SOIL SURVEY OF MARION COUNTY, OHIO.

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DESCRIPTION OF THE AREA.

Marion County, Ohio, lies just northwest of the center of the State, 45 miles north of Columbus. It is bounded on the north by Wyandot and Crawford Counties, on the east by Morrow County, on the south by Delaware and Union Counties, and on the west by Hardin County. It is irregular in outline, but the boundaries follow straight land lines. The county has an area of 409 square miles, or 261,760 acres.

Marion County occupies a broad, smooth to rolling plain which forms the divide between the Great Lakes drainage and the Ohio Basin. This plain has a general slope to the west and south, except in the northwestern part of the county, where the slope is to the north. The northern part of the plain was originally known as the "Sandusky plains." There is more or less dissection by drainage ways throughout the county. The largest streams are the Scioto and Little Scioto rivers. These two rivers join just southwest of Marion. From this point southward the river occupies a very narrow valley, but above the junction the valleys, which lie 30 to 50 feet below the surrounding country, attain a width ranging from 1 to 2 miles.

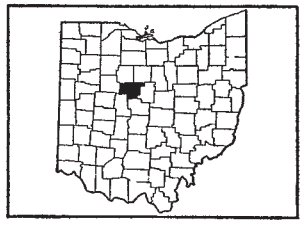

FIG. 39.—Sketch map showing location of the Marion County area, Ohio.

The topographic features of Marion County as a whole are remarkably uniform. The highest elevation, 1,079 feet, is in Tully Township, and the lowest, 880 feet, in Grand Township. Variations in topography are due almost entirely to erosion, and the rougher areas lie along the streams. The more irregular areas occur along Flat Run in the northeastern part of the county, along the Olentangy just south and southeast of Marion, along the Scioto north of Larue, along Rush Creek southeast of Larue, along the Tymochtee around Morral, at the head of the Little Sandusky River, and on both sides of the Little Scioto north of Marion. The local differences in elevation are due to stream erosion, but the slopes are not too rough for agricultural use, and only rarely are they steep enough to erode. In the

northwestern corner of the county there is a section of very flat country extending into Wyandot County, representing an old lake bed. The first and second bottoms of the Scioto and Little Scioto rivers, west and north of Marion, constitute floorlike areas, flat to undulating in detail and having an average elevation of about 920 feet. They lie 30 to 50 feet below the upland level.

The drainage of Marion County flows southward into the Ohio basin and northward into the St. Lawrence system. That part of the county north of a line running west from Big Island, and west of a line extending northeast from the same place, lies within the St. Lawrence drainage basin. The drainage of this area is carried by the Tymochtee, which rises in the vicinity of Big Island, and by the Little Sandusky, which has its source about 3 miles south of Morral. The remainder of the county lies in the Ohio basin and is drained by the Olentangy and the Big and Little Scioto and their tributaries. Only small areas of overflow or first-bottom land occur along the Scioto and Little Scioto Rivers. Most of the land in the bottoms of these streams is known as "second-bottom" land. The other streams of the county, mainly the Tymochtee, Little Sandusky, and Olentangy, and the Scioto River south of Greencamp, have cut narrow valleys to a depth of 30 to 40 feet. The grades on these main streams are fairly well established, and average 5 to 10 feet to the mile.

The branches of the major streams represent more recently established drainage ways and are merely meandering runs with a low average fall. Their courses generally range from 10 to 50 feet below the surrounding country, though in some cases the stream is practically on a level with the adjacent upland. For the most part the valleys of these streams have gentle slopes. The channels of these tributaries, as well as parts of those of the larger streams, have in places been deepened and straightened by dredging, and stronger grades established, thus making the streams more effective as drainage lines. However, the county as a whole is far from adequately drained.

The first white settlements were made about 1 mile south of Waldo in 1806. In 1814 and 1815 other settlements were made around Prospect. The area north of the Greenville Treaty line was not settled until about 1820. The earliest settlers came from Virginia, Kentucky, Pennsylvania, New York, and New England, with subsequently some immigration from Illinois. They were largely English, with some of German, Dutch, and Irish descent. Marion County was organized in 1821; its present boundaries were established in 1848.

The population is more or less evenly distributed, possibly being somewhat more dense in the vicinity of Marion than elsewhere. The

1910 census reports the urban population as 18,232 and the rural population as 15,739, the latter including all towns under 2,500. The density of the rural population is reported as 38.5 to the square mile.

Marion, situated in the center of the county, is the county seat. Its population, 1910 census, is 18,232, and in 1916, estimated, about 28,000. It is a manufacturing center, producing steel, steam shovels, machinery of all kinds including farm implements and tractors, also malleable castings, sulkies, motor ambulances, buggies, tile, lime, shoes, and silk. Marion has good transportation facilities, being on the main line of the Chicago & Erie, and on the Big Four line from Cleveland to Indianapolis and St. Louis. It is also served by a branch of the Erie to Cincinnati, by the Pennsylvania lines connecting Columbus and Sandusky, and by the Hocking Valley, which runs from Portsmouth, Ohio, to Toledo. Marion is also the northern terminus of the Columbus, Delaware & Marion interurban line, and is connected by electric line with Bucyrus, on the main line of the Pennsylvania Railroad and the Cleveland Southwestern traction line.

There are several smaller towns of local importance, including Caledonia and Martel, in the eastern part of the county. Martel has a population of about 160, and is located at the intersection of the Chicago & Erie, Big Four, and the Toledo & Ohio Central, which runs from Toledo to Charleston, W. Va. Caledonia has a population of 562, according to the 1910 census. Waldo is situated in the southeastern part of the county on the Pennsylvania Railroad, and has a population of 319. Prospect, located on the Columbus, Delaware & Marion traction line about 12 miles south of Marion, has a population of 945. Larue, in the west-central part of the county, on the Big Four, has a population of 772. Morral has a population of 334 and is located on the Hocking Valley Railway, about 12 miles northwest of Marion. Creameries are located at Waldo, Larue, and Marion, and at Morral there is a canning factory. All these towns have grain elevators and cattle-shipping pens. Marion is the only local market of importance. Most of the fattened cattle and the sheep and hogs from Marion County are marketed in Pittsburgh, Cleveland, Columbus, and Buffalo, with some in Chicago.

All the main roads are improved and have either macadam or gravel surfaces. The several limestone quarries and gravel pits in the county, especially those around Prospect and Waldo, afford ample material for road improvements.

Good rural schools are located throughout the county. Telephone lines reach all parts of the county.

Marion County is served by an agricultural agent and association; under this system there is a county-wide organization of farmers, and local organizations in 12 townships. The association has, among

other things, introduced the cooperative buying of fertilizer, binder twine, and tankage and cottonseed meal, which are used as feed.

CLIMATE.

The following table, compiled from the records of the Weather Bureau station at Marion, gives the salient facts concerning the climate of the county:

Normal monthly, seasonal, and annual temperature and precipitation at Marion.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1895).	Total amount for the wettest year (1913).	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December	30.4	67	−9	2.58	2.74	1.57	6.4
January	27.2	74	−17	3.00	4.07	10.80	7.4
February	26.1	74	−22	2.60	.52	2.12	6.6
Winter	27.9	74	−22	8.18	7.33	14.49	20.4
March	40.0	85	−2	3.62	.42	12.58	5.1
April	49.7	91	15	3.57	2.59	4.39	.5
May	60.9	101	24	3.64	1.53	2.41	T.
Spring	50.2	101	−2	10.83	4.54	19.38	5.6
June	69.7	103	35	4.07	4.06	3.52	0
July	73.9	105	42	4.29	2.21	4.94	0
August	72.0	101	38	3.08	1.80	2.17	0
Summer	71.9	105	35	11.44	8.07	10.63	0
September	66.5	100	29	2.97	2.61	2.93	0
October	53.4	91	15	2.59	.93	3.47	T.
November	40.6	76	7	2.56	3.70	2.74	.5
Fall	53.5	100	7	8.12	7.24	9.14	.5
Year	50.9	105	−22	38.57	27.18	53.64	26.5

The mean annual precipitation of 38.57 inches is distributed fairly evenly over the year, with somewhat greater totals for the spring and summer seasons than for fall and winter. There may be more or less extended periods of drought or rain, and these may cause a reduction in yields, though seldom severe enough to result in complete crop failures. The mean annual snowfall is given as 26.5 inches. This usually affords ample protection to the wheat crop.

Hail and wind storms seldom occur. The prevailing winds are from the west and northwest.

The mean annual temperature is 50.9° F. The temperature, as a rule, is without sudden and extreme changes. The lowest temperature recorded at Marion is —22°, and the highest 105° F. Cold waves occur in the winter and hot spells in the summer, but these are seldom protracted. It is often possible to plow throughout December.

The growing season is long enough for maturing all the general crops grown in the county. The average date of the last killing frost in the spring is May 6, and of the first in the fall, October 5. The date of the latest killing frost recorded in the spring is May 29, and the earliest in the fall, September 14. The average length of the growing season is 152 days. The grazing season usually lasts for nine months.

AGRICULTURE.

Agriculture in Marion County dates from the beginning of the nineteenth century. The higher lying parts of the county, which were originally forested, were the first to be brought into cultivation. The greater part of the lower lying, treeless sections was swampy and was not reclaimed and farmed until later. The early products consisted of corn, small grains, hay, and live stock and live-stock products, including wool. Shipments from Marion station about the middle of the century included the following products: Wheat, corn, oats, clover seed, wool, cattle, hogs, sheep, horses, and hay.

The most important changes in agriculture during the last 60 years consist of a decreased proportional acreage of wheat and an increased acreage of corn and oats. The 1880 census reports about 50,000 acres in corn, 25,000 acres in wheat, 12,000 acres in oats, and 24,000 acres in hay. Potatoes and orchard products were important, and the raising of hogs and sheep and the fattening of beef cattle received considerable attention.

The 1910 census reports a total of 57,445 acres in corn, with a production of 2,421,731 bushels, 32,943 acres in oats, producing 1,057,245 bushels, and 13,093 acres in wheat, producing 219,893 bushels, with a small acreage in rye, barley, and buckwheat. Of the hay crops, tame, or cultivated, grasses are reported on 36,690 acres, with a production of 55,673 tons. This acreage includes 22,662 acres in timothy, 2,819 acres in clover, and 11,119 acres in timothy and clover mixed. A very small acreage of alfalfa and millet is grown, with some coarse forage. Potatoes are reported on 1,487 acres, yielding 113,391 bushels, and other vegetables on 702 acres. The census reports a total of 49,639 apple trees, 11,686 peach trees, and 6,420 grapevines, with a small acreage of strawberries, blackberries, and raspberries.

The following table gives the value of the agricultural products of Marion County, according to the 1910 census:

Value of farm products, arranged by classes.

Product.	Value.	Product.	Value.
	Dollars.	Live stock and products:	*Dollars.*
Cereals	1,861,867	Animals sold or slaughtered	1,632,504
Other grains and seeds	20,588	Dairy products, excluding home use	187,524
Hay and forage	520,776	Poultry and eggs	313,482
Vegetables	122,403	Wool, mohair, and goat hair	117,893
Fruits and nuts	30,748	Total value	4,932,480
All other crops	124,695		

The status of the live-stock industry is indicated by the following table, compiled from the census of 1910:

Number of domestic animals sold or slaughtered and on farms and ranges.

Animal.	Number.	Animal.	Number.
Domestic animals sold or slaughtered:		In county on farms and ranges:	
Calves, sold or slaughtered	1,444	Milch cows	6,972
Other cattle, sold or slaughtered	7,364	All other cattle	10,864
Horses and mules, sold	1,681	Horses	10,081
Swine, sold or slaughtered	55,832	Hogs	63,808
Sheep and goats, sold or slaughtered	34,574	Sheep	73,785

The agriculture of Marion County at the present time consists of general farming, with corn, oats, wheat, and hay as the principal crops, combined with stock feeding. Oats and wheat are the chief money crops, while garden vegetables, potatoes, poultry and dairy products, and fruit are produced mainly for home consumption. There are a few commercial poultry farms and orchards in the county, but in general only the surplus of these products is sold. Dairying is of local importance around Marion and at Waldo and Larue. Corn is indirectly a money crop, being fed on the farm to stock, which is marketed. Some mixed timothy and clover hay is sold, but the greater part of the hay is fed on the farm. In addition to the feed crops produced in the county the 1910 census reports an expenditure of $71,804 for feed. Corn and peas are grown for canning in the vicinity of Morral. The industry is increasing in importance.

The hogs, sheep, and cattle are about evenly distributed throughout the various townships. The larger part of this stock is sold after fattening. The sheep and cattle are feeders shipped from western points; the hogs are raised in the county.

It is generally recognized by the farmers that the dark soils are best adapted to corn, while the light-colored and higher lying soils are better suited to wheat, oats, and hay. The low-lying or poorly drained soils and those along streams and subject to overflow are generally used for pasture. The heavy silty clay soils west of Marion and in the northwestern part of the county are recognized by the farmers as decidedly intractable, fall plowing being necessary in preparing the land for planting, and are considered as suitable only for corn and hay production. A great deal of this land is now in pasture.

The prevailing method of corn culture is to plow the land in the fall, especially in the areas of heavy, waxy soils, the plowing being done with three-horse and four-horse teams and in some cases by tractors. In most cases the furrow is 7 to 9 inches deep. As soon as the moisture content permits in the spring a three-horse or four-horse disk harrow is used, and this is followed by a spike-tooth harrow, a float, or drag, and sometimes a roller. After the seed bed is prepared by making a mulch 3 to 4½ inches deep, the corn is planted with check-row or disk planters. The date of planting ranges from May 10 to May 20 or 25, depending on the season. After the corn is up some farmers go over it with a light spike-tooth harrow or weeder and mulch it well to conserve moisture. Subsequent cultivations are performed with two-horse, three-shovel to six-shovel cultivators, which are set to cultivate shallow in order to prevent, as far as possible, breaking the roots. The corn is gone over three to five times in this way, depending upon the weather, before it is laid by. In some cases a single-horse cultivator is used late in the season, after the corn is 3 or 4 feet high, to hold the moisture by mulching and to kill the weeds. This is rarely done, however, where the corn has previously had sufficient cultivation.

Wheat is sown in the fall and oats in the spring, generally without plowing. Where wheat follows corn, the soil is stirred with a disk harrow, sometimes followed by a spike-tooth or spring-tooth harrow, and the wheat is then seeded with a disk drill. The land is sometimes rolled after the seed is sown, to hasten germination. Wheat is sown late in September or early in October. The same general plan is followed in preparing the land for oats. Disking corn ground instead of plowing enables earlier sowing, and has, moreover, proved more economical. Where wheat is sown among the corn shocks in the fall, oats usually are sown in the spring in the shock rows, so that there is no waste of land. Grasses for hay and pasturage are sown with wheat and oats. Timothy is seeded in the fall and clover in the early spring.

In many cases corn is harvested in the fall by husking it from the standing stalks, although a large part of the crop is cut with corn binders or by hand. The stover supplies roughage for cattle,

sheep, and horses through the winter. A considerable part of the corn crop is "hogged off." This saves labor and is a satisfactory way of fattening the hogs. Most of the shock corn is husked, although a part of the crop is shredded.

The oat crop is harvested about the last of July or the first part of August. The grain is cut with a 3-horse binder, shocked, and usually thrashed from the field after standing in the shock a week or 10 days. In rainy seasons it is stacked or stored in the barn. Wheat is harvested in the same manner about the first of July. Clover and timothy hay is cut, cured, and harvested with machinery. It is either stored in barns or stacked in the field and baled before winter sets in.

Hog, cattle, and sheep raising and fattening are the chief livestock industries. Dairying is of only local importance. Most of the hogs are raised in the county. As a rule two litters a year are obtained. They are allowed to run on pasture, usually clover fields, old meadows, or, through the winter, wheat stubble or corn land. At times both cattle and hogs are turned into the corn as soon as it is past the milk stage and begins to harden. Tankage is fed to hogs from self-feeders on most farms, as well as charcoal and salt. There is some cholera in the county, but the losses are minimized to a great extent by careful sanitation and vaccination. The hogs raised are mainly Duroc-Jerseys, Poland-Chinas, Chester Whites, or Berkshires.

Cattle are shipped into the county and allowed to graze through the summer. In the fall and winter they are either turned into the corn or fed shelled corn and fodder, supplemented with oil meal and clover hay. The fattened cattle are usually placed on the market about the first of the year. The feeders are mainly grade Herefords. Dairy herds are composed largely of grade Holsteins or Jerseys. Aberdeen-Angus, Hereford, and Shorthorn cattle are bred in the county.

Most of the sheep fed are shipped into the county. They are pastured through the summer and in the fall are put on wheat stubble or turned in corn fields either before or after the corn has been husked. They are primed with shelled corn and some oats. Western lambs are bought in September and sold about the first of the year, when prices are most satisfactory. Where wool is produced shearing is generally done in the spring, but some farmers shear in the fall the sheep and lambs that they intend to sell on the winter market. The sheep are mainly grade Shropshires. Some Shropshires are bred in the county.

These industries are practiced on what is known as the "extensive-pasture scale," and little or no soiling is done to supply supplementary feed. There are a few covered feeding lots, but most of the

feeding is done in open lots and in the pasture. The fattened stock is marketed in Cleveland, Buffalo, Columbus, Pittsburgh, and Chicago. In some cases it is shipped direct to the commission men, but smaller feeders sell to local buyers, who ship to the larger markets.

The farm buildings in Marion County as a general rule are well built and well cared for. Many of the houses have modern improvements, such as running water and acetylene lights. The barns as a rule are not large, as most of the grain is thrashed from the field. The machinery is modern and most farms are well supplied. A great many of the farms have gasoline engines for general use. Some farmers operate tractors and have their own shredders and ensilage cutters. There are a few silos in the county, but they are not common. The work stock consists of horses of good grade, generally of Belgian or Percheron blood. Percheron horses are bred in the county. Each farm has, as a rule, four to six heavy work horses in addition to driving horses. Some farmers raise one or two colts a year. In some cases mules are used for farm work.

The usual rotation practiced is corn, oats or wheat, and hay. Grass is generally allowed to occupy the land two and sometimes three years.

In the 1910 census 564 farms report a total expenditure of $17,021 for fertilizer. The fertilizer is applied to oats and wheat, at the rate of about 200 pounds per acre, very little being used on corn. Probably 75 per cent of the fertilizer used is acid phosphate, the remainder being 2–8–2, 1–8–2, and 10–2 mixtures. In some instances steamed bone is used. Some ground limestone also is used in the county.

The total expenditure for farm labor is reported as $294,494, distributed among 1,345 farms. The laborers are mainly native born; possibly the only itinerant labor used is in cutting and husking corn, for which $2 to $2.50 per day, with board, is paid. Farm hands usually are paid $30 to $35 per month, with board. There does not seem to be any great scarcity of labor in the county. Most laborers are hired by the year, and those with a family are furnished a house, wood, milk, a garden, and a few hogs.

The 1910 census reports a total of 2,141 farms in Marion County, about 93 per cent of the total area being in farm land. The size of farms in Marion County ranges from 40 or 50 acres to 1,200 acres or more. The average size is given in the 1910 census as 113.2 acres. Of the farm land, 89.4 per cent, or an average of about 101 acres per farm, is reported improved.

About 65 per cent of the farms are reported as operated by the owners, and practically all the remainder by tenants. In some cases the farms are rented on the cash basis, for $5 or $6 an acre, with some stipulation as to the crops to be sold and the stock to be kept on the farm. In most cases, however, the farms are rented under

the share system, the owner furnishing one-half the seed and fertilizer, and the owner and tenant sharing equally in the proceeds.

Good farm land, especially in the vicinity of Marion, sells for $200 to $225 an acre. Very little land in the county is sold for less than $100 an acre. The average assessed value of farm land is reported in the census of 1910 as $73.26 an acre. According to the same authority the value of all farm property averages $11,144 per farm. Of this 74.4 per cent is represented by the land, 12.9 per cent by buildings, 2.1 per cent by implements, and 10.6 by domestic animals.

SOILS.

Marion County lies wholly within the glaciated region. The bedrock, more or less deeply buried by till, is predominantly limestone or shale. The Niagara limestone, a magnesian limestone, is the lowest. It is found in the northwestern corner of the county, and is followed toward the east by the higher formations, the general dip being toward the east. The water-lime group occupies most of Salt Rock, Big Island, Greencamp, Montgomery, and Prospect Townships and all of Bowling Green Township. The lower Corniferous limestone strikes across the western side of Grand Prairie and Marion Townships and touches Pleasant and Prospect Townships east of the Scioto River. The upper Corniferous limestone underlies the remainder of Grand Prairie, Marion, Pleasant, and Prospect Townships, and the western part of Scott, Claridon, Richland, and Waldo Townships. The Huron shales underlie the eastern parts of Waldo, Richland, Claridon, and Tully Townships, and the Waverly sandstones are found only in the extreme eastern end of Tully Township.

The several advances and withdrawals of the continental ice sheet left a mantle of glacial debris over the county varying in thickness from 25 to 70 feet or more, the bedrock outcropping in only a few small areas. This mantle of glacial drift is known geologically as the Late Wisconsin and constitutes a part of the deposits of the Scioto Lobe of the Late Wisconsin glacier. The drift carries shale and limestone fragments. Through subsequent processes of weathering the soils of the county have been formed from this mass of drift material, to some extent of foreign origin, but largely of local origin. The extremely heavy texture of most of the soils and the preponderance of silt and clay material is presumably due to the presence of a large proportion of Huron shale material, and the general calcareous nature of the deep subsoil in many places is due to the presence of partly weathered limestone fragments.

The Miami, Crosby, and Bellefontaine soils are the higher lying, better drained, light-colored upland soils derived from calcareous

glacial material. In the Clyde, Brookston, and Newton soils the presence of shale and limestone fragments and the calcareous nature of the subsoil is lacking or less evident. These series include low-lying, poorly drained areas and are generally dark in color. They are derived from the same material as the Miami, Crosby, and Bellefontaine limestone and shale drift, but they have weathered under wet and swampy conditions. The original material has been modified also by the accumulation of organic matter. In addition, finer soil sediments have been washed or blown into the depressions where these soils occur. Some of the soils in this group also are derived from silt and clay that have been accumulated in temporary glacial lakes. Underlying these dark soils at no great depth is found unweathered glacial débris similar to that found under the lighter colored soils. Excluding Muck, 12 soil types, representing 10 soil series, were identified in Marion County.

The Miami soils are light brownish gray to almost ashy gray when dry. The subsurface material is yellow in the lighter members and mottled yellow and gray in the heavy types. The subsoil is dull yellowish brown streaked with iron and rotten shale fragments. A friable, calcareous till is encountered at 24 to 30 inches. Small fragments of shale and limestone occur throughout the 3-foot soil section. These soils have been formed through the weathering of ice-laid material, usually in the form of ground moraine. The topography is rolling to hilly, and drainage is fairly well established.

The Crosby soils are characterized by gray surface material with an ashy-gray to light-gray and yellow mottled subsurface layer. The predominating color of the subsurface material is gray with iron streaks. The subsoil is yellow or yellowish brown to grayish brown in color and heavy in texture, and has a compact, tough structure. At 28 to 30 inches a yellow, calcareous, friable till is encountered. The Crosby soils have been formed through the weathering of ground moraine. The topography is gently undulating to flat. The drainage and aeration are poor.

The Bellefontaine soils characteristically are slightly reddish brown to brown at the surface, with a reddish-brown, tough, compact subsoil underlain by yellow to brown, calcareous gravelly material. These soils are truly morainic in origin, and occur as ridges or knolls throughout the Miami soils. Drainage is good to excessive.

The Brookston series embraces soils with dark brown to dark brownish gray surface soils. The subsoil is yellow with gray streaks, the yellow becoming more prominent with depth. In places, yellow, friable, calcareous till is encountered at 30 to 36 inches. These soils have been formed through the weathering, under semiswampy conditions, of glacial till to which have been added sediments washed from the surrounding higher land and the remains of water-loving

vegetation. They, however, have not remained so long under swamp conditions as the Clyde soils. The topography is level to gently undulating, and the natural drainage very poor.

The Clyde soils are black, with bluish-black subsurface material and bluish-gray subsoils streaked with yellow in places, especially at a depth of about 36 inches. These soils have been formed through the weathering, under swampy conditions, of glacial debris. They have been influenced also by the washing and blowing in of finer sediments from the higher surrounding land, and the considerable accumulation of organic matter. For long periods these soils evidently were inundated, or in a swampy to semiswampy condition. The topography is generally flat. The natural drainage is very poor.

The Fox soils have brown to chocolate-brown surface soils. The subsoil is yellowish brown with a reddish tint. It is compact in structure and heavier than the surface material. The lower subsoil is generally a brown or yellowish-brown, incoherent mass of sand, gravel, silt, and clay. Rounded gravel of shale and limestone origin occurs on the surface and through the soil section, while the substratum consists generally of stratified sand and gravel. Fox soils are composed of transported material which occupies terraces above overflow. The topography is flat, and the drainage is good.

The Lucas series includes types with light brownish gray, smooth-textured surface soils and yellowish-brown, tough, heavy subsoils, which below 24 to 36 inches are moderately calcareous. In the lighter types the heavy subsoil is not reached within 15 to 24 inches of the surface, and the subsurface layer is similar in texture to or somewhat heavier than the surface soil, ranging from brownish yellow to yellow with slight gray mottlings. In the heavier types the soil rests directly upon the heavy subsoil, or at most there is only a thin gradation zone between the two. The Lucas soils are level to undulating and rolling in topography and in general have fair to good natural drainage. On some of the steeper slopes drainage may be excessive. The series is derived from lake-laid sediments. It differs from the Newton soils in having better drainage, lighter surface soils, and a yellower subsoil.

The Homer series includes gray to brownish-gray surface soils with mottled bluish-gray, yellow, and brown subsoils. These soils represent shallow lacustrine deposits underlain at no great depth by unweathered glacial till. They have been influenced in some cases by an admixture of coarse alluvial sediments. The topography is flat to undulating, and the natural drainage poor.

The surface soils of the types included in the Newton series are dark grayish brown to dark bluish gray. The subsoils are gray, tinted with yellow in places. These soils are entirely free from grit

and stone, and consist of lacustrine material. They have a flat topography and poor drainage.

The Genesee soils are brown to dark grayish brown at the surface, with yellowish-brown to dark-brown subsoils, faintly marked in places with gray streaks or mottlings. These soils are composed of material which has recently been transported by streams and deposited along their bottoms. They are subject to frequent overflow and receive additional deposits of sediment in times of high water. The topography is flat, and drainage is fair to poor.

Muck consists of black organic matter with some admixture of mineral material. As mapped in Marion County, it is shallow, and is underlain by grayish silt loam material streaked with iron.

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

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami silty clay loam	102,592	43.6	Homer loam	4,672	1.8
Better drained phase	11,520		Miami silt loam	3,136	1.2
Clyde silty clay loam	48,384	18.5	Lucas silty clay loam	2,496	.9
Brookston silty clay loam	43,456	16.6	Bellefontaine loam	2,240	.8
Crosby silty clay loam	12,544	4.8	Fox loam	1,280	.5
Genesee silt loam	10,944	4.2	Muck	320	.1
Newton silty clay	9,600	3.7			
Newton silty clay loam	8,576	3.3	Total	261,760	

MIAMI SILT LOAM.

The soil of the Miami silt loam, to a depth of 8 to 10 inches, is a light-brown or yellowish-brown, mellow silt loam, with a grayish cast when dry. The subsurface material, extending to depths of 10 to 20 inches, is a brownish-yellow to yellow, compact silt loam, slightly mottled in places with gray. The subsoil to a depth of about 30 inches is a dull yellowish brown to brown silty clay loam, faintly streaked with gray. It contains some iron streaks and rotten shale fragments and overlies a yellowish-brown, friable, calcareous clay loam till, containing partly weathered shale and limestone fragments and lime particles and extending to 36 inches or more. This type closely resembles the Miami silty clay loam, except that the upper 18 inches of the soil section is somewhat lighter in texture as a whole and is generally free from gray mottling. In places the silt loam type contains appreciable quantities of fine and very fine sand in the upper part of the soil section.

The Miami silt loam occurs in a small way west and southwest of Kirkpatrick, southeast of Larue, and around Decliff. A few areas are found in other sections of the county. The type occupies knolls and ridges and is surrounded by soils of the Clyde and Brookston series.

The surface is gently undulating to rolling, and the natural surface drainage is good, although the subsoil is generally poorly drained.

While practically all this type is under cultivation it is of little relative importance in the general agriculture of the county, owing to its small extent. The original timber growth consists of oak, sugar maple, ash, hickory, and walnut.

The important crops grown on this type are potatoes, wheat, oats, hay, and corn. Potatoes yield about 200 bushels per acre, wheat 20 to 25 bushels, oats 30 to 40 bushels, corn 40 to 50 bushels, and hay 1 ton to 1½ tons. The methods of handling and fertilizing this soil are identical with those practiced on the silty clay loam.

The Miami silt loam is closely associated with the Miami silty clay loam, and the land values are the same on the two types, ranging from $100 to $150 an acre, depending on the state of cultivation and location.

Owing to its light texture this soil is well suited to potatoes and vegetables. Liming and the use of manure give good results.

MIAMI SILTY CLAY LOAM.

The surface soil of the Miami silty clay loam is 7 or 8 inches deep and consists of a light-brownish or yellowish-gray, mellow silt loam. When dry the surface is ashy gray in color. The subsurface material from 7 or 8 inches to about 20 inches represents a gradual transition from a light to a heavy and compact silty clay loam. It is yellow, mottled or speckled with gray. The subsoil from 20 inches to 30 or 32 inches is dull yellowish brown, mottled with gray. The gray mottlings become less prominent and the yellow becomes brighter with depth. The upper subsoil is a silty clay, which is brittle when dry and plastic when wet. The lower subsoil is a yellowish-brown light clay loam to friable silty clay loam. It is calcareous and invariably spotted with white lime particles representing either decomposed limestone or precipitated calcium carbonate. The lower subsoil also contains weathered fragments of dark-brown shale. Scattered on the surface and frequently through the soil section are fragments of shale and limestone, with a slight admixture of foreign rocks. These, however, are relatively small in size and negligible in quantity, except along slopes where the finer soil material has been washed away to some extent.

This type cracks badly in dry weather, causing an excessive loss of moisture. It is locally known as "clay land." As a rule it is very uniform, and the areas are conspicuous. The type includes small areas, however, where the surface soil to a depth of 12 to 15 inches is a silt loam, and in which the soil is very similar to the Miami silt loam. These areas are small and of irregular occurrence. There is some variation also in the depth at which the calcareous till is encountered. It rarely lies above 2 feet. In the eastern and northeastern parts of the county it is generally found at depths of 33 to 36 inches, and in places below 36 inches, while in the western part it occurs at an average depth of 28 inches. The texture of this till material varies from a light clay loam or loam to heavy silty clay loam, the former texture predominating.

Owing to the ashy-gray appearance of the surface of the Miami silty clay loam when dry, it is sometimes difficult to distinguish it from the intimately associated Crosby silty clay loam, especially in the eastern and southern parts of the county. Where the Miami silty clay loam approaches the Brookston or Clyde soils, and where there is within the type a poorly drained or flat area, the character of the soil approaches that of the Crosby silty clay loam. Some small areas of the Crosby silty clay loam are necessarily included with this type in mapping. The type also includes some patches of Milton silt loam,[1] which occurs to a small extent just north of Marion in the vicinity of the quarries along the road to Bucyrus and also south of Marion around the Owen Quarry.

The Miami silty clay loam is uniformly distributed throughout the county. In the eastern, western, and southern parts it is found in more or less extensive areas, associated with areas of the Brookston silty clay loam. In the east-central and north-central parts of the county it forms islandlike bodies within areas of the Clyde silty clay loam.

The surface characteristically is nearly level to gently undulating and in places rolling. It is most irregular along streams, especially in the western part of the county. The surface drainage is adequate in most cases, but the underdrainage is deficient, owing to the heavy, impervious nature of the subsoil. Aeration is poor.

This is one of the most important types in the county, in point of extent and proportionate use. Probably 80 to 85 per cent of it is farmed. The tree growth consists of oak, hickory, beech, elm, sugar maple, and fir.

Oats, wheat, corn, and hay, consisting of mixed timothy and clover, are the principal crops. The feeding of hogs, sheep, and cattle is important. The stock is pastured through the summer and

[1] The Milton silt loam has a rich-brown soil with no mottlings, underlain by limestone within 3 feet of the surface. It is not mapped in this county.

early fall, and fattened in the pastures or in open sheds on oats, corn fodder, grain, and hay. A part of the corn crop is hogged off. Dairying is of little importance. Garden crops for home use, and around Morral peas and corn for canning, are grown. Berries, apples, and pears are grown in a small way.

Oats yield 30 to 50 bushels per acre, wheat 20 to 30 bushels, corn 40 to 50 bushels, hay 1 ton to 1½ tons, and sweet corn 1½ to 2 tons. Peas for canning have given a net return of $40 to $50 an acre.

Fall plowing is generally practiced, and where this plan is followed the seed bed is easily and satisfactorily prepared in the spring. Where corn is grown, frequent shallow cultivation is given to kill the weeds and conserve moisture. Barnyard manure is used extensively. It is applied on sod land in the fall, usually at the rate of about 2 tons per acre, and plowed under for the spring crop of corn. The land is allowed to stand in grass two or three years. Acid phosphate is practically the only commercial fertilizer in general use on this type. It is applied at the rate of about 200 pounds per acre on oats or wheat. Some lime is used.

This type sells for $100 to $150 an acre, depending on its state of cultivation and location with respect to towns and transportation lines.

This soil is materially improved by deepening the root zone by deeper plowing, and by the plowing under of barnyard manure and green-manure crops, such as clover, vetch, and soy beans. These crops, particularly clover, do well on this soil. Alfalfa has done well on the better areas of Miami silty clay loam, especially where limed and underdrained. While the material of the lower subsoil effervesces with hydrochloric acid, no reaction is noticeable in the surface soil and upper subsoil, all the lime originally present possibly having leached down to lower depths. This indicates that the type would be benefited by the application of lime, at the rate of about 500 to 800 pounds or more per acre. Underdrainage is another need of this soil, and it is generally recognized that the best results are obtained where this improvement has been made; but care should be taken not to imbed the tile too deeply in the heavy and compact subsoil, in order that they may be efficient. The thorough preparation of the seed bed and frequent mulching insure a large yield of corn, even in dry years.

Owing to the vigorous growth made by fruit trees and the quality of the fruit produced, together with the fact that the soil is hard to cultivate, it would seem that the type is well adapted to the sod-mulch system of orcharding.

Miami silty clay loam, better drained phase.—To a depth of 7 or 8 inches the surface soil of this phase is a yellowish-brown to brownish-gray silt loam to silty clay loam. The subsurface material, to a

depth of 15 or 16 inches, is a stiff silty clay loam of yellowish-brown to brownish-yellow color. This part of the soil section may be slightly mottled or streaked with gray. The upper subsoil to a depth of about 24 inches is a grayish-brown or dull yellowish-brown silty clay. This is underlain by a friable clay loam to loam consisting of calcareous till of a bronze-yellow color. Small shale chips and limestone fragments occur on the surface and throughout the soil section. The subsoil in places is streaked with rotten shale fragments or iron stains. The lower subsoil contains white lime particles. consisting of precipitated calcium carbonate or disintegrated limestone.

This phase differs from the main type only in having a somewhat browner surface soil and being generally free from large gray mottlings in the subsurface material and upper subsoil. In some places the phase is a silt loam in texture, but prevailingly the soil is considerably heavier than a silt loam. On steep slopes the surface material has been washed away in places, leaving the heavier subsurface soil exposed.

The Miami silty clay loam, better drained phase, occurs along both sides of the Olentangy River in the eastern part of the county, east and west of Morral, south of Marion, and around Prospect. It occurs in areas of broken topography, along stream courses, or as semimorainic areas in the open country as around Morral, south of Marion, and in the vicinity of Prospect.

The topography is rolling to rough and broken, especially along stream courses. In places the surface has an eroded or gullied aspect, in others it has a modified kame and kettle appearance, while in still other locations it occurs as long, rolling ridges. It is rarely sufficiently rough to preclude cultivation or to permit excessive erosion.

The surface soil is well drained and aerated. The underdrainage is also good, as the substratum at no great depth is made up of porous unconsolidated material.

The phase is not extensive, but probably 90 per cent of it is under cultivation. The original tree growth consists of sugar maple, oak, cherry, walnut, gray ash, and sycamore. The crops grown are oats, wheat, corn, hay, and potatoes. Stock feeding under the system of summer pasturing and fall grain feeding is carried on. In the vicinity of Morral a small acreage is devoted to the production of peas and corn for canning.

Yields of 40 to 50 bushels of oats, 25 to 35 bushels of wheat, 40 to 50 bushels of corn, and 1 ton to 1½ tons of hay per acre are obtained. Potatoes yield about 200 bushels per acre.

This land sells for $125 to $150 an acre, depending mainly on its location with respect to towns and transportation facilities.

This soil is generally well handled. Liming is beneficial, as is the liberal application of barnyard manure. The phase is well suited to the growing of alfalfa and potatoes.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, subsoil, and lower subsoil of the typical Miami silty clay loam:

Mechanical analyses of Miami silty 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.*
272103	Soil	0.6	2.2	1.6	6.8	8.8	59.8	20.2
272104	Subsurface	.1	.4	.5	2.9	5.6	47.2	43.1
272105	Subsoil	.2	.6	.6	4.9	5.9	46.4	41.6
272106	Lower subsoil	1.0	1.9	1.4	7.0	8.6	48.4	31.8

CROSBY SILTY CLAY LOAM.

To a depth of 7 or 8 inches the Crosby silty clay loam is light gray with a yellow tinge when wet and ashy gray when dry. The surface soil is a silt loam, and the subsurface to a depth of 14 or 16 inches is a light silty clay loam to heavy silty clay of ashy-gray color mottled with yellow. The subsoil to 28 or 30 inches is a plastic silty clay, which varies in color from dull brown or dull yellowish brown to mottled bronze yellow and gray. This part of the soil section usually is iron streaked and contains fragments of rotten shale. The lower subsoil is a yellow, friable, calcareous till. In places the till is encountered at about 36 inches. As a rule the predominating gray color of the surface and subsurface material gives way with depth to yellow or yellowish brown. The surface soil and subsurface soil are occasionally streaked with iron stains. The Miami silty clay loam and the Crosby silty clay loam are so intimately associated in places, especially in the southern part of the county, that it is impossible to map them separately, so that each type as mapped contains some inclusions of the other.

The Crosby silty clay loam occurs principally in the southern and southwestern parts of the county, in the vicinity of Waldo, and west of Greencamp, with a few scattered areas in other sections. It occurs as more or less extensive areas and patches within areas of the Miami silty clay loam. The topography is slightly undulating to flat, and the natural surface drainage and underdrainage are poor.

This type is quite extensive in the county, and probably 75 per cent of it is under cultivation. It is sometimes referred to as "beech land," beech being the principal tree growth. The forest growth also includes ash, hickory, oak, and maple.

General farming and hog raising are the chief industries on this type and the methods are the same as those prevailing on the Miami silty clay loam. The principal crops grown are oats, wheat, hay, and corn. Oats yield 35 to 40 bushels, wheat 20 bushels, hay 1 ton to 1½ tons, and corn 40 to 45 bushels per acre. Fall plowing is general, and frequent shallow cultivations are given the intertilled crops.

Barnyard manure, in light applications, is commonly applied in the fall, and about 200 pounds per acre of acid phosphate is applied to the wheat or oats land.

The price of land of this type ranges from $100 to $125 an acre, depending on the condition of the soil and nearness to markets.

The chief needs of this soil are better drainage and liming. Heavy applications of barnyard manure and the turning under of clover, soy beans, or some other legume materially improve the structure of the surface soil. Some areas of relatively low productiveness in the higher lying or clay lands of Marion County require tiling or ditching, followed by liming and heavy manuring.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Crosby silty clay loam:

Mechanical analyses of Crosby silty 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.*
272113	Soil	0.8	3.3	2.0	6.6	7.6	62.3	17.3
272114	Subsurface	.6	1.9	1.7	5.9	7.6	56.7	25.5
272115	Subsoil	.7	1.2	1.0	5.0	7.2	49.0	35.7
272116	Subsoil	.5	1.9	1.6	9.7	9.1	42.4	35.1
272117	Subsoil	1.5	3.0	2.0	10.8	11.0	40.1	31.7

BELLEFONTAINE LOAM.

The surface soil of the Bellefontaine loam is 8 or 10 inches deep and ranges in texture from a silt loam to a gritty heavy loam. The color varies from yellowish brown to slightly reddish brown. In places the soil is chocolate brown or dull reddish brown. The subsurface material to a depth of 20 or 22 inches is a reddish-brown to dark chocolate brown, tough, gritty, and gravelly clay loam. This is underlain by a yellowish-brown or bronze-yellow, gravelly, highly calcareous till of loam texture, which continues throughout the remainder of the 3-foot section. The substratum is composed of either unstratified or crudely stratified gravelly material with very little interstitial silt or clay. In places it is impossible to bore with the soil auger below 20 to 24 inches on account of the presence of this loose and unconsolidated gravel. Fine, rounded gravel is scat-

tered over the surface and through the soil section. The gravel in the soil and substratum is largely of shale and limestone origin, but some foreign material also is present. In several areas of this type north of Waldo along the Old Mud Pike, an area just southeast of the Marion Cemetery, two small areas northeast of Greencamp, and two areas in the southeastern corner of Tully Township the soil is a silt loam. In section 33 of Grand Prairie and section 4 of Marion Township, some Milton silt loam is included with this type. The Bellefontaine loam is closely associated with the Miami silty clay loam, better drained phase, and as mapped each may include small areas of the other.

The Bellefontaine loam is mapped in the vicinity of Waldo, in disconnected areas east of the main road between Waldo and Marion, and along the Scioto River from Greencamp to Prospect. Usually it occurs as narrow ridges on the sides of stream courses, but a few areas stand out above the surrounding country as knobs or hillocks.

The topography is prominently morainic and varies from rolling to hilly. Numerous kettle holes occur throughout the type. The surface drainage is good to excessive, and in a few places erosion is active. The underdrainage is adequate to excessive, owing to the porous gravel substratum.

On account of its relatively small extent this type is unimportant in the general agriculture of the county, though practically all the type is under cultivation. The tree growth consists of sugar maple, oak, ash, and wild cherry. Oats, wheat, corn, and hay are the principal crops. Oats yield 35 to 45 bushels, wheat 25 to 35 bushels, corn 40 to 50 bushels, and hay 1 to 1½ tons per acre.

This soil sells for $125 to $150 an acre, depending mainly on its location.

The Bellefontaine loam is handled and fertilized much like the associated Miami silty clay loam, better drained phase. Alfalfa is grown in a few small patches, and the soil seems well suited to this crop. Potatoes also do well. The type is in need of barnyard manure and frequent shallow cultivation to conserve moisture and minimize the reduction of crop yields in periods of drought. Although the subsoil is calcareous, where alfalfa is grown the addition of lime is beneficial.

BROOKSTON SILTY CLAY LOAM.

The surface soil of the Brookston silty clay loam, to a depth of 9 or 10 inches, is dark brownish gray to brownish-black, usually mellow and friable heavy silt loam to light silty clay loam. When dry the surface soil has a dark-gray color with a brownish tinge. The upper subsoil, to a depth of 22 or 24 inches, is a plastic silty clay loam ranging in color from dull yellow streaked with gray to bright yellow

or yellowish brown mottled with gray. The lower subsoil is a yellow to bright or bronze yellow, more or less faintly streaked with gray, friable silty clay loam. In some places bits of shale and limestone fragments are encountered in the soil and subsoil, and frequently rotten shale is found in the subsoil. The dominant yellow color in the subsoil becomes more prominent with depth. The lower subsoil becomes more friable with increase in depth, approaching calcareous till, but the till material is seldom encountered within the 3-foot section. This soil is closely related to the Clyde silty clay loam. In places it is difficult to separate these types satisfactorily, and as mapped each soil may include patches of the other. In the western part of the county, west of Larue, around Morral School and north of Ridgeway School, there are several areas of the Brookston silty clay loam that differ from the typical in that their soils are dark grayish brown and their subsoils brownish gray with faint rusty-brown mottlings. In sections 9, 10, 15, and 16 of Claridon Township there are four small areas of Brookston fine sandy loam which are mapped with the silty clay loam type because of their small extent. These areas consist of a brownish-gray fine sandy loam to very fine sandy loam, underlain at about 8 inches by a yellow sandy clay to fine sandy clay mottled with gray. The yellow becomes more prominent with depth, and at 24 to 30 inches a coarse, gritty calcareous till is encountered. The Brookston silty clay loam is lower in organic matter than the Clyde silty clay loam, as determined from 10 surface samples of each.

This type is widely distributed through the county; it occurs mainly in the eastern, southern, and western parts. It is associated with the Miami, Clyde, and Crosby silty clay loam types, and occurs generally as narrow strips between the Miami and Crosby soils. These narrow strips usually are continuous and represent old drainage ways through the higher lying land. The type also occurs in more or less extensive areas, as in Richland Township and both north and west of Caledonia. This soil is intermediate in position and characteristics between the Crosby and Clyde silty clay loams.

The type has a level to slightly undulating surface and lies a little lower than the general level of the surrounding country. In places, especially along the slopes of the Scioto Valley, it extends for some distance up the slopes of the surrounding higher lying land, and the topography is rolling. Both the surface drainage and underdrainage are inadequate. In most instances, however, the soil is more or less efficiently drained by tile or open ditches.

Owing to its comparatively wide extent this is an important type agriculturally. Probably 75 to 80 per cent of it is under cultivation. Elm, swamp maple, ash, red oak, linden, and hickory constitute the principal tree growth. The crops grown are corn, mixed clover and timothy hay, oats, and wheat, named in the order of their impor-

tance. Hog raising and cattle and sheep feeding are carried on in conjunction with the production of these crops. The stock is pastured through the summer months, and in the fall a part of the corn is hogged off and the remainder is fed in the pastures or in feed lots to cattle and sheep. Oats are used as a supplementary feed in fattening sheep. The hogs are fed beef scrap, charcoal, and salt in self-feeders. Corn yields 55 to 65 bushels per acre, hay 1½ to 2 tons, oats 40 to 45 bushels, and wheat 25 to 35 bushels.

In handling this soil the farmers recognize that its first need is drainage. Where it is adequately drained fall plowing is not always practiced. Wheat is seeded in the fall after disking the corn land. In growing corn the seed bed is prepared in the spring and frequent cultivations are given until the crop is laid by. Acid phosphate at the rate of about 200 pounds per acre is applied with the wheat seeding. About 2 tons per acre of manure is used on the sod land or wheat stubble, and is plowed under in the fall or spring. Wheat and oats sometimes lodge on this type. The land is usually kept in grass for hay and pasture two to three years.

This type is valued at $125 to $200 an acre, depending on its drainage, its location with respect to markets and highways, and farm improvements.

In dry seasons this soil cracks badly, and there is a relatively large loss of moisture through evaporation. The addition of organic matter, deeper plowing, and thorough mulching would improve its moisture-holding properties and its tilth. Lime apparently is beneficial, as is acid phosphate.

CLYDE SILTY CLAY LOAM.

The surface soil of the Clyde silty clay loam is a black silty clay loam about 9 or 10 inches deep. To a depth of 20 or 22 inches the subsoil is a plastic silty clay loam. The upper part has a bluish-black color, and the remainder is grayish. The lower subsoil is a gray, plastic silty clay loam to silty clay streaked with yellow. At 30 to 36 inches a mottled yellow and gray, more or less friable silty clay loam is encountered. With increase in depth the yellow becomes somewhat more prominent and the texture more friable, but the calcareous unweathered glacial debris is rarely encountered within 3 feet. Occasional small shale and limestone fragments occur on the surface and throughout the soil section, and in the lower subsoil traces of decayed shale and iron streaks are present. This soil is comparatively uniform, although in some areas the surface soil is only about 6 inches deep. Such areas approach a silty clay in texture. In some places the type has a very fine sandy loam to fine sandy loam surface soil and a gritty or sandy clay subsoil. This is

the case in several small areas east of the county infirmary, in section 21, of Claridon Township, and on both sides of the Little Scioto River in upper Grand Prairie Township. Some areas mapped as the Clyde silty clay loam southwest of Kirkpatrick in association with the Miami silt loam, and in Salt Rock Township south of Morral approach a silt loam in texture. In such areas the surface soil is a deep, mellow, black silt loam which when dry has a mealy feel.

In the Little Scioto Valley north and northwest of Marion some areas of soil are included with the Clyde silty clay loam which represent variations from the typical soil. To a depth of 12 inches the surface soil is a black, mellow silt loam to friable silty clay loam containing a considerable quantity of fine gravel and stone fragments. The surface soil is high in organic matter. From 12 to 17 inches a bluish-black to steel-gray plastic silty clay loam is encountered. This becomes tinted with yellow in the lower portion, and contains some grit and pebbles. From 17 to 36 inches the subsoil is a heavy silty clay loam to clay loam of a yellow and bluish-gray color, the yellow becoming lighter with depth. In the lower subsoil appreciable quantities of coarse gravel and fine grit are encountered. In places the top soil is a fine sandy loam, and the subsoil is a fine sandy clay or clay loam. The surface carries numerous large foreign bowlders, while the stone fragments found throughout are largely waterworn, and of shale, sandstone, and limestone origin. Unweathered glacial debris is found at 5 or 6 feet and at times is encountered within the 3-foot section.

When wet the surface soil of the Clyde silty clay loam usually is coherent and sticky. When dry the surface cracks badly. As noted in the description of the Brookston silty clay loam, the Clyde silty clay loam is closely associated with that type, but contains more organic matter and frequently has a more conspicuous black and bluish-black color.

This type occurs southeast, east, and northeast of Marion. It is mapped also in Salt Rock and Grand Prairie Townships, and occurs as more or less continuous areas representing depressions between areas of higher lying types.

The surface is flat to slightly undulating. In some cases the type extends well up the adjacent slopes on which the Miami silty clay loam predominates, and the topography in such places is rolling. Both surface drainage and underdrainage are naturally poor, and in many places tile and open ditches are used to improve them.

This is one of the most important and productive soils in the county, and probably 90 per cent of it is under cultivation. A large part of the type was originally prairie, but in places it is forested, chiefly with poplar, elm, and swamp ash.

The principal crops grown on this soil are corn, hay, oats, and wheat. Some truck crops are produced in the vicinity of Marion. Hog raising and sheep and cattle feeding are important on this type. Some of the corn crop is hogged off. Corn yields from 60 to 75 bushels of grain and 8 to 10 tons of stover per acre, hay 1½ to 2½ tons, oats 40 to 50 bushels, and wheat 30 to 40 bushels. Soy beans produce heavily.

For wheat this soil is plowed in the fall to a depth of 7 or 8 inches after a top-dressing of manure, at the rate of about 2 tons per acre, has been applied. In most cases, however, the corn land is disked and seeded to wheat, the shock rows being planted to oats in the spring. When opportunity is afforded, plowing for corn and oats is done in the fall after the land has been manured. Very little commercial fertilizer is used on this soil, but where any is applied acid phosphate is used. Small grains have a tendency to lodge on this type. Frequent shallow cultivation is given corn.

The Clyde silty clay loam sells for $150 to $200 an acre, the price varying with the drainage conditions and with location with respect to markets.

This type is considered among the most productive soils of the county, and it is generally well farmed. Although a large part is artificially drained, there is still much of it in need of this improvement. Deep plowing is advantageous.

FOX LOAM.

The soil of the Fox loam, to a depth of 9 or 10 inches, is a brown to light-brown silty loam to loam, generally containing relatively large proportions of fine sand and very fine sand. The subsoil varies from a gritty and gravelly loam to sandy loam or sandy clay loam. The subsoil is yellowish brown with a slight reddish tinge. In most cases it is underlain by stratified gravel and sand, and often it is impossible, on this account, to bore with the auger deeper than 2 feet. The surface soil usually carries sufficient silt and clay to cause it to clod on drying. Rounded gravel of limestone and shale origin is found on the surface and through the soil section. Areas of the Fox fine sandy loam occurring northwest of Larue and northwest of Marion are included with this type. The area of Fox loam mapped in sections 7 and 8 of Marion Township is a sandy loam underlain with limestone. The areas mapped as the Fox loam at Larue and Prospect approximate in characteristics the Waukesha loam.[1]

The Fox loam occurs as terraces above overflow along the Olentangy and Scioto Rivers and in the Little Scioto Valley north of

[1] The Waukesha series is characterized by dark-brown to black surface soils underlain by yellow gritty and gravelly subsoils. The series is not recognized in Marion County.

Marion. Its topography is flat to gently undulating. The surface drainage is good, and the underdrainage, as a result of the porous nature of the substratum, is good to excessive.

Owing to its small extent this is not an important type. Practically all of it is under cultivation. The important crops are corn, hay, oats, and wheat, and the yields range from 50 to 60 bushels of corn, 1 ton to 1½ tons of hay, 40 to 50 bushels of oats, and 25 to 30 bushels of wheat per acre.

Land of this type is valued at $100 to $150 an acre, depending on its state of cultivation and nearness to markets.

This is a good potato and alfalfa soil, though it is necessary to apply lime in order to get the best results with alfalfa. In dry seasons frequent shallow cultivation is necessary to obtain good yields of corn.

LUCAS SILTY CLAY LOAM.

The surface soil of the Lucas silty clay loam is gray, with a yellow tinge when wet. It is about 7 inches deep, and consists of heavy silt loam to silty clay loam. The subsoil, to a depth of about 20 inches, is a lighter gray, dense, brittle silty clay loam to silty clay, mottled with bright yellow or tan. The lower subsoil is a gray or bluish-gray, indistinctly mottled with brownish or tan yellow, brittle clay. This heavy material contains some white particles consisting of precipitated calcium carbonate. As a rule few stones occur on the surface, and the soil section is free from grit. The lower subsoil in some places is yellowish brown, streaked with drab, and contains partially decayed limestone and rotten shale fragments, a calcareous till being encountered at about 30 inches. Throughout this type there are areas having sandy surface soils and sandy clay subsoils, representing inclusions of the Homer loam.

This type occurs in the Scioto Valley west of Marion, as slight elevations through areas of the Newton silty clay loam and silty clay. The topography is flat to gently undulating. The surface drainage is fair, and the underdrainage is poor owing to the dense, heavy-textured subsoil.

This is an unimportant type because of its small extent. Practically all of it is cleared and under cultivation. The original tree growth consisted of beech, oak, and hickory.

The main crops grown are corn and hay with some oats and wheat. Stock feeding is carried on in connection with the production of these crops. Farming is conducted in the same manner as on associated types.

Corn yields 40 to 50 bushels per acre, hay 1 to 1½ tons, oats about 30 bushels, and wheat 20 to 25 bushels.

This soil is generally fall plowed for corn. Manured sod land usually is used for this crop. Further preparation of the seed bed is done in the spring, and the corn is given shallow cultivation until the crop is laid by. The corn stubble is disked in the fall and seeded to wheat and timothy. Practically no commercial fertilizer is used.

This type sells for $125 to $150 an acre, depending mainly on its proximity to markets.

The plowing under of green-manure crops, the liberal application of barnyard manure, and deep plowing improve the physical condition of the surface soil. Liming and the growing of soy beans are beneficial.

HOMER LOAM.

The Homer loam is of variable texture. The surface soil, to a depth of 6 or 8 inches, is usually a grayish-brown to brownish-gray, friable loam to fine sandy loam. The upper subsoil to about 20 inches is a yellow or yellowish-brown, mottled with gray, fine sandy clay to gritty clay loam. This is underlain by a dull yellowish brown clay loam, with traces of bluish gray and gray. Streaks of iron and rotten shale fragments are often found in the lower part of the soil section. At depths of 30 to 36 inches a brownish-gray, heavy, plastic silty clay to clay, containing white precipitated lime particles, is encountered. In some places a bronze-yellow or drab-brown, calcareous clay loam till, similar to that underlying the Miami silty clay loam, is found at about 30 inches. Small pieces of shale, limestone, and granitic material which may have been transported by stream waters or worked up from the underlying glacial till are often found on the surface and in the soil section. In several places this soil is a fine sandy loam in texture. This is the case in the areas directly southwest of Marion, around Cleveland School, and in the Little Scioto Valley north of Marion. In most cases, however, the type contains enough clay to cause cracking and baking when dry, and the surface in dry seasons has an ashy-gray cast, resembling the Crosby silty clay loam.

The Homer loam occurs in the Scioto and Little Scioto Valleys west and north of Marion as narrow strips or ridges adjoining the first bottom, especially of the Scioto, or where the second bottom approaches the uplands, as around Cleveland School and north of Marion. It is associated with the Newton silty clay loam, occupying ridges or knolls through this type.

The surface is undulating to flat, and the type occurs at slightly higher elevations than the surrounding soils. The surface drainage is good, but on account of the dense clay substratum the internal drainage is poor.

This is an unimportant type in the county on account of its small extent. Practically all of it is under cultivation, but there are scattered patches of woods consisting of beech, oak, and hickory, with some elm and ash.

The principal crops are corn, oats, wheat, and hay, named in order of their importance. Potatoes are grown successfully by a few of the farmers. Hog raising and cattle feeding are unimportant.

Corn yields 45 to 55 bushels per acre, oats 35 to 45 bushels, wheat 25 to 30 bushels, and hay 1 to 1½ tons. The land is plowed for corn and oats in the fall with the associated heavier soils. Corn is given frequent shallow cultivations before the crop is laid by. Corn stubble is disked in the fall for wheat. A small quantity of manure is applied in the fall and plowed under. Acid phosphate is practically the only commercial fertilizer used.

This type sells for $125 to $150 or more an acre, depending on its location and the character of the soil with which it is associated.

This type is in need of organic matter, which may be supplied by barnyard manure or green-manure crops. Lime also is beneficial. The underdrainage should be improved.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, subsoil and lower subsoil of the Homer loam:

Mechanical analyses of Homer 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.*
272139	Soil	0.6	3.4	3.4	28.1	14.0	37.2	12.9
272140	Subsurface	.4	3.1	3.7	30.7	12.7	30.3	19.1
272141	Subsoil	.4	2.0	2.7	22.2	15.4	30.5	26.8
272142	Lower subsoil	1.3	1.7	1.2	10.3	7.0	35.1	43.3

NEWTON SILTY CLAY LOAM.

The surface soil of the Newton silty clay loam consists of a dark-gray or black heavy silt loam to light silty clay loam, about 10 inches deep. To a depth of about 18 inches the subsurface material is a dark-gray silty clay loam, with slight tinges of yellow. The yellow becomes more prominent and the gray assumes a lighter shade with depth. The upper subsoil consists of a yellow and gray mottled or speckled silty clay loam. Yellow becomes the dominant color with increase in depth. The lower subsoil is encountered at about 30 inches. It is more friable than the overlying material, and has a bronze-yellow color streaked with iron stains. The substratum consists of stratified sand and clay. The soil is practically free from stones. Unweathered glacial till is encountered at depths of 10 to 15 feet.

This type includes some low, wet swales of heavier textured soil having more of a dark grayish brown color. These represent areas of the Newton silty clay, but the areas are too small to be mapped satisfactorily. Some areas of this Newton soil south of the Scioto River have on the surface considerable fine sand and small gravel, apparently deposited by the overflow waters of Rush Creek and the Scioto River. In the forks between these two streams the soil is more or less gritty and sandy, and at about 36 inches calcareous till is encountered. The type cracks badly on drying.

The Newton silty clay loam occurs in the Scioto bottoms west of Marion, and is the predominating soil in this part of the county. It is composed of material deposited in temporary glacial lakes.

The topography is flat to gently undulating, and in some places the surface is more or less dissected by old drainage ways. The natural drainage is poor, and on account of the heavy, plastic nature of the subsoil the underdrainage is inadequate. In most instances, however, the type has been ditched and tiled and is fairly well drained.

This type is about equal to the Clyde silty clay loam in agricultural value. It is practically all under cultivation. Originally it was swampy and supported only a few trees, including elm, swamp ash, swamp maple, and oak.

The most important crop on this soil is corn, but hay, oats, wheat, and cowpeas also are grown. Hog raising and cattle feeding are followed under the system prevailing on other soils. A part of the corn crop is always hogged off, and most of the remainder is husked in the field and the stalks left standing, though some farmers have silos and still others store the dry fodder for winter feed.

Corn yields 60 to 75 bushels, hay 1½ to 2½ tons, oats 40 to 50 bushels, and wheat 30 to 40 bushels per acre. Cowpeas give good yields. The land for corn or oats is plowed in the fall, and given further preparation in the spring. The crop is given frequent cultivation. Where available, manure is applied to the land in the fall, but practically no commercial fertilizer is used on the type. Corn stubble is prepared for wheat simply by disking.

Land of this type sells for $150 to $200 an acre, depending on the drainage and location.

This soil is difficult to handle, and an improvement in its physical condition is needed. This may be accomplished by adding manure, plowing under green-manure crops, growing cowpeas, applying lime, and providing efficient drainage.

The following table gives the results of mechanical analyses of samples of the soil, subsoil, and lower subsoil of the Newton silty clay loam:

Mechanical analyses of Newton silty 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.*
272143	Soil	0.1	0.8	1.0	12.9	10.6	47.2	27.5
272144	Subsoil	.3	1.0	.9	12.5	12.7	42.0	30.7
272145	Lower subsoil	.1	1.0	.7	8.1	11.5	43.2	35.2

NEWTON SILTY CLAY.

The surface soil of the Newton silty clay is about 7 inches deep and consists of a dark-gray heavy silty clay loam to silty clay, often showing rusty-brown mottling. The surface soil is slightly lighter textured than the subsoil and contains considerable organic matter. The upper subsoil, extending to a depth of about 20 inches, is a dense and brittle silty clay of a gray color, in places faintly streaked with yellow. The lower subsoil is a brittle silty clay. It is gray in color, and streaked with tints of yellow, which become more prominent with depth, although the gray color predominates throughout the 3-foot section. The subsoil has a greasy or soapy feel. No grit occurs in any part of the soil section, but occasional rounded pebbles may be found in the lower subsoil. There is evidence of calcareous till within the 3-foot section, and this material seems to lie at considerable depth. In the smaller areas of this type south of Agosta and westward toward Larue, or where the soil is associated with the Miami silty clay loam or the Lucas or Homer soils, some variations occur. The surface soil may be a silty clay loam, grayish brown or yellowish brown in color, with rusty-brown mottlings, and the subsoil a light steel gray or bluish gray with rusty-brown mottlings. On drying this type cracks badly, cracks 2 inches wide and 8 to 10 inches deep commonly being formed.

This soil occurs in two main bodies, one in the northwestern part of the county in Grand and Salt Rock Townships, and one in Big Island Township, west of Marion. There are several small areas in the vicinity of Springhill School. It occupies continuous and extensive areas and apparently was formed under lake conditions. The topography is flat. Both the surface drainage and underdrainage are poor.

This is a relatively unimportant type in the county, both on account of its small extent and its low agricultural value. However, probably 90 per cent of it is cleared. There are a few patches of elm, poplar, and swamp maple, with some oak.

The chief crops grown are corn and hay, with some oats and wheat. Some sweet corn for canning is grown. A large part of this type is used for pasture. Stock feeding is practiced in conjunction with grain farming. Corn yields 40 to 50 bushels of grain and 5 or 6 tons of stover per acre. Hay yields 1 ton to 2 tons, oats about 30 bushels, and wheat 20 to 25 bushels per acre.

This soil is recognized as being decidedly intractable and is locally known as "Jack-wax land" or "Kildeer land." It is necessary to plow in the fall, in order that winter freezing may pulverize the surface soil, so that a seed bed can be prepared in the spring. Manure in light applications is practically the only fertilizer used. Where farmed this soil is either tiled or drained by open ditches. Corn stubble is disked in the fall and seeded to wheat and timothy, although the type is not well suited to wheat. Corn is cultivated as frequently as possible, but it often receives only one or two cultivations, and in such cases the yield of stover is low.

This type sells for $125 to $150 an acre, depending on its location and drainage.

Deep plowing, the heavy application of manure, the turning under of clover, the growing of soy beans, and the application of lime at the rate of about 800 to 1,000 pounds per acre are effective means of improving the structure and general tilth of the Newton silty clay. This type as a whole is in need of better drainage. Where artificial drainage has been installed decidedly better crop yields are obtained. It is necessary, however, to place the tile 25 to 35 feet apart, and at shallow depths, in order that they may act effectively. The cost of such intensive tile draining is high, and the value of the undrained land would largely determine whether or not such a large amount of tile draining could be done profitably. This land is generally well supplied with main open ditches which provide outlets.

The beet industry has been successfully developed on land similar to this in the western part of the State. This crop is not grown on the type in this county, however, apparently because there is no factory near to handle the product.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Newton silty clay:

Mechanical analyses of Newton silty clay.

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.*
272101	Soil	0.0	0.4	0.5	4.7	4.6	49.7	39.8
272102	Subsoil	.0	.4	1.4	6.0	2.6	41.2	48.5

GENESEE SILT LOAM.

The surface soil of the Genesee silt loam consists of about 15 inches of grayish-brown to brown, mellow silt loam. The subsoil, to a depth of about 24 inches, is a light-brown, compact silt loam to silty clay loam, faintly streaked with gray or rusty brown. The lower subsoil is a brown to dark-brown clay loam. At times the subsoil contains appreciable quantities of grit and sand, and in places it is mottled or streaked with gray. Below 36 inches the material becomes coarser in texture and grades into sand and gravel. This type, in the oxbows of the Big Scioto River, includes some wet, swampy areas that are relatively dark at the surface and have a silty clay loam to silty clay subsoil, with no coarse material.

This type occurs as first bottoms along the larger streams of the county. The topography is flat, and the natural drainage is good. The type is only slightly elevated above the streams, however, and is overflowed at times of high water.

The Genesee silt loam is unimportant in this county, very little of it being farmed. It supports a scattered growth of willow, with some poplar, elm, and walnut. Most of the type is cleared, but its chief use is for pasture and hay land. Hay yields 2 to 2½ tons per acre. It takes about 2 acres to support a steer.

The value of this soil depends largely on the character of the land with which it is associated and the pasturage afforded. It sells for $100 to $125 an acre.

In other sections of the country this soil has proved to be a good corn soil, and in Marion County, where the type can be protected from overflow without too much expense, profitable yields of corn could probably be obtained.

MUCK.

To a depth of 6 or 8 inches the material mapped as Muck consists of black, more or less thoroughly decomposed organic matter, with which an appreciable quantity of mineral soil material is mixed. This surface deposit is underlain by a gray or grayish-brown silt loam or silty clay loam streaked with bog iron. The black mucky surface material is invariably shallow, rarely extending to a depth of more than 10 inches.

Areas of Muck occur in Scott and Claridon Townships, in association with the Clyde soils, and apparently represent depressions where there has been a greater accumulation of organic matter. The surface is flat, and both surface drainage and underdrainage are deficient.

Owing to its small extent the Muck in Marion County is relatively unimportant. Corn and truck crops are practically the only crops grown. Corn yields 75 to 80 bushels per acre. The Muck areas are valuable for trucking.

This land ranges in value from $125 to $175 an acre, depending on its location.

No fertilizer or manure is applied. The Muck is generally plowed in the spring. Almost all of it is drained by open ditches and tile.

SUMMARY.

Marion County, Ohio, lies just northwest of the center of the State. It has an area of 409 square miles, or 261,760 acres. The county occupies a broad, smooth to rolling plain, more or less dissected by drainage ways. The Scioto and Little Scioto Rivers are the chief streams. The natural drainage is far from adequate and considerable areas have been drained artificially.

The first white settlements were made in this region in 1806. The county was organized in 1821 and its present boundaries were established in 1848. The population is reported in the 1910 census as 33,971. Marion, the county seat, is the largest town, with a population reported in 1910 as 18,232. Rail transportation facilities are good, and the county is well supplied with good roads.

The climate is temperate, with ample rainfall in the growing season and considerable snow. The mean annual temperature is reported at Marion as about 51° F., and the mean annual precipitation as 38.57 inches, with 26.5 inches of snowfall. The growing season averages 152 days.

The higher land was the first to be brought under cultivation. Grain growing and stock feeding early became the chief agricultural industries. The present agriculture consists of general farming combined with stock feeding. Corn, oats, hay, and wheat are the principal crops. Oats and wheat are the chief money crops, and garden vegetables, potatoes, poultry and dairy products, and fruit are produced mainly for home use. The corn is indirectly a money crop, being used to fatten stock. Some hay is sold, but the greater part is fed on the farm. Hog raising is probably the most important live-stock industry. Sheep and cattle are shipped in from western points and fattened for market.

The broad adaptation of the soils of the county to the chief crops is generally recognized. In general, up-to-date methods of farming are practiced. The farms are well improved, have modern, well-kept buildings, and are supplied with a good equipment of improved farm machinery. The work stock consists mainly of horses of good grade. Crop rotation is generally practiced. All available

manure is applied to the fields, but little commercial fertilizer is used. Farm labor is efficient and is well paid.

The farms in Marion County are prevailingly a little over 100 acres in size; the average size is reported in the 1910 census as 113.2 acres. The census reports 2,141 farms in the county, about 93 per cent of its total area being in farm land. Of the farm land, nearly 90 per cent, or an average of about 101 acres per farm, is reported as improved. About 65 per cent of the farms are operated by their owners and practically all the remainder by tenants, who farm the land mainly under the share system. The average value of farm land is reported in the 1910 census as $73.26 an acre, although little land is sold for less than $100 an acre. Good farm land, especially near Marion, sells for $200 to $225 an acre.

Marion County is in the glaciated region of the United States, and the soils chiefly belong to two provinces, the Glacial and Loessial and the Glacial Lake and River Terrace. The bedrock is predominantly limestone or shale. Most of the soils are heavy textured. Some of the material is calcareous.

Excluding Muck, 12 soil types, representing 10 soil series, are mapped. The higher, better drained, and light-colored soils of the upland are classed with the Miami, Crosby, and Bellefontaine series. The Clyde, Brookston, and Newton series include the low-lying, poorly drained, and generally dark-colored soils.

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