and gravel, and contains a considerable percentage of very fine sand. The subsoil is a yellow or mottled yellow and gray slightly heavier silt loam, which at a depth of 15 to 20 inches grades into yellowish-brown, slightly mottled, silty clay loam. Below this the material consists of a brownish moderately calcareous till, in which the percentage of sand and gravel increases with depth.

This soil closely resembles the Carrington silt loam in texture, but it is easily distinguished from the latter by its lighter color, which is the principal basis of separation. The Miami silt loam as a whole is deficient in organic matter. Along the contact with the Carrington the surface soil is somewhat higher in organic matter and more productive than elsewhere. This condition is found in the northern part of the areas along Pine and Mud Pine Creeks, and the soil gradually becomes darker as it extends away from the stream channel.

The surface of most of this type is undulating, and the natural drainage is good. Along Mud Pine Creek the surface is more rolling and the slopes steeper than usual in Benton County. It is in this area that the soil is most typically developed.

The Miami silt loam is not an extensive type in the present survey, but it occupies nearly one-third of Warren County, which lies to the south. The type owes its origin to the weathering of calcareous till. It embraces the greater part of the originally timbered area of the county. At present some hickory, bur oak, red oak, white oak, and walnut are found growing upon it.

The Miami silt loam is easily tilled, and artificial drainage is less necessary than on any of the other soils in the county, though tile drainage frequently improves its physical condition. It is devoted to the same crops as the Carrington silt loam, but the yields of corn and oats are somewhat lower. The yields are higher in wet seasons than in dry and are frequently decreased by drought. This type is generally recognized as the best soil in the county for wheat, and where good cultural methods are followed yields of 18 to 35 bushels per acre are obtained. Clover does well, and some rye is grown for pasturage. While the yields of the cereal crops, except wheat, usually are

somewhat lower than on the more productive prairie soils, farmers generally state that the quality of the grain is superior.

Practically the same cultural methods are followed as on the prairie soils, except that little fall plowing is done, because of the tendency of the soil to wash during the winter.

Liberal applications of stable manure increase the productiveness of this type, being especially effective in improving the physical condition of the soil and increasing its power to hold moisture. The use of the mineral fertilizers usually results in increased yields. Applications of finely ground limestone at the rate of 1 to 3 tons per acre also have proved beneficial.

The price of land of this type ranges from \$135 to \$150 an acre.

CLYDE SILTY CLAY LOAM.

The surface soil of the Clyde silty clay loam consists of a dark-gray or black silty clay loam about 10 inches deep, underlain by a drab or gray, plastic silty clay, which becomes mottled with pale gray and yellow with increase in depth. There are some variations in the type, due largely to the different degrees of drainage. In the more poorly drained areas there has been a greater accumulation of organic matter, and the surface soil is more friable and in places approaches Muck.

This type is distributed throughout the county, the largest areas being found in the vicinity of Boswell, Earl Park, Wadena, and in the eastern part of the county. It is derived from glacial material deposited in depressions and low-lying, flat areas along the minor drainage ways. The natural drainage is poor, but practically all the type has been reclaimed.

This soil is well suited to the production of corn, and the greater part of it is devoted to this crop. The average yield is between 45 and 50 bushels per acre. In exceptionally wet seasons even the artificial drainage may be inadequate, and the corn may be drowned out. In such cases millet is sown. Oats do fairly well, but have a tendency to lodge. A heavy growth of bluegrass affords good pasturage.

Methods of cultivation are the same as on the Carrington soils, but care must be taken not to work the ground when too wet. Fertilizers are not used.

The price of farms made up largely of this type is high, ranging from \$200 to \$250 an acre.

WABASH SILT LOAM.

The Wabash silt loam is not typically developed in Benton County and is of limited extent. As mapped it includes a mixture of soils of alluvial origin, ranging from fine sandy loam to clay loam or silty

clay loam. The color is dark brown to black to a depth of 8 to 16 inches. The subsoil is quite variable in depth and character. It consists for the most part of a dark-colored loam to clay loam or clay, mottled with yellow. The lower material in places is a heterogeneous mixture of clay, sand, and gravel. This condition obtains principally along Pine, Mud Pine, and Sugar Creeks near their places of exit from the county. In their upper reaches, as well as along the smaller streams, the type frequently consists of poorly drained material similar to the Clyde silty clay loam. In this variation the soil contains a high percentage of organic matter, is subject to more frequent overflow, and in origin is not wholly alluvial.

With the exception of a very few patches, this soil is used for pasturage. The native growth consists of wild grasses, ironweed, elm, and willow.

MUCK.

Muck is composed of decayed and decaying vegetable matter mixed with a small quantity of mineral matter washed in from the adjoining higher lying soils. The surface material is very black, and characteristically is loose and fluffy when dry. This is underlain by brown fibrous peaty material which in turn rests upon a brown or yellowish-brown, light-textured loam. Occasionally the lower subsoil is a yellow to drab silt loam or clay.

Muck occupies slight depressions. The depth of the mainly organic material varies from a few inches in the small areas to over 3 feet in the larger bodies. As mapped, the Clyde silty clay loam includes a few small areas of shallow Muck or chaffy land.

The natural drainage is very poor, and tiling and ditching have been resorted to in order that crops may be grown. Muck is an unimportant soil in Benton County, as its total area is very small. It is confined to a few areas in the northern and eastern parts of the county. Some of it is planted to corn, which gives good yields if not injured by early frosts, and the remainder is used as pasture. Bluegrass does well.

Celery, onions, lettuce, and cabbage might profitably be grown on the Muck areas for local markets. A complete fertilizer mixture, with 4 per cent nitrogen, 8 per cent phosphoric acid, and 10 per cent potash is generally used on Muck soils, potash providing the most effective element. Applications of ground limestone are often necessary to correct acidity.

SUMMARY.

Benton County, Indiana, adjoins the western boundary of the State, lying in the third tier of counties south of Lake Michigan. It embraces 408 square miles, or 261,120 acres.

The topography varies from level to gently rolling, with the highest elevations in the north-central part. The county is drained by small streams which have their headwaters within its boundaries. Tile drains and open ditches supplement the natural drainage throughout the county.

This region was first settled about 1830, and the county was organized in 1840. The population is reported in the 1910 census as 12,688. The population of Fowler, the largest town and the county seat, is given as about 1,500.

The county has good transportation and shipping facilities. There is a considerable mileage of improved roads, which extend into all sections. Chicago, Indianapolis, and Lafayette are the principal markets for farm products. The county is one of the most prosperous in the State, and agriculture is steadily advancing.

The mean annual temperature is about 51° F. There is an average growing season of 165 days. The mean annual precipitation, about 39 inches, is fairly well distributed throughout the year, though crops are likely to suffer from drought, except where careful tillage is employed to conserve the moisture in the soil.

The agriculture of the county consists almost entirely of grain farming. Over 75 per cent of the land in crops is devoted to corn and oats. The remainder is used mainly for forage crops and some wheat. The yield of corn averages about 37 bushels per acre and of oats about 33 bushels per acre. Hog raising is the principal branch of the live-stock industry. The county produces from 35,000 to 37,000 hogs each year. Some cattle and sheep are fed for market.

Much of the land is in large holdings. The 1910 census gives the average size of the farms as nearly 200 acres. Of the farms, about 54 per cent are operated by tenants. Over 96 per cent of the area of the county is reported in farms, and of the farm land over 97 per cent is reported improved. Land values are high. The Miami soil sells at about \$150 an acre and prairie types at \$200 to \$250 or more.

Benton County is a part of the broad prairie belt that extends westward through Illinois, and the soils are characteristic of prairie regions. In addition to Muck, five series of soils, each represented by one type, are recognized and mapped.

The Carrington silt loam, occupies 26.8 per cent of the area of the county. This is a dark-brown prairie soil, well suited to the production of corn, oats, clover, and grass. The topography is gently rolling to nearly level.

The Brookston silt loam is by far the most extensive soil in the county, occupying 64.6 per cent of the total area. This also is a dark-brown prairie soil. It is highly productive, and practically all of it is under cultivation.

The Miami silt loam is locally known as clay land. It is a light-colored, well-drained soil, formerly timbered, and was the first soil type cultivated. It is well suited to general farming and is an especially good grass soil. This type covers only 3 per cent of the area of the county.

The Clyde silty clay loam is the heaviest soil of the area. It occupies depressions and the more poorly drained parts of the prairie lands. With thorough artificial drainage it is a strong corn and oats soil.

The Wabash silt loam embraces all the alluvial, or first-bottom, lands along the larger natural drainage ways. Small areas are under cultivation to corn. The remainder is used as pasture.

Muck consists mainly of decayed vegetable matter. Only a few small areas are mapped in this county. Corn is the only cultivated crop grown, and yields are good. The Muck areas support a good growth of bluegrass.



[PUBLIC RESOLUTION--No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture "

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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