

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE OHIO AGRICULTURAL EXPERIMENT STATION,  
CHARLES E. THORNE, DIRECTOR.

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# SOIL SURVEY OF THE CLEVELAND AREA, OHIO.

BY

J. E. LAPHAM AND CHARLES N. MOONEY.

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[Advance Sheets—Field Operations of the Bureau of Soils, 1905.]



WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
1906.

[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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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., May 14, 1906.*

SIR: In furtherance of the policy of the Bureau to cooperate wherever practicable with State organizations desiring soil surveys as a basis for their experimental work, a survey of the Cleveland area, Ohio, was undertaken during the summer of 1905. Within this area is located one of the experimental farms of the Ohio Experiment Station, and the work was requested by Prof. Charles E. Thorne, the director of that station. The accompanying report covers this work, and I recommend its publication as advance sheets of the field operations of the Bureau of Soils for 1905, as provided by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

HON. JAMES WILSON,  
*Secretary of Agriculture.*

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### MAP.

Soil map, Cleveland sheet, Ohio.



# SOIL SURVEY OF THE CLEVELAND AREA, OHIO.

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

## LOCATION AND BOUNDARIES OF THE AREA.

The Cleveland area covers the Cleveland, Berea, and Euclid quadrangles, for which topographic maps have been made by the U. S. Geological Survey, and includes a land surface of 326,016 acres, or about 510 square miles. The survey includes all but the eastern tier of townships in Cuyahoga County, besides 50 square miles of Lorain County, 29 square miles of Medina County, and 19 square miles



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

of Summit County. The southern and eastern boundary lines of the area are each about 26 miles in length, the western boundary being only about 18 miles long. The whole northern boundary, which is about 30 miles long, is formed by Lake Erie. About 25 square miles of land not devoted to agriculture is covered by the city of Cleveland, which is situated in the north-central part of the area.

## HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The Cleveland area is a part of the old Connecticut Western Reserve, lying along the south shore of Lake Erie. In 1795 a resolution was passed by the Connecticut legislature providing for the sale of the lands of this reserve. They were bought by a number of individuals, who formed the Connecticut Land Company and began preparations for the immediate colonization of the lands. In the following year a party under the leadership of Moses Cleaveland was sent to explore and survey the reserve lands. Coming by the way of Lake Erie, they landed at the mouth of the Cuyahoga River and laid out a town on the east bank, naming it Cleveland in honor of their leader. The following spring two families, nine persons in all, established themselves in the new village, and in this year the first crop of corn was grown on a patch of land previously cleared by the Indians. The following year the first crop of wheat was harvested. In 1800 the reserve was made a part of Trumbull County in the Northwest Territory. Following the establishment of a Territorial government and the release by Connecticut to the United States of its jurisdiction over the region, whereby titles to land could be perfected, there was an inrush of settlers, particularly at the close of the war of 1812.

Partly because the location of Cleveland proved unhealthful, and partly because of the water power afforded by the streams, the newcomers and many of the older settlers moved to the uplands, and Newburg, now a suburb of Cleveland, became the principal settlement. But with the increase in commerce and the development of the harbor facilities the lower settlement began to grow more rapidly, until now Cleveland is the largest city in the State.

The pioneer settlers of the Western Reserve were entirely of Connecticut Puritan stock, coming either directly or indirectly from that State, some of them having settled temporarily in New York or Pennsylvania before finally moving westward. These pioneers were a hardy class, well able to withstand the hardships of developing a new country. They were very industrious and practiced the strictest economy. Their living was obtained partly from farming and in part from hunting and trapping. Game was plentiful and formed an important part of their sustenance. Unlike many of the early Western pioneers, they did not make hunting their main occupation, but came to the reserve to till the soil, being attracted by accounts of the great productiveness of the soils of the Ohio country. As the early settlers had a surplus of agricultural products that could be exchanged with the Indians for furs, the fur trade was important for a number of years.

Corn and wheat were the first crops grown and have continued to be the staple crops of the section. A few vegetables were grown for

home use. The Indians had cleared small patches of land which they cultivated in a primitive way to corn, beans, pumpkins, squashes, artichokes, and tobacco. The pioneers adopted the growing of tobacco from the Indians, and this crop became a medium of exchange. They also learned from the Indians how to make maple sugar. Maple trees grew abundantly and the production of sugar and sirup increased greatly after markets were obtained, and large quantities are still made in this section. Potatoes were introduced early and became one of the important staple crops. The orchard fruits were also introduced early and succeeded well, but they received little attention and the orchards were allowed to deteriorate. Wild grapes and berries were found in great abundance. The settlers brought some live stock with them, both the horses and cattle being of fair grade.

Because of the lack of transportation facilities and outside markets little progress could be made, and for a number of years prior to 1825 agriculture was at a standstill. It is said that the price of wheat was as low as 25 cents a bushel, potatoes sold for 10 cents a bushel, and other products in proportion. Stacks of wheat were allowed to rot in the fields. What little commerce was carried on in those early days was by pack horses over the old Indian trails. One of these led along the lake shore from Buffalo to Detroit, and another from the Ohio River up the Muskingum River and across the divide to the head of Cuyahoga River, following down that stream to Cleveland, where all the trails converged. In time, however, roads were made and stages passed regularly between the different points.

In 1825 the Erie Canal was opened to traffic, developing the lake-carrying trade, and this was followed by the opening of the Ohio Canal in 1832. It is to these canals that this section owes its earliest development, and they continued of great importance for over thirty years. With the transportation facilities afforded by the canals outside markets could be reached and prices of agricultural products rose, wheat going, it is said, to \$1.25 a bushel, and the prices of other products rising in proportion.

In the early forties the building of railroads began, still further increasing the facilities for transportation. Their construction has continued until now several of the main trunk lines of the country pass through Cleveland.

Not only was an impetus given to the production of staple crops, which by 1850 was double that of 1840, but also to a general improvement in agriculture. During this period improved farm machinery was coming into use and attention was being given to the introduction of new and better varieties of field crops and fruits and to the improvement of live stock. During this period, also, some improved varieties of grapes were introduced and succeeded so well along the lake shore that their production has increased greatly. At first they

were used entirely for making wine, but in later years they have been marketed largely for table use. Another important industry which developed rapidly was sheep raising. At first attention was given entirely to the production of wool. This was greatest about 1850, when over 200,000 pounds of wool was produced in Cuyahoga County alone. Until 1880 the average was something over 100,000 pounds annually. With the fall in price of wool in the late seventies, and the increasing demand for mutton, the attention of growers was directed to the mutton breeds, with the production of wool as a secondary consideration. In recent years the sheep-raising industry has greatly declined in Cuyahoga County.

With the growth of population in the city of Cleveland came an increased demand for dairy products, and soon the dairy industry became very important. Butter and cheese were made on most of the farms until the establishment of creameries and cheese factories about 1890. The manufacture of butter and cheese has been largely discontinued of late years, owing to the demand for milk.

Market gardening is another important industry that has developed to meet the growing needs of Cleveland's population. The census figures show that in 1840 the value of market-garden products in Cuyahoga County, which then had a population of about 26,000, was a little over \$4,000, while in 1900 the value was over \$300,000.

#### PHYSIOGRAPHY AND GEOLOGY.

The surface topography of the area surveyed is somewhat varied, the northwestern and western parts, west of the West Branch of Rocky River, being rather flat and the fall insufficient for good surface drainage. Practically all of the country lying south of a line drawn from Euclid to Berea possesses an undulating or rolling surface, rising from an elevation of about 750 feet above sea level on the upland at Euclid to over 1,250 feet in Royalton Township, Cuyahoga County, and in the northern part of Medina and Summit counties. Noticeable features in the topography are the Lake ridges and the deeply cut ancient valley of the Cuyahoga River. The ridges are three in number and are most prominently developed west of the Cuyahoga River. From the Cuyahoga River to Rocky River their trend is nearly parallel with the Lake, but after crossing Rocky River they take a more south-westerly course, diverging from the present shore line of Lake Erie. These ridges are about 20 feet in height, and slope quite abruptly toward the north, the southern slope being very gentle. They are usually composed of sand or gravel, and represent the coarser materials washed up on an ancient lake shore by the action of the waves.

The valley through which the Cuyahoga River flows is an ancient one, and is remarkable for its depth and width. Well borings made

in the bottoms along the present river show that, for a distance of 20 miles up-stream from the lake it was once more than 200 feet deeper than at the present time, and that it was again filled in prior to the establishment of Lake Erie at its present level, and the cutting through of the present stream. No stratified, bedded rocks are to be seen in the valley, both banks having been filled in with drift prior to the recutting of the Cuyahoga and the establishment of its flood plain.

Rocky River, on the other hand, exhibits sharply cut banks through the Erie shale at many points, and is much more narrow and shallow. What is now the East Branch of Rocky River, however, is evidently much more ancient and has performed a work of erosion through the townships of Strongsville and Royalton nearly as great as has the Cuyahoga, the high table-lands on each side rising more than 300 feet above the stream bed. A number of terraces have been built up in the Cuyahoga Valley. These are usually either sandy or gravelly in character, the most noticeable of which is the extensive gravel terrace on the west bank of the river, north of Brecksville. The Cuyahoga and Rocky rivers, with their short, deeply eroded lateral tributaries, constitute the river drainage of the Cleveland area.

The underlying rocks of the area, of the Devonian and Carboniferous systems, are buried beneath a deposit of glacial material or of sediment deposited in Lake Erie when it occupied a higher position than at present. The Erie shale, covered in part by the Dekalb clay, occupies the lowest position in the geological scale, and is the upper member of the Devonian system. Between this and the Berea grit occur the Cleveland and Bedford shales, of somewhat coarser texture than the Erie shale. These are all well exhibited along the banks of Rocky River. The Berea grit is a medium to fine grained sandstone, used extensively for building purposes and for the manufacture of grindstones. Great quantities of this stone are quarried at Berea, on the East Branch of Rocky River, as well as at several other places within the area. Neither it nor the beds of shale between which it occurs seem to exert much influence upon the texture of the soil, except perhaps that the Berea grit is, to some extent, responsible for the coarser texture of the higher lying phase of the Dunkirk loam.

The Cuyahoga shale overlies the Berea grit and separates it from the Carboniferous conglomerate, a sandstone containing in some localities (mainly south of the Cleveland area) a great many quartz pebbles. This sandstone has resisted erosion much better than the Cuyahoga shale, and caps the highest hills of the area, such as the one in the northern part of Brunswick Township, Medina County, the hill in Royalton Township, Cuyahoga County, and the one northeast of Northfield. It outcrops as ledges on some of these hills, and exerts a slight influence upon the soil. It is largely responsible for the area of

Miami stony loam, in Northfield and Bedford townships, and the presence of the sandy material affects to some extent also the texture of the Miami clay loam in Royalton Township, rendering it slightly lighter and more friable.

## CLIMATE.

The appended table, showing the mean monthly and annual temperature and precipitation, was compiled from the records of the Weather Bureau station at Cleveland. These records are the mean of an unbroken period of thirty-three years and should represent fairly the climatic conditions of the area. As will be seen by the table, the mean annual temperature is 49° F. The seasonal means for winter, spring, summer, and fall are, respectively, 28.2°, 46.1°, 69.7°, and 52.3° F.

*Normal monthly and annual temperature and precipitation.*

Month.	Cleveland.		Month.	Cleveland.	
	Temper- ature.	Precipi- tation.		Temper- ature.	Precipi- tation.
	° F.	In.		° F.	In.
January.....	26.6	2.48	August.....	70.0	2.79
February.....	27.2	2.81	September.....	63.9	3.49
March.....	34.2	2.78	October.....	52.9	2.71
April.....	46.1	2.26	November.....	40.1	2.82
May.....	58.1	3.36	December.....	30.8	2.64
June.....	67.2	3.81	Year.....	49.1	35.51
July.....	71.9	3.56			

Lake Erie undoubtedly plays an important part in modifying the climate along its shores. In general the temperature does not rise so high as it does farther inland, nor does it fall so low as it does in the central part of the State. The highest maximum ever recorded was 99° F., and the mean maximum for the year 57° F. Frequently there occur hot, humid spells of short duration, but as a rule the high temperature is offset by the cool breezes from the lake during the heat of the day. The lowest minimum recorded is -17° F., which is about 3° F. higher than for the central part of the State. The mean minimum is 42° F. The extreme range is 116° F.

The mean annual precipitation is 35.51 inches. The seasonal means are, for spring, summer, fall, and winter, respectively, 8.40, 10.16, 9.02, and 7.93 inches. Ordinarily the precipitation is, as shown by the means, well distributed and sufficient to grow all crops, but short spells of drought are common, as also seasons of excessive rainfall. The least rainfall for any year was 24.53 inches, and the greatest 53.51 inches. The average annual snowfall is 42.5 inches.

The dates of the last killing frost in spring and the first in fall during seven years are given in the following table. As deduced from these

records the average date of last killing frost in spring is seen to be April 26, and the first in fall October 30. The latest date during this period was May 26, and the earliest October 2. This allows a long enough season safely to grow all farm crops.

*Dates of first and last killing frosts.*

Year.	Cleveland.		Oberlin.	
	Last in spring.	First in fall.	Last in spring.	First in fall.
1897 .....	May 26	Oct. 18	.....	Sept. 28
1898 .....	Apr. 5	Oct. 28	Apr. 6	Do.
1899 .....	Apr. 16	Oct. 2	...do...	Sept. 30
1900 .....	May 10	Nov. 9	May 10	Oct. 20
1902 .....	Apr. 15	Nov. 28	May 10	Oct. 10
1903 .....	May 2	Nov. 8	May 2	Oct. 24
1904 .....	Apr. 20	Oct. 24	Apr. 22	Sept 22
Average .....	Apr. 26	Oct. 30	Apr. 24	Oct. 6

The mean annual hourly velocity of the wind is 14.6 miles. During the late fall and winter months the prevailing direction is southwest, while during the rest of the year it is southeasterly, except in March and April, when it is west.

SOILS.

Exclusive of Meadow and Muck, eight types of soil are recognized in the Cleveland area. These are adapted to a rather diversified agriculture and range in texture from a gravelly loam to a stiff, waxy clay. There are no coarse sands, however, the sand particles being very fine in the Dunkirk gravelly loam, Dunkirk loam, and Dunkirk fine sandy loam. The different types appear tabulated below in the order of their areal importance:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami clay loam .....	243,456	74.7	Miami stony loam .....	8,000	2.5
Dunkirk fine sandy loam .....	27,328	8.4	Dunkirk loam .....	2,880	.8
Wabash loam .....	14,080	4.3	Muck .....	768	.2
Dunkirk clay .....	10,688	3.3	Meadow .....	704	.2
Dekalb clay .....	9,728	3.0			
Dunkirk gravelly loam .....	8,384	2.6	Total .....	326,016	.....

MIAMI CLAY LOAM.

The soil of the Miami clay loam ranges from 6 to 9 inches in depth and is a silty loam of medium friability. It, however, contains enough clay to cause it to clod when turned by the plow. On many of the fields the clods are reduced with some difficulty. From 5 to 10 per cent of small stone (usually angular) is in some instances scattered about

on the surface. The stones are seldom numerous enough to interfere with cultivation and are not often removed from the fields. In a normal state of moisture the color of the soil is a yellowish brown, having a pale grayish cast. When the cultivated fields become thoroughly dried the surface has a yellowish-gray appearance.

The subsoil is a heavy, compact clay loam, the clay content of which below 18 inches is sufficient to make the material smooth and polished when rubbed between the thumb and finger. The color to this depth is usually a pale yellow, in some instances slightly mottled with light gray. The subsoil becomes more compact with increasing depth and the clay content higher, reaching its maximum at 30 inches, where the color is several shades darker—a medium brown. At this lower depth a few shale chips, about one-half inch in diameter, are frequently encountered in boring.

There is some variation in the texture of the soil and subsoil throughout the area, depending upon the topographic and drainage features. Upon the steeper slopes near the streams the texture of the soil and subsoil is occasionally seen to be somewhat coarser, and in some instances a few more stones are present. This is also true upon the upland for a distance of a few rods back from the streams. In the flatter situations and near the boundary line of the Dunkirk clay the soil is somewhat darker and contains more clay and the subsoil is heavier and more mottled.

The Miami clay loam has the widest distribution of any soil type within the area and is found in all parts of the sheet outside of the city of Cleveland.

The surface of the greater proportion of this type is only gently undulating, the drainage channels being quite shallow. Near the main streams, however, the surface features show more relief and the topography is sometimes quite hilly. For the most part the surface drainage is adequate, though, except on the distinctly rolling fields, the best results are only secured by underdrainage. Without artificial assistance an excess of water is retained by the heavy, compact subsoil, rendering the land late and wet.

The Miami clay loam is derived from glacial material which has been transported varying distances and mixed with and modified by the residual matter left behind by the weathering of the native rock.

This type of soil is moderately productive and responds quite readily to proper methods of cultivation and drainage. It is naturally too late for the early market vegetables, but the ordinary farm crops—such as corn, wheat, oats, grass, etc.—do very well. It is a fair apple and pear soil, and though hardly as favorably looked upon for grapes as the Dekalb clay, it is one of the best in the area.

The principal crops grown on the Miami clay loam are corn, oats, and wheat. Corn produces on an average about 30 bushels to the

acre; wheat 20 bushels, oats 35 bushels, and hay from 1 to 2 tons. A great many late potatoes are grown upon this type within the area, but produce only a moderate yield. Grape culture receives considerable attention, especially along the lake ridges, a yield of from 2 to 4 tons to the acre being secured.

The following table shows the average results of mechanical analyses of the fine earth 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.
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent.</i>				
14135, 14139.....	Soil.....	1.6	3.1	2.1	7.8	8.8	49.6	26.8
14136, 14140.....	Subsoil.....	.8	2.0	1.6	5.7	6.9	42.9	39.5

The following sample contained more than one-half of 1 per cent of calcium carbonate (CaCO<sub>3</sub>): No. 14136, 4.4 per cent.

#### DUNKIRK FINE SANDY LOAM.

The Dunkirk fine sandy loam to a depth of 10 or 12 inches consists of a brown or reddish-brown sandy loam, which is quite fine in texture. The soil is generally very loose and mellow and is easily worked. No clods form to interfere with the maintenance of good tilth. There is seldom any stone at the surface, though along the crests of some of the lake ridges in the northwestern part of the area some small gravel is mixed with the soil and subsoil. This occurs where the band of gravelly material is too narrow to indicate upon the map as a separate soil type.

The subsoil is a yellow sandy loam, generally considerably heavier in texture than the overlying soil. Occasionally thin streaks and lenses of light-colored clay are found, but as a rule the clay is evenly distributed among the grains of fine sand, resulting in a plastic and sometimes sticky sandy loam, uniformly colored and without mottling. Except in the situations mentioned above there is no gravel or stone in the subsoil.

The Dunkirk fine sandy loam is confined to the northern part of the area, occurring along the North and Middle ridges and on the delta upon which the city of Cleveland is built.

On the lake ridges the type is usually found as a long, narrow strip, parallel with the escarpment, and extending back about a quarter of a mile from the crest onto the higher terrace. The topography here is either uniformly sloping, as along the face of the escarpment, or gently rolling, as on the upper terrace. East of the Cuyahoga River the surface is for the most part quite flat, though slightly undulating along some of the small streams.

Wherever the surface is undulating the subsoil is naturally loose and porous enough to make the drainage of the type usually adequate without resorting to much tiling or ditching.

The Dunkirk fine sandy loam is formed through the agency of wave and stream action and is the weathered product of the coarser sediments deposited in lakes, rivers, deltas, etc.

The Dunkirk fine sandy loam is the best adapted to general trucking and market gardening of any of the soils in the area. Its relatively free drainage and porous structure make it a warm soil which does not contain much water in excess of crop needs. It is the most desirable soil for the earlier vegetables, such as peas, sweet corn, early potatoes, cucumbers, asparagus, strawberries, etc. Though this type of soil is used to a considerable extent for general farm crops, a very large acreage is devoted to the growing of small fruits and vegetables for the local market.

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

*Mechanical analyses of Dunkirk fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
14121, 14123.....	Soil.....	0.7	2.7	3.7	39.5	32.4	11.2	9.2
14122, 14124.....	Subsoil.....	.1	1.0	1.0	40.8	35.1	12.5	9.2

#### DUNKIRK GRAVELLY LOAM.

The soil of the Dunkirk gravelly loam averages about 10 inches in depth and is a dark-brown loam containing silt and the different grades of sand in varying proportions. In many instances it is much more sandy than silty in character, a condition which is frequently found along the ancient lake ridges. From 20 to 50 per cent of small gravel, up to one-half inch in diameter, is scattered over the surface. This gravel consists, for the most part, of flat pieces of shale which have been partially rounded by the action of water.

The subsoil is a light-brown or yellowish loam, generally of about the same texture as the soil, though in some instances more sandy, especially below 30 inches. The content and distribution of gravel is similar to that in the soil. Borings were not made below 36 inches, but several bank sections were seen, showing the gravel to extend to depths ranging from 4 to 20 feet or more.

The principal areas of the Dunkirk gravelly loam are found in the northern and northwestern parts of the survey, though it is well developed also in the central part in terraces along the Cuyahoga River. These terraces are usually very flat topped, with rather steep slopes down to the streams. Along the lake ridges the front of the

escarpment, while quite sloping, is always gentle enough to allow cultivation, while the top of the ridge has usually a slight fall back toward the south. Only upon the broader, flatter terraces is the natural surface drainage insufficient to take care of the ordinary rainfall. The presence of the gravel generally secures fair under-drainage, though ditching is sometimes of advantage in the flatter situations.

The Dunkirk gravelly loam is, in the case of the lake ridges, the weathered product of material washed up along the shore line of Lake Erie when it occupied higher levels than at present. The terraces in the Cuyahoga Valley and along the smaller streams are also of ancient formation, having been derived from the gravel and other material brought down by the streams and deposited as deltas.

In favorable topographic situations, and where not too freely drained and droughty, it is one of the best soils in the area for fruit. With the exception of the Dunkirk fine sandy loam it is the best type for general market gardening and is also an excellent soil for corn and potatoes. The type as a whole is devoted to general agriculture, though in locations nearest to the city the greater proportion of the acreage is used for vegetables, including nearly every variety which can be brought to maturity in this climate.

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

*Mechanical analyses of Dunkirk gravelly loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
14117, 14119.....	Soil.....	5.5	9.1	2.9	6.1	8.6	46.5	21.2
14118, 14120.....	Subsoil.....	4.7	9.4	3.1	6.5	9.0	46.2	20.8

DUNKIRK CLAY.

The Dunkirk clay, to an average depth of about 9 inches, consists of a dark-gray or drab heavy clay loam or clay. Slight mottling is frequently noticed. The clay content is so high that the soil usually cracks at the surface and, when cultivated, shows a tendency to break into small angular and more or less cubical lumps. There is seldom any stone or gravel present either in the soil or subsoil.

The subsoil is a drab heavy, sticky clay, which is mottled with light gray and with brown iron stains. This brown staining is not infrequently accompanied by the presence of a few minute iron concretions, giving a slightly granular texture to the material.

The greater proportion of the Dunkirk clay is found in the edge of Lorain County, in the northwestern corner of the survey. Smaller

areas of it are to be seen irregularly distributed in other parts of the survey, generally in depressions along drainage channels.

The surface of this type is uniformly low and flat, and the natural drainage is never sufficient rapidly to dispose of surplus rain waters. A very thorough and expensive system of ditching and tiling is necessary to fit this type of land for agriculture, and even under the best of conditions obtainable many of the fields are late and wet in the spring.

The soil is the weathered product of the finer sediments of the glacial debris, deposited in somewhat basinlike depressions, where the conditions of drainage were deficient.

When well drained and properly cultivated, the Dunkirk clay is a fair soil for grass and grain and the heavier farm crops. With the exception of some of the later and heavier types of vegetables, such as cabbages, it is not well adapted to gardening. It is principally used for the ordinary crops, and produces, under favorable conditions of climate and cultivation, an average of about 30 bushels of corn, 25 bushels of wheat, and about  $1\frac{1}{2}$  tons of hay to the acre.

The following table shows the average results of mechanical analyses of the soil and subsoil of the Dunkirk clay:

*Mechanical analyses of Dunkirk clay.*

Number.	Description.	Fine gravel	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
13360, 14113.....	Soil.....	0.4	2.0	1.5	5.0	4.2	35.7	50.7
13361, 14114.....	Subsoil.....	.3	1.1	1.1	4.1	4.8	31.0	57.4

MIAMI STONY LOAM.

The soil of the Miami stony loam averages about 9 inches in depth, and is a light-brown loam containing considerable silt, together with an appreciable quantity of very fine sand. The texture is, as a rule, noticeably coarser than that of the Miami clay loam, resulting in a more mellow, easily tilled soil. From 10 to 40 per cent of stone, for the most part angular pieces of fine-grained sandstone, are scattered about over the surface of the fields and mixed with the subsoil. The subsoil is a yellow loam, with some lack of uniformity in its texture. In some localities it is decidedly silty. In others, where the sandstone formation, known as the Berea grit, is near the surface, it contains considerable fine sand. The sand not infrequently occurs in small pockets, resulting from the breaking down, in place, of the friable, easily disintegrated fragments of sandstone, which form in some instances from 20 to 50 per cent of the whole mass. The stone strewing the surface and distributed through the subsoil, in parts of the area where the Berea grit does not reach the surface, consists generally of angular and subangular fragments of shale and of rounded, glacially transported boulders of crystalline rock.

The Miami stony loam is found distributed in all parts of the area. The largest continuous body is located northeast of Northfield. Another occurs about 4 miles northwest of Olmsted Falls. The topography of most of the areas, with the exception of the one last named, which is rather flat, is quite sloping. Some of the areas occur in the vicinity of well-defined benches, where the overcapping ledges of sandstone terminate rather abruptly upon the underlying shale. Examples of this are to be seen northeast of Berea, and again in the long, narrow areas passing through Independence. The drainage of this type is fairly adequate, owing to the rolling topography and to the physical assistance of the rock fragments in the subsoil.

The Miami stony loam is a glacially transported soil and its origin is similar to that of the Miami clay loam, its coarser texture being due to the sandy material received from the disintegration of fragments of sandstone of the Berea grit or Carboniferous conglomerate. The rounded crystalline stones, granite, gneiss, etc., have traveled with the glacier many hundred miles from the north.

The Miami stony loam is adapted to the needs of a fairly diversified agriculture, and can be used for most of the ordinary farm crops. It is a somewhat earlier soil than the Miami clay loam, and, the stones seldom being numerous enough to interfere with cultivation, the soil remains in better tilth with less labor and weeds are more easily controlled. About the same class of crops are grown upon this type as upon the Miami clay loam, and, so far as could be observed, the yields do not differ materially.

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

*Mechanical analyses of Miami stony loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
14131, 14133.....	Soil.....	1.0	3.7	3.0	13.2	13.2	45.4	19.6
14132, 14134.....	Subsoil.....	1.6	4.5	3.3	14.4	11.5	36.9	27.4

#### DUNKIRK LOAM.

The Dunkirk loam is characterized by a brown loam soil extending to a depth of 8 to 10 inches. While the soil consists mainly of silt, with some clay, it contains enough sand to make it appear somewhat like a sandy loam. It is somewhat more granular than the Miami clay loam, and contains more clay than the Miami stony loam. The subsoil is a yellow and brown mottled heavy loam or sandy clay. The sand and clay material of the subsoil is not intimately and uniformly mixed, but appears somewhat in the form of pockets and lenses. In

some localities, however, over an area of several acres, borings will show a subsoil distinctly more sandy than the greater portion of the type. Though there is scarcely ever any stone found at the surface, there are occasionally a few fragments of sandstone in the subsoil, but these are not sufficiently numerous to influence the character of the underdrainage.

Local areas occur, principally as long, narrow strips along the lake ridges, in which the color of the soil and subsoil is considerably darker, while the texture is slightly heavier. This condition usually occurs in depressions where there is deficient drainage and a greater accumulation of organic matter.

The greater part of the Dunkirk loam lies along the East and West branches of Rocky River, in the western half of the sheet, together with an area in Brooklyn Township, and one on a terrace of the Cuyahoga River near its confluence with Tinkers Creek.

With the exception of the narrow areas mentioned above as occurring in depressions along the Lake ridges, the type occupies level or gently undulating positions, usually adjacent to streams, so that drainage can be secured at a reasonable expense. Without artificial drainage some of the areas of this type are exceedingly difficult to manage, the sandy clay subsoil retaining an excess of water to a greater extent even than the apparently heavier subsoil of the Miami clay loam.

The Dunkirk loam is formed from the glacial materials brought down from the north, largely modified by the sandy material derived from the weathering of the sandstone formation, which is usually in close proximity to this type. The depressed areas of dark-colored soil in the vicinity of the Lake ridges are due in large part to the wash received from the more elevated soils surrounding them, which are usually of a sandy nature.

When sufficient drainage has been secured the higher lying phase of the type should make one of the best soils in the area for potatoes, and it is also fairly well suited to late vegetables and to the general farm crops, especially corn and oats. The general use to which it is applied is for the ordinary farm crops, and the yields secured average about the same as upon the other heavier upland types of soil.

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

*Mechanical analyses of Dunkirk loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
13695, 14115.....	Soil.....	1.4	6.7	5.1	16.6	9.8	38.1	22.1
13696, 14116.....	Subsoil.....	2.4	8.3	6.5	17.4	10.2	32.5	22.5

## DEKALB CLAY.

The soil of the Dekalb clay averages about 6 inches in depth and consists of a pale-yellow or grayish-yellow heavy clay loam or clay, which cracks at the surface when left long uncultivated and which clods when turned by the plow. Small, thin chips of shale, an inch or less in diameter, are often scattered over the surface. In many instances the soil has a very high clay content, as shown by the manner in which it polishes when rubbed between the thumb and finger.

The subsoil is generally a uniformly colored yellow clay, showing little mottling. The clay is extremely heavy, though it is rather dry and brittle than unctuous. In some localities the underlying shale rock is encountered at less than 3 feet from the surface, and in these situations there is sometimes a small percentage of fine shale chips mixed with the subsoil. There are seldom any large fragments of shale in either soil or subsoil.

The Dekalb clay is confined to the northern bench or terrace adjoining Lake Erie and occurs in a strip varying from one-quarter to over a mile in width, trending in a direction parallel with the lake shore. It is well developed west of Dover Bay, at Lakewood, and north and northeast of Nottingham. It occupies a position for the most part level, though in a few localities, along the small streams which intersect it, it is seen to be slightly rolling. Natural drainage is never adequate, owing to the densely heavy subsoil, and a generous system of tiling or ditching is necessary to carry away surplus water.

The Dekalb clay appears to be more nearly a residual soil than any other type in the area, and probably owes its origin principally to the degradation of the fine-grained Erie shale through wave action of Lake Erie at a time when the lake occupied a higher level than at present, the material being transformed into a soil by the agencies of atmospheric weathering.

This type of soil is in especial favor for grape culture, and though it is generally thought to be a relatively unproductive soil for grains, grass, and the cereals, it is said by the growers to do well in vineyards. It is a soil, however, which requires special care in the matter of drainage and cultivation, as it is naturally intractable and droughty. Quite a large number of vineyards are situated upon it, the yields averaging about 2 or 2½ tons to the acre. The Concord is the variety usually grown, though some Delawares and Niagaras are also produced. Besides grapes the type is used for pasturage and for the ordinary farm crops, the yields being usually below those for the Miami clay loam.

The following table shows the average results of mechanical analyses of the fine earth of the soil and subsoil of the Dekalb clay:

*Mechanical analyses of Dekalb clay.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
13343, 14111.....	Soil.....	2.2	3.8	1.5	3.5	3.4	37.2	48.2
13344, 14112.....	Subsoil.....	1.2	2.3	1.0	2.2	3.5	28.9	60.5

WABASH LOAM.

The Wabash loam is generally a brown loam possessing a soft, loose, silty texture. In some instances there is no essential change in character of the material down to the maximum depth of the borings—36 inches. Usually, however, the line between the soil and subsoil occurs at about 12 inches. The subsoil is a brownish-yellow silty loam, containing considerable clay, but noticeably less compact than the subsoil of the Miami clay loam. It is not often that there is any stone present in either the soil or subsoil.

Some variation exists in the characteristics of this type. Sometimes both soil and subsoil are lighter in color than in the case of the greater proportion of the type, and the subsoil, particularly, is heavier in texture and oftentimes exhibits a greasy consistency.

The principal areas of the Wabash loam occur along the Cuyahoga and Rocky rivers. It is also found bordering the majority of the smaller streams of the area. The type is almost wholly flat, rarely being relieved by the undulating or terraced topography not infrequently seen in the stream bottoms in many sections of the country. Artificial drainage is required to carry off the excess of water, especially in the spring, during high water in the adjacent streams and when some of the bottoms themselves are frequently inundated.

The Wabash loam is an alluvial type of soil and is formed by deposits of fine earth washed from the upland, carried down by the streams, and built up along their banks in times of freshet.

Well-drained areas of this type are very well suited to corn and are also desirable for many of the garden vegetables. Selected areas from the sandy phases fulfill the general requirements of a potato soil, and profitable returns ought to be secured. It is, however, in general use for the ordinary farm crops, but more particularly for corn, which, under favorable conditions, produces from 40 to 60 or more bushels per acre. Upon some of the sandier phases of the type, situated at convenient distances from the city, a little market gardening is carried on.

The following table shows the average results of mechanical analyses of the fine earth of the soil and subsoil of this type:

*Mechanical analyses of Wabash loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
14127, 14129.....	Soil.....	0.1	0.5	0.6	5.2	10.5	62.3	20.2
14128, 14130.....	Subsoil.....	.1	.6	.6	13.5	21.1	49.7	13.6

MUCK.

The Muck mapped in the area consists of a black soil containing a large amount of vegetable matter and having a light, loose, mealy texture. It varies considerably in depth, ranging from 6 inches to 2 feet or more. The subsoil, if any is present in the conventional 36 inches to which the soils are examined, is generally a heavy drab or blue silt and clay.

Areas of this type occur southwest of Northfield, northeast of Berea, and northeast of North Olmsted. It occupies flat, marshy depressions in the upland, and a complete system of drainage is necessary to bring it under cultivation.

Muck owes its origin to the incorporation with the mineral material of a great quantity of organic matter, in the absence of drainage and under conditions which favored an excessive growth of swamp vegetation.

This soil is very useful and desirable for the growth of such crops as onions and celery. It is also a very fair corn soil, and often good potato crops are grown upon it. It is generally used, however, for corn and for pasturage. From 30 to 50 bushels of corn per acre are usually produced.

MEADOW

The term Meadow applies to certain areas having no definite arrangement of soil particles, and covered with a rank growth of marsh vegetation, occurring along some of the smaller streams and in depressions where there is little or no drainage. The surface of these areas is frequently boggy, and they have no present agricultural value other than the limited amount of pasturage which they furnish. The largest extent of Meadow occurs southeast of Northfield. These areas are capable of reclamation, and when thoroughly drained will produce many of the farm crops which do not require too early spring cultivation.

## AGRICULTURAL CONDITIONS.

The farming land in the Cleveland area is under a high state of cultivation, and is devoted to a diversified agriculture. That part of the area which is in close proximity to the city is especially valuable, because of the desirability of the land for market-gardening and for building lots. The farms are, for the most part, equipped with good buildings, both barns and dwelling houses, and the grounds surrounding the dwellings are in many instances as well kept and trimmed as those around the city homes. The farmers enjoy a fair degree of prosperity, and there is comparatively little indebtedness among them. They employ up-to-date methods, and the majority of them know how to make agriculture pay. The prices for land for fruit and vegetable growing range from \$150 to \$800 or more per acre, depending upon nearness to the city and the texture and drainage of the soil, as well as upon the climatic conditions. Farms on the Miami clay loam bring, for general agricultural purposes, from \$50 to \$100 or more per acre, according to geographic location, buildings, etc.

According to the census of 1900, 67 per cent of the farms are worked by their owners, while four-fifths of those operated under the tenant system are on a cash rental basis, the rate ranging from \$3 to \$8 or more per acre. Many of the farms of this class are used for market gardening, and the leases are often for long terms of years. Only about 4 per cent of all the farms of the area are rented on shares.

While the average size of the farms in Cuyahoga County, as given by the Twelfth Census, is 52 acres, there are over 500 farms containing more than 100 acres each. Many of the small 10 to 20 acre farms are owned by foreign-born citizens, principally Poles and Bohemians. They are a thrifty class, good gardeners, and utilize every square foot of the land in a most thorough manner.

The farm labor of the area is very largely employed by the day, from \$1 to \$2, according to supply and demand, being paid. Much of the day labor is drawn from the foreign population of Cleveland and the small towns, and is fairly abundant, especially for work that can be conveniently reached by the various lines of suburban electric cars. The laborers hired by the month, most of whom are of American parentage, usually receive from \$18 to \$25, with board. In 1899 there was expended for labor in Cuyahoga County \$407,810, or an average of about \$90 for each farm.

Corn, wheat, oats, and grass are the common field crops grown in the area. The acreage given to grass, for hay and pasturage, is much greater than to any other crop, oats, according to the statistics of 1900, holding second place. Hay brings a good price and finds a ready market in the city and is a profitable crop to grow. Dairying is one of the most important industries in the area, over 5,000,000

gallons of milk having been supplied to Cleveland in 1899. Ensilage forms one of the principal items in the feed of the cattle during the winter, so that a considerable percentage of the corn is cut green for this purpose. The power harvester and shredder are in common use. Quite a large acreage within the area is devoted to potatoes, and in years of favorable seasons and prices the industry is profitable. During the present season (1905) there has been considerable complaint of the potato blight, and the yield is below the average, probably under 50 bushels to the acre. The late varieties are usually the ones grown. The large demands of the city of Cleveland for fresh vegetables has resulted in the establishment in the immediate territory surrounding the city of an important market-gardening industry, and all of the fruits and vegetables that can be grown in the latitude of northern Ohio are produced with profit. A variety of soils is found along the old Lake ridges, and the length of the growing season is somewhat extended by the tempering influence of the lake. The same advantages of soil and climate are largely responsible for the concentration along the most northern lake ridges of extensive and profitable vineyards. Some of the grapes are made into wine, but the greater proportion is marketed in baskets. The total value of the product of the vineyards in Cuyahoga County in 1899 was \$255,306, while, for the same year, the value of orchard products, apples, cherries, peaches, plums, pears, etc., was \$162,462.

The farmers of the area show an intelligent understanding of the adaptation of soils to crops, and wherever circumstances permit they select such soils as best suit the requirements of the crops to be grown. The greater proportion of the early vegetables are grown upon the lighter soils of the old lake ridges, while the heavy Dekalb clay, which has proven well adapted to grape culture, is, to a large extent, devoted to that crop. Many vineyards are also to be seen upon the Miami clay loam. The greater proportion of the Wabash loam is used for corn, which produces more abundantly upon this than upon any other type in the area.

The Cleveland area enjoys excellent transportation facilities. The Nickel Plate Railroad parallels the Lake Erie shore throughout the area, a distance of about 30 miles, while the Lake Shore and Michigan Southern Railway has about an equal mileage, diverging from the Nickel Plate Railroad at Cleveland in a southwestern direction. Both of these roads run into Chicago, and make direct connections with New York, giving splendid facilities for both passengers and freight. The Big Four Route connects Cleveland with Columbus, Cincinnati, and St. Louis, while the Pennsylvania Railroad, the Wheeling and Lake Erie, the Erie Railroad, and two branches of the Baltimore and Ohio Railroad give service in southerly and southeasterly directions. Besides the steam roads, five suburban electric lines run into and through

Cleveland and carry express and freight as well as passengers. Daily boats ply between Cleveland and Buffalo, Toledo, Detroit, and other lake ports during all but the winter months. Much has been done toward the establishing of good public roads radiating from Cleveland in different directions through the area, and many miles of brick and macadamized roads have already been constructed. Much yet remains to be desired in the building of the country dirt roads, and it is believed that if the supervision of their location, grading, and drainage were intrusted to an expert in road building both economy and convenience would result.

An excellent market for the farm and garden produce of the area is afforded by Cleveland and the small suburban towns. Cleveland at present numbers nearly half a million population, and its growth from year to year is steady and substantial. Its market needs offer every incentive for the highest development of market gardening, dairying, and general agriculture.

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