U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

[Cooperating with the Ohio Experiment Station, Charles E. Thorne, Director.]

SOIL SURVEY OF THE WESTERVILLE AREA, OHIO.

BY

J. E. LAPHAM AND CHARLES N. MOONEY.

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[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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SOIL SURVEY OF THE WESTERVILLE AREA, OHIO.

By J. E. LAPHAM and CHARLES N. MOONEY.

LOCATION AND BOUNDARIES OF THE AREA.

The Westerville area is situated in the south-central part of the State of Ohio, and comprises about 475 square miles. It includes all of the Westerville and Dublin quadrangles of the United States Geological Survey, which lie between 82° 45′ and 83° 15′ west longitude, and 40° and 40° 15′ north latitude. No definite civil boundaries are followed, but the area includes the northern half of Franklin County, together with a narrow strip along the western edge of Licking County,

FIG. 1.—Sketch map showing the location of the Westerville area, Ohio.

the larger parts of the townships of Mill Creek and Jerome in Union County, about 12 square miles of Madison County, and a belt about 3 miles wide along the southern boundary of Delaware County. The area takes in a part of the northern edge of the city of Columbus, which is located midway of the southern boundary. Columbus is in the same longitude as Detroit, and the same latitude as Philadelphia.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

It was not until after the close of the Revolutionary war that the first permanent white settlements were established in the section of the State covered by the present survey. Franklinton, on the site of the present city of Columbus, was laid out in 1797 by Lucas Sullivant, who came from Virginia to survey the lands known as the Virginia Military District, and to be used for the benefit of the soldiers from that State who fought in the war of the Revolution. Following the settlement at Franklinton were others scattered along Alum Creek and the other water courses of Franklin and the adjoining counties, wherever the most desirable farming lands were located. Wheat, which was cut with a sickle and thrashed with a flail, was one of the principal crops grown by the early settlers. For several years there was no mill or settlement nearer than Chillicothe, and much difficulty was experienced in getting the wheat ground into flour. The first small mill in Franklin County was built about 1799 a short distance above Franklinton. The first store was built in Franklinton about a year after settlement began, but for several years Chillicothe, 45 miles south, on the Scioto River, was the town to which the pioneers journeyed to secure their merchandise and get their mail.

Franklin County was organized in 1803, from Ross County, and Delaware was erected from Franklin in 1808. The first settlement in Delaware County was made in 1801, 5 miles below where the town of Delaware now stands. The early settlers of Delaware, as well as of Franklin County, came principally from Pennsylvania, New York, and Virginia, and from Massachusetts and the other New England States.

Lack of transportation was a great bar to progress during the early history of the section. The country being heavily forested, the roads were few and in bad condition, and as much as possible of the travel was made by boat on the rivers. In 1825 the National road, which Congress had ordered constructed from Cumberland Gap to the Ohio River, reached the latter point, and in 1836 it was constructed through Columbus in the direction of Indianapolis. In 1825 the Ohio Canal, which was to connect Cleveland with Portsmouth on the Ohio River, was commenced. The Columbus feeder tapped the canal at Lockburn in the southern part of Franklin County in 1831, and the main canal was finished in 1838. The first railroad was begun in Ohio in 1841, and in 1850 the first passenger train ran into Columbus on the Columbus and Xenia Railroad.

Considerable interest was early manifested in the establishment of agricultural societies and fairs, and in the improvement of cattle and other live stock. By act of the legislature, 1828, an agricultural convention was authorized to be held annually in Columbus, at which all of the counties of the State were to be represented.

CLIMATE.

The appended table gives the mean monthly and annual temperature and precipitation for the station of the Weather Bureau at Columbus. While there are several voluntary observation stations within the area and around it and records have been kept for a number of years, the data are in all cases incomplete. The records given are for a period of twenty-six years. They are continuous and complete, and should fairly well represent the conditions obtaining in the area. The mean annual temperature, as shown by the table, is 52.2° F. The seasonal means for winter, spring, summer, and fall are, respectively, 30.7°, 51°, 73°, and 54.2° F. The average maximum temperature for the summer season is 83.2° F. Hot spells are of common occurrence, during which the temperature sometimes reaches 90° F. or more. These periods of extreme heat are generally accompanied by a high relative humidity and often by hot nights. The winter weather is quite variable. The average minimum temperature is 23.7° F., though a temperature as low as −20° has been recorded in both January and February. The average snowfall for the past twenty-six years is 23.5 inches.

The average date of the first killing frost in autumn is October 16 and of the last killing frost in spring April 16. The rainfall is usually well distributed throughout the year, the least fall occurring in the autumn and winter months. The seasonal averages for spring, summer, autumn, and winter are, respectively, 10, 10.20, 8.07, and 8.99 inches. The prevailing direction of the winds throughout the year is generally southwesterly, though in February and March they are westerly and in September southerly.

Normal monthly and annual temperature and precipitation.

Month.	Temperature.	Precipitation.	Month.	Temperature.	Precipitation.
	°F.	*Inches.*		°F.	*Inches.*
January	28.8	3.04	August	72.6	3.06
February	30.8	3.25	September	66.5	2.54
March	39.0	3.28	October	54.6	2.33
April	51.4	2.89	November	41.6	3.20
May	62.6	3.83	December	32.6	2.70
June	71.2	3.55	Year	52.2	37.26
July	75.3	3.59			

PHYSIOGRAPHY AND GEOLOGY.

The Westerville area consists of a comparatively level plain having a slight fall to the south. The maximum elevation of 1,140 feet above sea level is reached in the southeast corner of Delaware County, on the eastern edge of the map, while the least elevation is found 17 miles

farther southwest, where the Olentangy River flows from the area. Into this plain four principal valleys have been eroded by the Scioto and Olentangy rivers and by Alum and Big Walnut creeks, which are crossed in the order mentioned in traveling through the area from west to east. These streams take nearly straight, almost parallel, and approximately equidistant courses a little east of south, flowing from the northern to the southern boundary of the area. The higher intervening uplands average about 4½ miles in width, and from their crests to the streams the topography shows a gentle slope at the rate of about 100 feet to the mile, the relative depths of the valleys ranging from 100 to 200 feet. The immediate escarpment or stream bank is apt to be quite abrupt, ranging in height from 15 to 30 feet or more above the bottoms. Along the streams varying widths of alluvial flats have formed, the most extensive ones being seen along Alum and Big Walnut creeks. The Scioto River flows through a narrow, gorgelike valley and little alluvium has been deposited along it. Shorter, lateral streams, tributary to the four main ones, have eroded small valleys into the upland, and where these join the main streams their banks are sometimes quite high and steep. A narrow strip of bottom land sometimes fringes their lower courses.

The greater portion of the upland plains is only gently undulating. In Harlem Township, Delaware County, in the northeastern corner of the area, the fall is seen to be in some places less than 20 feet to the mile; and, also, in the southwestern part of the area the surface appears quite flat to the eye, and only a very slight fall is shown by the topographic contour lines. With the exception of these two localities, however, the fall is sufficient to secure easy drainage, and the surface is undulating enough to afford pleasing relief to the eye.

The natural forest growth has been largely cut away so that for the most part only small, sparsely timbered wood lots are at present to be seen. Probably not over 10 per cent of the area is forested. The original growth on the Miami clay loam upland consisted largely of the various oaks, beech, and hard and soft maple, while the swamp white oak, hickory, and black walnut were the predominating species on the lower lying Miami black clay loam and the bottom lands. In the last few years considerable interest has been manifested by some of the farmers in the planting of trees for post timber and other uses, the common locust and catalpa being the species selected for this purpose.

The underlying rock structure of the Westerville area consists of limestones and shales of the Devonian and Carboniferous ages. Belonging to the former division are the Corniferous limestone and the Huron shales, while the Carboniferous age is represented in the area by the Waverly group. The Corniferous limestone is found in the western part of the area, mainly west of the Scioto River. This lime-

stone is hard and offered much resistance to preglacial erosive agencies, so that lateral stream drainage tributary to the Scioto is not as well established as in some other parts of the area. This formation, with the possible exception of a very narrow strip on the east bank of the Scioto, has been covered with glacial material and the prevailing type of soil, the Miami clay loam, shows no recognizable difference in character from that covering the central and eastern parts of the area surveyed. The rock is not exposed except along the Scioto River, where it is quite extensively quarried for building purposes.

The Huron shales, the next highest in the geological scale, cover the greater portion of the area, extending in a broad belt from north to south. These blue shales constitute much the most easily eroded rocks of the area, and the cutting of the streams has resulted in producing a rougher, more undulating topography, especially near the edge of the escarpment, where the short lateral water courses join the main streams.

The rocks of the Waverly group are confined to the eastern and northeastern parts of the area. They consist of shales and a fine sandstone, in the latter of which a quarry has been opened at Sunbury. These rocks, like those of the underlying Huron shales, are covered with a blanket of glacial drift and enter into the composition of the soils only so far as their residual material has been mixed and ground up and left in an altered state by the passage of the glaciers. The Miami clay loam is here as elsewhere the principal type.

SOILS.

The soil conditions of the Westerville area are quite uniform, and only four distinct types have been recognized.

The following table gives the relative and actual extent of each of these types:

Areas of different soils.

Soil.	Acres.	Per cent.
Miami clay loam	267,264	87.8
Miami loam	17,856	5.9
Miami black clay loam	16,128	5.3
Miami gravelly loam	3,136	1.0
Total	304,384	.....

MIAMI CLAY LOAM.

The soil of the Miami clay loam, to an average depth of 10 inches, possesses a fine uniform silty texture, exhibiting little variation in the most widely separated parts of the area. Though the soil contains a relatively high percentage of clay, the particles are so masked

by the silt that the clayey characteristics of a sample as a whole are not noticeable when in a normal state of moisture. There are sometimes present a few granules of shale or limestone of the size of coarse sand or fine gravel, giving to the mass a very slightly gritty feel. These can oftentimes be broken down between the thumb and finger. Very little stone occurs in the soil or subsoil of this type, except along the escarpments bordering nearly all the streams and bottom lands. In these situations the glacial gravel is exposed, and a band of from 2 to 10 rods wide of more or less gravelly soil results. Where this is of sufficient width to indicate on the map, it appears as Miami gravelly loam. The surface color varies from a light yellowish brown, in locations where natural drainage is the best, to a dark brown, in areas of slight depression and at the line of contact with Miami black clay loam. The texture of the soil in the latter instances is somewhat heavier, the subsoil remaining about the same.

The subsoil is a compact silty clay, slightly mottled with dark-brown or bluish clay in some instances, but the color is usually a uniform brownish yellow. The subsoil becomes gradually heavier with increasing depth, and a few chips of shale or limestone are sometimes encountered. Except along the streams, as mentioned above, there is but little stone or gravel in the subsoil, until the glacial till or bowlder clay is reached at a depth of from 4 to 6 feet.

Miami clay loam is the predominating type in point of distribution, and is found in all parts of the area surveyed, forming 87.8 per cent of the entire area of the sheet. The topography varies somewhat. Along the principal streams there is often quite an abrupt fall of from 20 to 50 feet from the uplands down to the bottoms, the escarpment line being more or less dissected by small lateral streams. Upon the upland, from 2 to 5 miles back from the main streams, the surface is slightly undulating. The natural drainage in the latter situations is usually deficient, and to improve this condition a great many miles of open ditches and tile drains have been put in. Even those portions of the type where a fairly undulating surface prevails require a more thorough drainage than they generally receive.

The Miami clay loam is derived from a combination of the residual material, caused by the weathering of the underlying rock, and the various assortment of materials subsequently brought down and distributed by the glaciers. In this work the glaciers were assisted by a considerable volume of water from the melting ice.

The Miami clay loam is essentially a grain and hay soil, and is well adapted to general farming purposes. Of the grain crops, wheat and oats do best. Hardly as good results are secured with corn as upon the Miami loam and the best drained areas of Miami black clay loam, but it is nevertheless a very good corn soil in seasons of normal rainfall and under intelligent methods of cultivation. Under good methods

of cropping and cultivation wheat will yield on an average from 20 to 25 bushels and corn from 40 to 50 bushels per acre. Hay produces 1 to 2 tons, the product being timothy and clover, separate or mixed. A small proportion of the home vegetables produced in the area is grown upon this type.

The following table gives the average results of mechanical analyses of typical samples of the soil and subsoil of the Miami clay loam:

Mechanical analyses of Miami clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
12820, 13213, 13215, 13217, 13219..	Soil	0.8	2.4	1.8	5.4	7.5	58.6	21.2
12821, 13214, 13216, 13218, 13220..	Subsoil.....	.7	2.5	1.8	6.0	7.6	44.0	36.9

In order to ascertain the manurial requirements of this soil a large sample was collected 1 mile west of Dublin. The soil here is a light-brown silty loam of uniform texture, the sample being taken to a depth of about 7 inches. The history of the particular field from which the sample was taken was not obtained, but the larger part of the area of the Miami clay loam has been in cultivation for fifty years or more, receiving occasional small applications of stable manure.

Results obtained by the wire-basket method indicate that a good increase in productiveness may be obtained by an application of cowpeas and lime; that an application of nitrate of soda and acid phosphate will give a moderate increase; and that a very small increase may be obtained by use of manure, of acid phosphate, of lime, or of potash, or by a combination of these.

In these tests wheat plants were used as an indicator and the results are held to be applicable only to related crops and to the particular field from which the sample was taken.

MIAMI BLACK CLAY LOAM.

The surface 12 inches of the Miami black clay loam consists of a dark-brown to nearly black fine-grained loam, composed mainly of silt, but containing enough clay to render it quite sticky when wet, and to cause it to form wide and deep cracks at the surface when it is allowed to dry without cultivation after a rain. If plowed or cultivated when wet, clods form to a considerable extent, though upon contraction some of these latter show a tendency to slake and break down into small angular and more or less cubical granules, forming a sort of mulch at the surface. A small amount of sand of the finer grades occurs in the soil, but its presence is scarcely discernable to the touch or to the unaided eye. Rarely is any stone or gravel seen at the sur-

face or in the subsoil of the Miami black clay loam. Cultivated under the proper conditions of moisture, the soil works up loose and mellow and forms an excellent seed bed.

The subsoil consists of a heavy, sticky, waxy clay, so close and compact in structure as to offer great resistance to the passage of water. The clay content usually increases with depth, though in some cases the subsoil is seen to grow somewhat lighter and more silty just below 30 inches. The color of the upper section of the subsoil is a very dark drab, slightly mottled with brown. Below 18 to 24 inches the color is usually a slightly mottled brownish yellow.

The Miami black clay loam is found most extensively developed in the southwestern part of the area, though it is sparingly distributed in other parts. In the vicinity and west of Hayden and Kileville occur some quite large and connected areas. In the eastern and central parts of the area there are to be seen many small and irregularly shaped areas from one-half acre to 2 or 3 acres in extent, occurring in depressions in the Miami clay loam. Though these are quite noticeable in driving over the roads and are of importance in the relation of the adaptation of soils to crops on individual farms, the scale of the map (1 inch to 1 mile) did not admit of their being separately shown, and it was necessary to omit many of these smaller areas from the map. In the case of the larger areas of Miami black clay loam in the western part of the survey it was impossible to recognize many of the clay knolls (Miami clay loam) which occur scattered about in otherwise uniform areas of the black clay loam.

The Miami black clay loam is nearly always found in flat or more or less basinlike areas. Narrow strips also occur along some of the smaller drainage ways, especially at their upper ends. Because of their relative nearness to natural outlets and the oftentimes greater fall, these latter-mentioned strips are the most easily drained of any of the areas of Miami black clay loam. The larger more continuous bodies of the type, found at some distance from natural drainage outlets, require considerable outlay to fit them for the production of cultivated crops.

The Miami black clay loam was formed after the retreat of the glaciers in the areas of depression and poor drainage. These wet spots favored the growth of a great deal of vegetation, the decay and subsequent incorporation of which with the mineral matter is responsible for the resulting black soil.

Well-drained areas of Miami black clay loam are especially well adapted to corn. The subsoil is usually abundantly supplied with moisture for the needs of the crop, and if worked at the right time and under favorable conditions cultivation is not difficult. The land needs to be very thoroughly underdrained and the water table lowered. Wheat gives good yields in favorable seasons, but one year with

another it is best confined to the Miami clay loam. If the ground is first thoroughly drained, potatoes would do well upon this type, as also some varieties of vegetables, such as celery, onions, cabbage, etc.

At present corn, wheat, and oats are the principal crops grown upon the Miami black clay loam, the former having the largest acreage, and yielding from 40 to 75 bushels under average conditions. Wheat produces about 25 bushels in good years, while about 50 bushels of oats per acre are secured. Grass is usually grown in rotation with corn and wheat, and yields on an average about 1½ tons. A great many of the kitchen gardens of the area are situated upon the Miami black clay loam. It is noticeable that in areas of Miami clay loam the dwelling houses will frequently be located near a spot of the black clay loam of half an acre or so in extent, suitable for the home garden.

The following table shows the average results of mechanical analyses of the soil and subsoil of the Miami black clay loam:

Mechanical analyses of Miami black clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13209, 13211.....	Soil	0.8	2.1	2.1	7.0	7.2	51.9	28.6
13210, 13212.....	Subsoil.....	.5	2.0	1.5	4.5	7.9	50.3	33.1

In order to ascertain the manurial requirements of this soil a large sample was collected 2½ miles southeast of New California. The sample was taken to a depth of 8 inches, the soil at this point being a black clay loam which clods badly. The field from which the sample was taken has been in cultivation for probably more than forty years, has been poorly handled, and has received no fertilizer, except small quantities of stable manure. It has been planted to corn, oats, and grass, but the yields have been below the average for this type of soil.

Results obtained by the wire-basket method indicate that only a moderate increase in productiveness can be obtained by the application of manure, and only a very small increase by the use of lime or any form of mineral fertilizers. They furthermore seem to indicate from the excellent growth obtained in the untreated soil that improved mechanical condition of the soil by cultivation will prove more beneficial than the addition of fertilizers.

In this test the soil was placed in ideal physical condition and a favorable water content was maintained during the growth of plants. Wheat was used as the test crop, and while the results are held to be applicable only to the field from which the sample was taken and to general farm crops, it seems probable that they will apply in a general way to the greater part of this type of soil in the area.

MIAMI GRAVELLY LOAM.

The soil of the Miami gravelly loam, to a depth of about 10 inches, is a reddish-brown loam, containing from 10 to 30 per cent of medium-sized gravel, which has a tendency to give good tilth. The subsoil consists of a heavy clay loam or clay, containing from 20 to 50 per cent of mingled gravel, shale, and limestone chips, rendering the boring below 24 inches very difficult. The gravel seldom exceeds 3 inches in diameter, while the greater proportion of it is much smaller.

With the exception of a few isolated areas in the eastern and southeastern parts of the sheet, the Miami gravelly loam is found only along the Scioto and Olentangy rivers and Alum and Big Walnut creeks, in the southern extension of their courses through the area. In the latter location the type occurs upon the forelands and second bottoms, immediately along the streams and areas of Miami loam or bottom lands. On the forelands the topography is quite apt to be abrupt, the angle in some cases being prejudicial to cultivation, and the height of the face of the escarpment ranging from 10 to 30 or more feet. The type sometimes occurs in the river bottoms, as a second terrace, or as a low ridge in the Miami loam. In these instances the topography is much smoother, and the terraces usually flat topped. Near the eastern limit of the area occur a few glacial hills, rising from 15 to 40 feet above the level of the surrounding plain. These are in some cases gravelly enough to be classed with the gravelly loam type; in other cases, however, the areas are too small, or the gravel is not sufficiently abundant. By reason of its favorable topographic position and the relative high porosity caused by the contained gravel, the Miami gravelly loam is nearly always adequately drained.

The Miami gravelly loam has been derived from the coarser materials carried by the glaciers, their arrangement being modified to a greater or less extent along the streams by the action of water.

The second bottom phase of this type is admirably adapted to corn, wherever the drainage is not so free as to make the soil too droughty. Alfalfa should also do well in these positions, and the stony slopes might with advantage be utilized for grapes and other fruit. At present the Miami gravelly loam areas are devoted to the ordinary farm crops, corn, wheat, oats, hay, and to some extent, vegetables. The yields secured upon the sloping forelands, where there is too free drainage, are from 10 to 30 per cent less than upon the upland Miami clay loam. On the second bottoms, however, the yields are very good, 50 bushels of corn to the acre being frequently secured. Wheat and oats produce well, and good returns are obtained from grass crops.

The following table shows the average results of mechanical analyses of the fine earth of soil and subsoil of the Miami gravelly loam:

Mechanical analyses of Miami gravelly 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.*
13205, 13207.....	Soil	3.7	8.9	4.2	6.3	5.5	38.2	32.7
13206, 13208.....	Subsoil.....	5.4	11.5	4.8	5.5	4.2	24.5	43.8

MIAMI LOAM.

To the depth of 10 or 12 inches the soil of the Miami loam is a dark-brown mellow loam, comparatively easy to cultivate. A very slight amount of fine sand is sometimes present, but not in sufficient quantities materially to affect its loamy characteristics. While the soil has somewhat the appearance and color of the Miami black clay loam, it is lighter in texture, more tractable and easily cultivated, and not so much inclined to form clods. The subsoil consists of a heavy clay loam, ranging in color from a dark brown mottled with drab to a light brown or brownish yellow at the lower depths. Gravel often underlies this type at 3½ to 5 feet, but is seldom encountered in the 3-foot borings.

The Miami loam is found along all of the larger and most of the smaller streams of the area. Its best development is seen along Alum and Big Walnut creeks, where it averages nearly half a mile in width. It also occurs along Olentangy River, though the Scioto Valley, within the area, is deeply cut and narrow and little of the Miami loam has formed along it. The type usually occupies flat first bottoms though in some cases it occurs as slightly undulating and terraced second bottoms. In the latter position the surface drainage is more favorable and inundation is less likely to occur. Most of the first bottoms are overflowed annually, and sometimes oftener. Diking is sometimes resorted to at the bends of the streams to overcome this condition as much as possible and to prevent destructive washing of the fields by swift currents. While the underlying gravel is a natural aid to the drainage of the type, extensive systems of ditching and tiling are necessary in some localities to secure the best results.

The Miami loam has been formed by the deposition of sediments washed down from the uplands, and carried down by the streams during high water. This sedimentation has been going on ever since the emergence of the land from the sea and is still in progress.

Areas of the Miami loam upon the lower first bottoms should be devoted to such crops as can be matured after the subsidence of the spring floods. Upon such fields it is not safe to sow winter wheat or to try to grow alfalfa, which will not long endure submergence. On

the second bottoms alfalfa and clover do well, and the soil is also especially well adapted to corn. Some of the heavier garden vegetables are profitably grown upon this type.

The type as a whole is devoted chiefly to corn, which yields from 50 to 80 bushels to the acre. Clover produces from 1 to 2 tons, and is an important crop. Alfalfa has not come into general favor, though a few small fields have been successful. Wheat yields from 20 to 30 bushels to the acre upon the second bottom phase of the type. It is less frequently grown upon the first bottom, owing to the danger of destructive flooding.

The following table gives the average results of mechanical analyses of the soil and subsoil of the Miami loam:

Mechanical analyses of Miami loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
13201, 13203	Soil	0.3	1.1	0.9	2.5	3.5	51.3	39.9
13202, 13204	Subsoil	.8	2.6	1.7	3.5	3.0	39.3	48.8

In order to ascertain the manurial requirements of this soil a large sample was collected from a field 1 mile west of Worthington. The sample was taken to a depth of 8 inches, and is a brown, mellow, silty loam, easily cultivated.

The field from which the sample was taken is bottom land. It has been in cultivation for many years, producing large yields of corn, the average at present being over 60 bushels per acre. No stable manure has been used, but small applications of acid phosphate have been applied with wheat, the average yield of this crop being good.

Results obtained by the wire-basket method indicate that a marked increase in productiveness may be obtained by an application of stable manure; that a small increase may be obtained by the use of cowpeas and lime, but that only a very small increase may be obtained by the use of lime alone or by the use of any form of mineral fertilizer.

In these tests wheat plants were used as an indicator and the results are held to be applicable only to related crops and to the particular field from which the sample was taken. To what extent they are applicable to other crops is a subject for further investigation.

AGRICULTURAL METHODS.

The agricultural methods of the area do not differ in any important respect from those in use in other sections where farming operations are confined principally to dairying and the growing of grain. The sulky plow is used only to a very limited extent, the common walking plow, cutting both a wide and deep furrow, and drawn by

two or three horses, being generally employed. For crushing the refractory clods of the Miami clay loam and the Miami black clay loam both the land roller and "rubber" are used. The latter is made by fastening three or four 2-inch planks together and lapping them in such a way that their sharp corners project and crush and smooth the clods rather than compact them as the implement is drawn over the surface. Many of the farmers consider this a more efficacious implement than the roller for smoothing irregularities in the surface and crushing the clods. After rolling or smoothing the land sometimes requires to be gone over two or three times with the harrow before it is sufficiently well pulverized to form a proper seed bed and to prevent undue evaporation of the soil moisture beneath.

In the operation of haying all of the most modern labor-saving appliances are brought into use, such as hay tedders, improved hayrakes, loaders, and stackers. The greater proportion of the corn is cut by hand, though machine binders are in use where the crop is gathered for ensilage. Small grain is, of course, all harvested with the self-binder.

The practice of crop rotation is quite general, consisting usually of corn followed by wheat or some small grain; then grass, which is allowed to occupy the ground for one or two years; followed by corn again. The barnyard manure produced is usually thoroughly utilized, and comparatively little commercial fertilizer finds its way upon the lands of the area.

AGRICULTURAL CONDITIONS.

The farms of the Westerville area are, with few exceptions, moderately well drained, intelligently cultivated, and equipped with buildings suitable to their needs. A great many of the dwellings are commodious, possess neatly painted, attractive exteriors, and are surrounded by large, well-shaded, and well-tended grounds. There is comparatively little indebtedness among the farmers of the area, and many of them, by the exercise of good business judgment, the adoption of up-to-date methods, and careful attention to details, are able to accumulate something each year above their living expenses. Many of them have telephones in their houses, some have natural gas for heating, lighting, and cooking, and others are fortunate enough to have an electric suburban car line pass their doors. The whole area is served by the rural free postal-delivery system, thus enabling the busy farmer to receive his daily paper and mail without the necessity of going to town for it. Educational advantages are excellent. The common schools are well conducted and well patronized, and the opportunities for a college or university training are afforded both within the area and in the nearby towns of the State.

According to the census of 1900, a little over half of the farms of the area were operated by their owners, while about 30 per cent were

worked by the tenant system. Of the latter class of farmers a little over half, or 17 per cent of all in the area, were paying a cash rental ranging from $3 to $5 an acre. The share tenants usually furnish stock and tools and receive one-half the crop.

While there are a number of farms in the area, especially in the western part, containing above 150 acres each, the average size is about 85 to 90 acres. Of the total area, from 85 to 90 per cent is under cultivation, the remainder being woodland and such waste land as occurs in steep-sided ravines and gullies and along some of the streams.

The farmers of the area complain considerably of the difficulty in securing labor. Farm hands are scarce and demand moderately high wages, the maximum being about $22 a month, including board, and, in some instances, the maintenance of a horse. These farm hands are all white, and the most of them are intelligent, efficient, and industrious workers, and the wages do not seem out of proportion to their services.

The principal products of the area are hay, corn, and small grain. Although considerable wheat is still grown, generally in rotation with corn and grass, its production is gradually being abandoned, owing to low prices and the close competition of the Western States. The census for 1900 shows that in 1899 a little less than 60,000 acres were sown to wheat in Franklin County, while according to figures prepared by State officials the acreage in 1905 is only a little over 29,000 acres. There has also been a decrease of over 27,000 acres in the planting of corn during the same period of time. This decrease is partially balanced by a 26 per cent increase in the production of oats, by the increased acreage of rye, and by grass sown both for hay and pasturage. The appreciation of the manurial value of clover is increasing, and the acreage of it and other leguminous plants, grown as soiling crops, is being extended. Several thousand acres of grass are grown in the area for pasturage, and in 1904, according to State agricultural statistics, there were sold in Franklin County nearly 3,000,000 gallons of milk. Over 750,000 pounds of butter were produced by the farmers, while the factories in Franklin County made 111,330 pounds more. There are several creameries and skimming stations within the area. The cattle, as well as other live stock of the area, including horses, hogs, and sheep, number among them thoroughbreds and grades of the standard breeds, and in general are very well suited to the requirements.

The greater proportion of the fruit grown in the area is for home consumption, and, with the exception of apples, none of the varieties attain a yield of commercial importance. The cultivation of vegetables for profit receives little attention, except in the vicinity of Columbus, where some of the later, heavier varieties are successfully grown. The best-drained portions of the Miami loam are fairly well adapted to this profitable industry.

There are no special evidences of recognition of the adaptation of soils to crops, except perhaps that the Miami black clay loam is generally more exclusively devoted to corn than to other crops, though wheat, oats, and grasses are also quite extensively grown upon the same type. The production of corn also receives special attention upon the areas of Miami loam.

Columbus is an important railroad center, and numerous lines radiate thence in all directions, giving quick transportation and the best of service for both passengers and freight to St. Louis, Cincinnati, and the South; Indianapolis, Chicago, Detroit, Cleveland, Pittsburg, Norfolk, and New York and the East. Besides these well-equipped steam roads the area is served by four suburban electric lines passing directly through it, together with several more which operate in a southerly direction out of Columbus. These all carry freight and express as well as passengers, and are of distinct benefit to the farming sections through which they pass. A very creditable system of country roads and turnpikes is maintained in the area. Nearly all of the main thoroughfares are surfaced with stone, the quite common custom being to build up the stone-surfaced driveway wide enough for one track upon one side of the road, leaving the other with the natural dirt surface for travel in dry weather.

Columbus, with a population approaching 150,000 people, affords an excellent market for all kinds of farm produce. Other important markets are Cleveland, distant 139 miles; Cincinnati, 125 miles; Chicago, 314 miles; and Pittsburg, 193 miles. It will thus be seen that a wide range in the choice of markets and transportation lines is offered the producers of the Westerville area.

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