

SOIL SURVEY OF THE COLUMBUS AREA, OHIO.

By WILLIAM G. SMITH.

LOCATION AND BOUNDARIES OF THE AREA.

The Columbus sheet covers an area of about 471 square miles. In form it is a rectangle, with its east and west dimension 27 miles long and its north and south extending $17\frac{1}{2}$ miles. Columbus, the principal city, is located in the north central portion of the area. The area includes, approximately, the southern half of Franklin County, the northern one-seventh of Pickaway County, and small portions of the adjoining counties of Madison, Fairfield, and Licking. Geographically the area lies between latitude $39^{\circ} 45'$ and 40° north, and longitude $82^{\circ} 45'$ and $83^{\circ} 15'$ west. (See fig. 10.)

The location is an interesting one in many ways. The soils are all quite distinct as regards texture and adaptability to certain methods of farming, and the history of the development of the region contains much of general application.

HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

On July 13, 1787, the Congress of Confederation, assembled in New York City, enacted the famous ordinance of the Northwest Territory. Fifteen days later this Congress passed an act disposing of 5,000,000 acres of land in Ohio at about 10 cents per acre. The following year the Ohio Company, with 1,500,000 acres under its control, planted its first permanent settlement (Marietta) in Ohio at the mouth of the Muskingum River. The remainder, consisting of 3,500,000 acres, was secured by the Scioto Company. Two million acres more were granted to John Cleves Symmes between the Little and the Great Miami rivers.

Large inducements by these land companies were at once offered settlers, and soon many immigrants came into the Ohio Valley. In fact, emigration from the East to this new, rich territory became so great as to alarm the older settled region, even to the point of issuing antiemigration pamphlets in a vain attempt to check it.

As a result of the exploitations of these land companies, the existence of large areas of cheap Government land, and the enactment by Congress of military and refugee grants, the Miami Valley, the Mus-

kingum Valley, and the Scioto Valley, in which the present soil survey is situated, soon became the home of many pioneers.

The earliest settlement in the area surveyed occurred in 1797, about which time the town of Franklinton—in 1802 incorporated as Columbus—was laid out and occupied by emigrants from Kentucky and Pennsylvania. In 1799 some other families settled on Darby Creek, near where at present stands the town of North Liberty, and others located near the mouth of Gahanna Creek. From all these places settlement gradually extended, following, naturally, the principal water courses.

The soil proved to be very productive. Large crops could be produced, plenty of grazing lands were to be had along the streams, and the fattening of cattle and hogs and the making of dairy products were all possible; but it was of no use to produce, for there was practically no market beyond the local, because of the lack of transportation facilities. The roads over the Allegheny Mountains to the east were well-nigh impassable, even if the great distance to the eastern market had not made the movement of crops impracticable. The only outlet was by flatboat down the Mississippi and Ohio rivers to New Orleans, and thence to the outside world. This means of transportation, though used, entailed much arduous labor, not to mention danger to life. The first flatboats to descend to New Orleans after the raising of the Spanish embargo were floated in 1788. They were manned by 150 armed men—armed because of the danger from attack by the Indians and outlawed whites, especially on their long march back from the market, for the return had to be made on foot. Hazardous as was this method of transportation, many entered it, and the trade grew to large proportions, continuing until after the war of 1812.

All this time a steady stream of immigrants, attracted by inducements offered by the land companies, continued to pour into the Ohio Valley, and the products of the soil began to far exceed the demand of the then available market. It became evident that some other outlet than that by way of the Ohio and Mississippi rivers was necessary to the continued growth and development of the then settled portion of Ohio. At this juncture, in 1805, George Renick, whose farm was situated about 40 miles south of Columbus, on the Scioto River, near the present site of Chillicothe, crossed the Alleghenies with 68 head of fat steers and drove them to Baltimore in good condition, selling them at a good profit. This experiment was followed by others equally successful, cattle being driven to Philadelphia and New York. Thus was opened up a new avenue of trade and a new industry, the live-stock industry, which soon led to the importation and improvement of breeds of cattle, sheep, swine, and other farm animals.

The next important factor in the development of the now rapidly growing agricultural industry of Ohio at large and the area surveyed in particular was the extension of the national turnpike from Cumberland, Md., to Zanesville, Ohio, and later, in 1833, to Columbus. By 1836 the road had reached Indianapolis, Ind. Important also was the completion, in 1831, of the Columbus feeder of the Ohio Canal, which gave the area direct water communication with the Ohio River and Lake Erie. By 1838 the Ohio Canal connected Columbus with Cleveland, Toledo, Cincinnati, and Portsmouth. In 1850 the first railroad, extending from Columbus to Xenia, was built, and one year later a road was in operation between Columbus and Cleveland.

With each improvement in transportation the production of the staple crops and of cattle, of dairy products, and of wool kept pace, and the history of the development of this area all in the brief period of the first half of the nineteenth century is truly remarkable.

A change in condition, due to the opening of the newer West, then began to affect the Ohio farmers, just as those of the Eastern States had been affected by the competition of Ohio. Great transcontinental railroad lines were laid down, and back to the Eastern market came thousands of cattle which had been fed on the range and fattened on the millions of bushels of grain grown on these new lands. Immense crops of wheat were raised and sent to the Eastern market, reducing the price to from a third to a half of what it had been. Had it not been for the fairly good local market here the farmers would have suffered even more than they did from this competition. As it was, many became bankrupt and farms were sold at sheriffs' sales, while mainly those who rapidly adjusted their methods to fit as far as possible the new conditions continued to do fairly well.

The West, however, even with its rich soils could not continue to produce the bounteous crops with the methods employed. The continual cropping of the fields to wheat without manuring soon brought about the inevitable result of reduced production. The natural ranges also began to deteriorate. Vast areas were ruined by overstocking, by the introduction of sheep, which cropped the grass to the roots, and other improvident methods. Thus the competition became less strenuous, and matters mended in Ohio. Now the readjustment of conditions has progressed until the agriculture of the area is again on a prosperous footing.

CLIMATE.

The summer temperature is characterized by periods, one and two weeks in duration, of warm weather, when the thermometer registers between 90° and 104° F. during the day, and does not fall below 60° or 75° F. at night. When accompanied by a high humidity and slight

wind movement the atmosphere becomes very oppressive, sickness is increased, and the fungous diseases of plants become more prevalent. These heated terms are most likely to occur during July and August, but the greater part of the summer the temperature ranges between 60° and 80° F. The normal annual temperature is 51.8°, and the normal monthly temperatures range from 29.4° F. in January to 74.9° in July.

The winter temperature generally ranges between zero and 50° F., but the mercury sometimes sinks as low as 20° F. below zero, and sometimes rises to 70° F. above zero.

The average date of the last killing frost in spring is April 20, and the average date of the first killing frost in fall October 18. The depth to which the soil freezes during winter varies from 6 inches to 20 inches or more, depending on the intensity and duration of the cold, the snow covering, and the character of the soil. The clay soils freeze to a less depth than the more open sandy and mucky soils.

The normal annual precipitation for this area is about 38 inches. In the midwinter season the precipitation takes place as snow, which usually covers the ground to a depth of from 4 to 8 inches for periods of from two to six weeks of January and February, protecting shrubbery and small grains from the severest weather. Open winters, however, are not uncommon and some damage is done, especially to winter grains and grasses.

During the fall and spring the precipitation usually occurs in rain storms of considerable duration, favorable to absorption by the soil. In the summer season, however, the precipitation comes in local showers not so favorable to absorption by the soil and sometimes so violent as to flow over the surface of the soil directly into the streams. The rainfall for the summer months ranges from about 2 to 9 inches, the normal ranging from 3 to 4 inches. The relative humidity in winter fluctuates daily from about 30 to 50 per cent, and in summer from about 40 to 65 per cent, though during the periods of excessively warm and moist weather a relative humidity of from 80 to 95 per cent is often registered. The annual average sunshine is about 45 per cent of possible sunshine. For January the average sunshine is 30 per cent, and for July it is 55 per cent. The days of continued cloudiness are limited mostly to the winter season. The prevailing winds are from the west and southwest. The winds from the east and southwest bring the rains. Cloudbursts and tornadoes are not common, but occur occasionally and are sometimes so severe as to cause loss of life and property. The table following, showing rainfall and temperature by months, is compiled from the records of the Weather Bureau station at Columbus.

Normal monthly and annual temperature and precipitation.

Month.	Columbus.		Month.	Columbus.	
	Temper- ature.	Precipi- tation.		Temper- ature.	Precipi- tation.
	°F.	Inches.		°F.	Inches.
January	29.4	3.09	August	72.6	3.22
February	30.5	3.33	September	66.6	2.73
March	37.6	3.31	October	53.7	2.55
April	51.5	2.67	November	40.6	3.27
May	62.1	4.04	December	32.7	2.51
June	72.4	3.44	Year	51.8	38.07
July	74.9	3.91			

PHYSIOGRAPHY AND GEOLOGY.

The area surveyed consists geologically of a deposit of glacial drift varying from a few feet to over 200 feet in thickness, resting on a rock floor composed of limestone in the western border and passing toward the east through shale into sandstone.

The drift material is thought to have been deposited during a long period of time, the forepart of which was characterized by the southward movement of the vast ice sheet. The surface of the rocks over which this mass of ice passed was ground into a fine flour, which became the clay constituent of the drift. The larger rock fragments were rounded and shaped into the boulders and gravel, also a salient feature of the drift material. Intermixed with this material of local derivation there is a considerable quantity of foreign material transported by the ice from the regions farther north. Boulders composed of gabbro, gneiss, and granite are found which have no representatives in place in the area.

The drift varies greatly in different localities, and it is therefore difficult to construct an ideal section or to draw consistent conclusions as to the forces that operated during its deposition. In a general way the material seems to have been first laid down in strata of sand and gravel and large rounded stones, upon which was deposited later the boulder clay. The latter material is of special interest, as it is the principal source of the soils of the area.

The forces operating in building up the drift were doubtless much modified by the irregularities of the rock floor upon which the material rests. The preglacial stream valleys and the hills and knobs all had a part in giving to the drift local variations that seem difficult to explain and which do not fit into the very general section just given. For example, instances are found where the boulder clay is overlain or interbedded with the gravel.

It has been suggested that the stratified drift was laid down during a time when the ice retreated northward, when immense quantities of water flowed rapidly over the whole area in one vast sheet. The nicely

stratified beds of sand and gravel often found underlying the clay certainly give color to such a theory. Later, when the water moved more slowly or possibly stood as a lake over the area, the clay and silt, together with rocks and boulders and gravel dropped from floating ice, were deposited. The possibility of lacustrine origin of the boulder clay was once supported by the hypothesis of a glacial dam at Cincinnati, but the existence of such a dam is now called into question through some of the later geological researches. At the close of the Glacial period the surface of the drift must have presented an almost level plain, possessing only very slight variations in the form of easy sloping knolls and ridges. This formation is shown to-day in the interstream portions of the area.

The present physiography of the region is the physiography of the ancient plain, more or less modified through erosion by the streams in building up the present drainage system.

The principal streams flowing through the area are the Scioto River, the Olentangy River, Big and Little Darby creeks, Big and Little Walnut creeks, and Alum Creek. All of these streams flow southward into the Ohio River, while their branches have a general east and west direction.

The stream valleys are not usually very extensive, the largest occurring along the Scioto River, varying from three-fourths mile to $1\frac{1}{2}$ miles in width. Along the smaller streams the width is usually between one-fourth and three-fourths mile.

The sides of the stream valleys are usually quite steep, and some along the Scioto River and Darby Creek are quite high as well as steep, rising from 50 to 150 feet above the stream bed.

Two well-defined terraces usually occur along the streams. The lower, or "first bottom," as it is locally called, lies from 8 to 20 feet above the stream beds and is generally indicated by the Miami loam soil type. The higher terrace, locally called "second bottom," lies from 20 to 60 feet above the stream beds and gives rise to the important Miami gravelly loam soil type. Sometimes on a high first bottom or a low second bottom a sandy-textured soil is developed, which, had it occurred more extensively, would have been mapped as Miami sandy loam.

The clay upland of the interstream areas represents that portion of the drift that has not been modified by stream action, the principal change since the time it was laid down being due to swampy conditions that have prevailed in the poorly drained depressions. (See Pl. XXIV, fig. 1.) The upland, which is locally known as the "third bottom," in its naturally drained portions gives rise to the extensive and agriculturally important Miami clay loam. The depressions where swampy conditions once obtained are occupied by rich black soil, mapped as Miami black clay loam.

The stream valley areas as well as the uplands are quite generally underlain by gravel; but while the material is the same, the mode of occurrence is very dissimilar. Under the valley areas there is little if any stratification, although the beds are supposed to be the result of a reworking by the streams of the stratified portion of the glacial drift and of the superimposed bowlder clay. The present soil covering of the valleys is thought to have been laid down when the terraces successively formed the flood plains of the streams. On the higher terrace, which is no longer subject to overflow, 2 to 4 feet of reddish clay and silt mixed with from 5 to 20 per cent of gravel was deposited. Where the river is not leveed the lower terrace is still subject to overflow, and the upbuilding of the soil is still going on.

The rocks of the area afford lime, cement, and building stone of various kinds. The black shale, outcropping near Columbus, is ground and used in the manufacture of brick, but the greater part of the clay used in the making of tile and brick comes from the yellow clay subsoil of the uplands.

SOILS.

The soils of the Columbus area are all derived from the weathered glacial drift, modified in the case of some of the types by stream and swamp action. The soil types, four in number, have all been recognized before, being similar in origin, texture, and crop adaptation to the soils mapped in Montgomery County, Ohio, during the season of 1900.^a All the soils of the area are fertile and important agriculturally.

The appended table gives the extent and proportion of the whole area of the several types.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami clay loam	222, 336	73. 6	Miami gravelly loam	18, 944	6. 3
Miami black clay loam	33, 792	11. 2	Total	301, 952	.....
Miami loam	26, 880	8. 9			

MIAMI CLAY LOAM.

The Miami clay loam is the most extensive of the soil types mapped, occurring as clay uplands between streams and covering about 74 per cent of the area. It consists of from 10 to 12 inches of a yellowish silty loam underlain by a stiff, mottled yellow clay subsoil, which in turn generally grades into the bowlder clay substratum. Sometimes gravel, rock fragments, and bowlders are present on the surface to an appreciable extent, but such occurrences are infrequent and such areas

^aSee Report on Field Operations of the Division of Soils, 1900, p. 85.

may be considered one of the rare variations rather than a feature of the type.

Along the larger streams, like the Scioto River and Big Darby Creek and their principal branches, the Miami clay loam is sometimes underlain with a well-defined stratum of gravel and sand, often several feet in thickness. This constitutes one of the principal variations of the substratum of the Miami clay loam, but it is in only a small portion of the area in the aggregate. It is important, however, in that it improves the drainage of a type usually deficient in this essential point.

Another variation of the typical section is where the Miami clay loam rests directly on the rock floor. Such occurrences are found in the north central and northeastern portions of the area. In such cases the type is often marked by the presence of 5 to 15 per cent of small fragments of shale and sandstone, derived evidently from the underlying rock and mixed with the clay during the period of glacial action.

The type as a whole is remarkably uniform in texture as well as in color, which is usually yellow or pale yellow. It is also quite evenly distributed throughout the area, the interstream areas being always of this type except in the depressions where swampy conditions have given rise to a black soil—the Miami black clay loam. There is, however, a decided demarcation in point of fertility between the darker, richer yellow colored soil usually found in the better-drained situations along the larger streams, and some of the whitish-yellow soils more typical of the areas remote from the streams. In some cases the darker-colored areas extend considerable distances back from the streams into the upland. The better natural drainage makes the reddish-yellow soils usually more friable and earlier.

The surface of the Miami clay loam is on the whole rather flat, especially in the locations more remote from the larger streams. Near the streams the surface becomes gently rolling, or, as is the case along the Scioto River and Big and Little Darby creeks, even very hilly. The natural drainage is poor, except near the streams, and artificial drainage has to be practiced on all the more level areas in order to insure good crops.

The Miami clay loam is derived from the weathering of the drift material laid down at the close of the Glacial epoch. This drift consists of a yellow clay grading into the unchanged boulder clay at a depth of from 3 to 6 feet. The more general forces alone have operated in the formation of this type, and only along the drainage channels has the soil been modified by stream action.

The original forest growth consisted largely of the hard-wood trees common to the State, namely, several varieties of oak, sugar maple, soft maple, beech, basswood, black walnut, poplar, wild cherry, white

and black ash, black gum, elm, hickory, buckeye, and ironwood. No native growth of the evergreens, such as the pine and cedar, occurs in this area. Occasionally a small sugar-maple grove is seen, from which a profit is realized by the sale of sugar and sirup.

The Miami clay loam may not be regarded as a naturally fertile soil, because of deficiency in organic matter, but its texture is such that it can be brought up to a high state of fertility. The dark-yellow colored soil is apparently naturally the more fertile, producing crops possibly 10 per cent in excess of the yields on the whitish-yellow soil, but this seeming advantage is doubtless due in part to better natural drainage, which makes the soil more easy to keep in proper tilth and allows it to be cultivated earlier in the season. On the other hand, the light-colored soil sometimes has a peculiar, waxy texture and is very refractory in tillage. In wet weather such soil runs together like wax, drains very slowly, and if plowed at such times clods, when the preparation of a proper seed bed becomes difficult and expensive. The addition of manure, a wise system of rotation, and good artificial drainage have in many cases partially corrected this undesirable character of the soil.

The Miami clay loam as a whole seems well adapted to general farm crops. The grasses and small grains do well, and much corn is grown also. Wheat yields from 20 to 35 bushels per acre, and crops of from 40 to 50 bushels have been grown by some more expert farmers in favored fields. Oats yield from 40 to 60 or more bushels and corn from 40 to over 100 bushels per acre. The rotation practiced by many farmers is (1) corn; (2) grain—such as wheat, oats, or rye, on which is seeded, in the spring usually, a mixture of clover and timothy; (3) hay and pasture, which in turn is followed by corn.

The wheat is sometimes exchanged for flour at the small gristmills, but this practice is not so common as formerly, as custom mills are less numerous. The corn is consumed largely on the farm by hogs and beef and dairy cattle.

Millet and fodder are grown for hay and ensilage to supplement the permanent pastures, and where sheep are kept rape is used for this purpose.

Orchard fruits and small fruits seem to do very well on this type of soil, and orchards are a common feature of the homestead.

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

Mechanical analyses of Miami clay loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
6957	2 miles NW. of Alton.	Silty loam, 0 to 10 inches.	2.18	1.02	2.82	3.08	10.32	10.48	53.74	18.50
6961	1 mile NE. of Georgesville.	Brownish silty loam, 0 to 12 inches.	1.76	.64	2.20	2.46	8.04	10.94	55.86	20.10
6963	2 miles NE. of Reynoldsburg.	Light-yellow silty loam, 0 to 10 inches.	2.05	1.00	2.32	1.86	5.74	10.10	57.14	21.96
6958	Subsoil of 6957.....	Reddish clay, 10 to 36 inches.	1.18	.50	3.14	2.60	8.02	9.78	42.30	33.64
6964	Subsoil of 6963.....	Reddish-brown clay, 10 to 36 inches.	.81	.80	2.44	2.44	8.30	11.44	39.90	35.02
6962	Subsoil of 6961.....	Reddish-brown clay, 12 to 36 inches.	.70	.84	1.94	1.74	5.98	8.10	41.84	39.40

MIAMI BLACK CLAY LOAM.

The Miami black clay loam consists of from 10 to 20 or more inches of black loamy clay underlain by a yellow or sometimes dark-bluish clay subsoil. It occurs in two principal areas, one in the vicinity of Derby and the other south of Dakrumm, and small areas, from 5 to several hundred acres in extent, are frequently found throughout the area surveyed, being associated with the level tract of the Miami clay loam and also occurring as narrow strips along the smaller drainage ways. The local variations in texture are not very great. Gravel, rock fragments, and boulders sometimes occur, as in the Miami clay loam, but on the whole the Miami black clay loam is remarkably uniform and quite free from rock fragments or gravel of any kind. In the small areas, the surface soil is underlain by a yellow clay subsoil similar to the subsoil of the Miami clay loam; but in the two large, well-defined areas from 2 to 3 feet of black clay loam may be found before the underlying yellow clay is reached.

The areas of this type, as would be expected, are flat and noticeably basinlike, lying from 1 to 3 feet below the surface of the surrounding Miami clay loam. Within the last twenty or thirty years, many of these depressions held standing water, from 1 to 2 or more feet deep, nearly the whole season through. Now these depressions have nearly

all been drained and put under cultivation by the use of tile under the land, connecting with open ditches leading to the natural drainage channels.

The Miami black clay loam owes its origin to depressions left in the glacial drift. These have gradually been filled in by wash from the surrounding lands and long accumulation of the remains of aquatic plants, the depressions originally lacking drainage and containing more or less water. The resulting soil is the dark, remarkably fertile clay of loamy texture mapped under the name of this type.

The Miami black clay loam, by reason of the large amount of vegetable matter and usually abundant moisture supply, is one of the strongest soils in this area. It seems especially adapted to corn, but, so far as its fertility and texture are concerned, it is also well suited to general farm crops and small fruits. Because of the tendency of the soil to "heave" during the alternate freezing and thawing of the winter season, such crops as clover and winter grains are liable to suffer injury. After the soil has been drained and brought under cultivation, it becomes more compact, by reason of the breaking down or readjustment of the vegetable mold, and less injury is found to result to winter crops.

This soil is the typical corn land of the area. The reported yields of corn range from 40 bushels to 120 bushels, and of wheat from 20 bushels to 40 bushels per acre in favorable seasons. When the season is too wet, as is occasionally the case, grain crops are liable to lodge some.

A weed very generally noticed, which seemed peculiar to this type, was the common milkweed (*Asclepias syriaca* L.). This weed springs up from underground rootstalks and escapes destruction from the ordinary vertical-toothed cultivator. Another weed noticed, and evidently difficult to eradicate, is the common pokeweed. Rotations involving the plow or knife cultivator seem to be about the only effective way of holding these weeds in check. In pasture land they are very persistent, as neither cattle nor sheep seem to eat them.

The farm buildings are not usually located on this type, but rather on the adjoining Miami clay loam.

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

Mechanical analyses of Miami black clay loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
				P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
6951	1 mile W. of Derby.	Black clay loam, 0 to 12 inches.	4.48	0.20	0.94	1.10	5.48	6.06	64.78	21.44
6953	1½ miles NW. of Derby.	.....do.....	4.21	.18	1.62	1.72	7.76	7.80	59.12	21.66
6955	2 miles SE. of Dakrumm.	.....do.....	6.20	.96	2.58	2.02	6.26	7.94	57.74	21.76
6954	Subsoil of 6953.....	Dark mottled-yellow clay, 12 to 36 inches.	1.39	.64	1.62	1.00	3.70	5.92	65.78	21.22
6952	Subsoil of 6951.....	.....do.....	1.22	.16	.60	.54	4.08	5.62	67.28	21.72
6956	Subsoil of 6955.....	Clay, 12 to 36 inches.	1.75	1.60	3.06	2.24	5.18	7.06	52.42	28.24

MIAMI LOAM.

The Miami loam consists of 8 to 12 inches of a dark sandy loam, underlain by a black clay loam. Oftentimes there is little or no difference between the soil and subsoil—a black, moderately heavy loam extending to a depth of 3 feet or more. Usually this material is underlain by a bed of limestone gravel.

The Miami loam is remarkably uniform as to texture. The only variations are where the soil is slightly more sandy or in small local areas, where it has a mucky texture. Occasional gravel spots, from 1 to 2 acres in extent, are also found. The gravel content in such cases ranges from about 10 to 30 per cent.

The type occurs as the lower terrace along all the larger and nearly all the smaller streams. The surface is generally very flat, with, however, an occasional area of gently rolling character. The elevation above the stream beds varies from about 8 to 20 feet, the greater portion being usually less than 20 feet, and the type is thus subject to overflow by spring freshets where not protected by levees.

The Miami loam owes its origin to stream deposits of silt and clay, laid down during the spring floods when the waters extended far on each side of their normal channels. As the floods receded later in the season, aquatic plants and rank vegetation sprang up and were buried beneath another deposit of clay and silt by the following season's overflow. This process, continued for centuries, has resulted in the forma

tion of the deep, rich, black soil of the Miami loam, now overlying to a depth of from 2 to 6 or more feet the gravel floor of what was probably a larger stream.

Very little of this soil is in forest, as it is in great demand for cultivation. A dense growth of oak, black walnut, sycamore, and hickory once grew on these river bottoms, and fragments of these forests may now be seen fringing the streams. Before the land was cleared the forest sometimes held the flood water nearly the whole season through, but since the clearing of the land, the construction of ditches, and the laying of tiles the drainage condition of the type has become quite good.

The areas of Miami loam vary in width from one-eighth mile to 1 mile, extending from the streams which they border back to the gravelly second bottoms and clay uplands. (See Pl. XXIV, fig. 2.)

The levees, which are extensive and from 8 to 15 feet in height, are usually built by individual owners or through cooperation of several owners of the lands benefited, and not by a system of taxation, as is the case in the States bordering the Mississippi River, where levees may benefit lands 50 or more miles back from the river.

The Miami loam is especially adapted to corn and late vegetables. It is not so well suited to the production of the winter grains and clover, for the reason that there is possibility of flooding from stoppage of the drainage channels during the winter, from a break in the levees, or from unusually high water in the spring. There is not the same injury from "heaving" with this type as there is with the Miami black clay loam.

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

Mechanical analyses of Miami loam.

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
				P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
6967	3 miles NW. of Groveport.	Dark loam, 0 to 12 inches.	5.80	0.16	0.82	0.60	1.64	4.00	72.16	20.40
6965	1 mile S. of Columbus.	.....do.....	3.48	.44	1.10	1.00	9.60	18.78	44.72	24.28
6966	Subsoil of 6965.....	Dark-brown clay loam, 12 to 36 inches.	3.60	.00	.38	.20	2.22	5.20	66.68	24.96
6968	Subsoil of 6967.....	Dark-brown loam, 12 to 36 inches.	2.79	.06	.32	.14	.70	4.36	64.54	29.46

MIAMI GRAVELLY LOAM.

The Miami gravelly loam consists of from 10 to 12 inches of reddish clay loam underlain by a stiff, buff-colored or reddish clay subsoil, beneath which is usually found a well-defined gravel bed. The gravel is usually limestone, and the stratum also contains rounded boulders, the matrix being sand and clay. The gravel content of the soil and subsoil varies from about 10 per cent to 30 per cent, the quantity of gravel in the soil seldom being so great as to interfere much with tillage.

The type is locally known as "gravelly second-bottom land." It occurs as terraces along nearly all the streams, and lies several feet above the Miami loam terrace, being 20 to 60 feet above the stream beds. Lying as they do in generally narrow stream valleys, the areas of this soil, like those of the Miami loam, are never very wide, nor does the former occur so much in the form of continuous strips as the latter.

The surface is sometimes quite flat, but usually it is gently rolling. The natural drainage conditions are very good, both by reason of the surface conditions and because of the gravel stratum which underlies the type.

This soil type is derived from the weathering of the material forming the gravelly second bottoms. These second bottoms owe their origin to an action similar to that noted for the Miami loam, with, however, the exception that conditions were such that no great accumulation of vegetable matter took place, probably because of the better natural drainage of these high terraces. At the close of the Glacial period the whole of the area was more or less uniformly covered with several feet of yellow clay drift. After a time drainage ways began to form, finally resulting in the present well-defined channels. The streams were doubtless greatly swollen during much of their early history, and owing to the swift currents clay and silt were carried away, while extensive beds of gravel remained, forming the floor and sides of the streams. As the streams cut deeper and became reduced in volume these gravel beds became subject to overflow only during floods, when a deposit of clay and silt was effected. Thus the formation of the Miami gravelly loam and the Miami loam terraces took place in the same way, the only differences being the greater quantity of gravel and less amount of vegetable matter accumulated in the soils of the higher-lying terrace.

As might be inferred from the similarity in origin of these two soils they not infrequently grade into each other, and the change from one type to the other is so gradual as to make the determination of the boundary lines quite difficult. Still, on the whole, the local variation of the Miami gravelly loam is very slight, and the type characteristics are fairly distinct throughout the area surveyed. A slightly sandy texture is sometimes found, in which case the drainage is apt to be excessive and the soil more liable to be droughty.

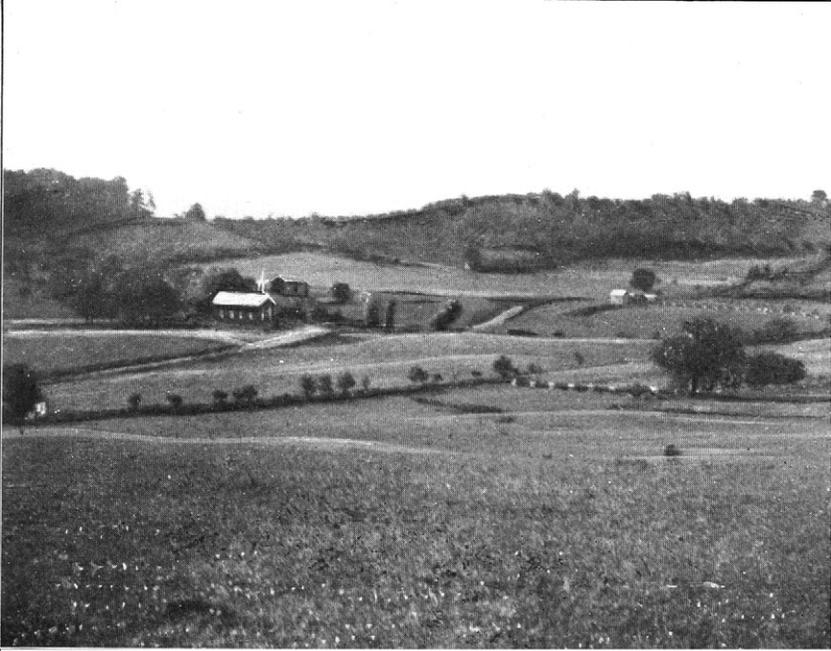


FIG. 1.—GENERAL VIEW OF THE UPLANDS, SHOWING THE ROLLING CHARACTER OF THE COUNTRY, COLUMBUS AREA, OHIO.

This is the Miami clay loam, the principal wheat soil of the area. Not so well adapted to corn as the Miami black clay loam.



FIG. 2.—MARKET GARDENING OF THE MIAMI LOAM, COLUMBUS AREA, OHIO. THE FIRST TERRACE.

The Miami gravelly loam is the leading market-garden soil of the area, being used for this purpose to a large extent in the vicinity of the larger towns, especially Columbus. It is also well adapted to the general farm crops. The excellent subdrainage afforded by the gravel substratum, and the clayey texture of the overlying soil and subsoil is an ideal soil structure. Such a soil warms up quickly in the spring, readily parts with its excess of water, and yet retains sufficient moisture to supply the ordinary needs of the crop. The more successful gardeners, however, irrigate their fields, generally by means of water pumped from wells into tanks by windmills. Water is usually reached at from 8 to 20 feet below the surface.

The market garden crops consist chiefly of onions, lettuce, tomatoes, radishes, melons, cabbage, sweet corn, potatoes, beans, and peas, all of which seem to thrive. When the location does not favor gardening, such crops as corn, wheat, and grass, and tobacco are successfully grown on this soil. Corn yields from 40 to 60 bushels, and wheat from 15 to 25 or 30 bushels per acre. Sorghum also does well. Naturally the soil is better adapted to early maturing crops than to crops that mature late in the season, as the perfect drainage is apt to produce a droughty condition in long periods of dry weather.

These second bottoms were much sought after by the early settlers because of their productiveness, and they soon became cleared and tilled, leaving little of the original forest growth standing.

The Miami gravelly loam makes an ideal location for the farmstead. The natural drainage is good, and the underlying gravelly loam affords a near supply of good drinking water. Many fine farm buildings are seen on this type, usually with surrounding apple and cherry orchards, well-kept gardens, and patches of small fruits.

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

Mechanical analyses of Miami gravelly loam.

[Fine earth.]

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.*	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
6971	2½ miles S. of Columbus.	Brown gravelly loam, 0 to 10 inches.	1.11	4.40	11.20	5.94	9.56	5.60	45.26	17.94
6969	2 miles W. of Brice.	Dark silty loam, 0 to 10 inches.	1.17	5.56	7.22	3.50	4.82	6.20	40.94	31.20
6972	Subsoil of 6971.....	Reddish-brown clay with gravel, 10 to 36 inches.	.68	3.52	12.10	6.40	11.40	8.04	38.62	19.36
6970	Subsoil of 6969.....	Reddish clay, 10 to 36 inches.	1.62	7.14	12.60	5.98	5.86	3.76	31.14	32.42

DRAINAGE.

The first drainage of the soil in the vicinity of Columbus for agricultural purposes was undertaken about forty years ago. To-day it is estimated fully a fifth of the area surveyed, including the lands most in need of drainage, is underlain by tile drains.

The soils naturally most in need of drainage are the Miami black clay loam and the Miami clay loam, both situated in the upland or interstream areas. The surface of these soils is generally flat, though modified by low undulations from 5 to 10 feet high and by small natural drainage channels that lead to the larger streams and rivers of the area. These natural drainage channels are utilized as main drains, in a large measure taking the place of the extensive private and county ditches that must be dug as a preliminary to thorough tile drainage in the more level areas of northern Ohio. Occasionally, however, an extensive flat area is found where wide, deep, open ditches are necessary. Sometimes the owner or owners of the lands to be most benefited take the matter in their own hands and build the ditch. Sometimes the landowners petition the county commissioners for a drain, and they direct the county surveyor to lay out the course of the ditch and set the grade stakes, as well as to apportion the assessment for construction against the adjoining lands, as nearly as possible in proportion as they are benefited by the ditch.

The two types of upland soil pointed out as deficient in drainage are so because of the impervious character of their clay subsoil and by reason of their topography. Of the two, the Miami black clay loam has been the most benefited by underdrainage, in many cases the areas having formerly been under water for the greater part of the growing season. The thorough tile drainage of such areas has changed the soil to one of the best in the area for corn and one excellent for grain and grass. Two main effects are responsible for the improvement—the removal of standing water and the reduction of damage from “heaving” caused by the freezing and thawing of the soil when in a too saturated condition.

That tile draining should greatly benefit these areas of heavy clay soil, lying for the most part in depressions generally swampy and frequently covered with water, would naturally be supposed, but that the higher lying Miami clay loam would be very much improved by tiling is less easily surmised. This has been found to be the fact, however, and tile drains are being extended into the flatter areas of this soil as rapidly as time and means permit.

The quality of crops grown on the underdrained soils is improved and the yield is increased. On the Miami black clay loam the increase in value is said to be 50 per cent and on the Miami clay loam from 10 to 30 per cent over the crops produced on the same fields before draining.

The "second bottoms," where occurs the Miami gravelly loam, are usually well drained naturally, but the "first bottoms," in which is found the Miami loam, when so situated that an outlet can be had, are drained, and with profit. The improvement in the condition of this soil by drainage is said to be about the same as in the case of the Miami black clay loam.

It is not within the scope of this report to go into the details of installing a drainage system, nor is it practical to give the cost of putting in such systems, as each one must vary with the character of the soil and topography. The heavier the soil the closer together must be the drains, and in the flatter areas of Miami black clay loam it has been found that a drain is not effective for a greater distance than a rod on each side. Even with the low cost of tile in this area the cost of thoroughly underdraining an acre is quite large.

Tiles are manufactured in the area from the clay found in the subsoil of the uplands. At one time there were 17 factories, large and small, in operation in Franklin County alone. Now there are perhaps 5, all large and well-equipped concerns.

The price of tile as given by one of these ranges from 20 cents per rod for 3-inch tile up to \$4.50 for 20-inch tile. The large sizes are now being used for main drains, instead of open ditches.

The tile drains have proved to be very durable. Drains laid twenty or thirty years ago are apparently in as good condition to-day as they were when put in. They can thus be classed as one of the most permanent improvements that can be put on the farm, while the practical results of their use in the production of crops have proved them to be one of the most valuable. Throughout the area the condition of the land with respect to drains has become an important factor in determining its value in the market.

With a fifth of the area already tile-drained, and with the rapid extension of the system now going on, it is thought to be only a question of a comparatively short time when the remainder of the area, excepting of course those lands with a porous structure and a gravelly subsoil, will also be improved in like manner.

AGRICULTURAL CONDITIONS.

The farmers of the Columbus area are quite prosperous. Mortgages on farms are being paid, improvements added, and machinery purchased. The better and more intensive tilling of the fields is also an indication of a thriving industry. It is said that the conditions now are much better than one or two decades ago.

The size of the farms varies considerably, ranging from 20 acres to perhaps 500 acres. The area of the greater number ranges from 50 to 140 acres. The average size for Franklin County, computed from figures furnished by the Twelfth Census of the United States, is 84.41

acres, which doubtless represents fairly accurately the average for the Columbus area.

The farmstead usually consists of from 5 to 10 acres, with a substantial frame or brick house, a barn and shed, and other outbuildings. Native shade trees and thrifty orchards of fruit trees usually surround the farm buildings.

The houses range in value from \$800 to \$3,000, the average being probably between \$1,000 and \$1,600. The barns are good, substantial structures, though generally less expensive than the houses, in this respect differing from the barns found in Lancaster County, Pa., and in some other parts of the East. The farm buildings, both houses and barns, are nearly always well painted. Nearly all the farms are fenced. The old-style worm-rail fence and the modern wire fences are found side by side, but the latter are gradually displacing the former.

The acre valuation of the land, taking the area as a whole, ranges from \$40 to \$120, depending on improvements, location, and character of soil. The usual asking price is from \$60 to \$100 per acre. The tax rate, local and State, is about \$1.50 per \$100 valuation. The valuation is usually about 60 per cent of the price of the land at forced sale.

Nearly every farm in the area is well equipped with plows, harrows, grain drills and binders, cultivators, mowing machines, wagons, and lighter vehicles, and very few places were noted where these were not properly housed when not in use.

According to the Twelfth Census, 72.5 per cent of the farms of Ohio are operated by the owners, while of the remainder 8.7 per cent are operated by tenants paying a money rental and 18.8 per cent by tenants on shares. These figures probably represent fairly well the conditions of tenure in the Columbus area. The money rental of land ranges from \$4.50 to \$6.50 per acre per season, any higher rate being usually unprofitable to the tenants. When rented on the share basis the owner receives about two-fifths of the crops. In the census figures just quoted managers of farms are included in the percentage of farms operated by owners. The suggestion is made that the number of farms that are being operated by "managers," who may or may not own a part interest in the farm, is increasing. The Twelfth Census also gives the percentage of gross income of the farmers, figured on the total investment, as 16.8 per cent. The average net income is not given, but it is, of course, very much below this figure.

The condition of the industry with respect to labor can not be said to be entirely satisfactory. The supply during most of the year is ample, but at times, during harvest, help is scarce and wages high. The wages by the month with board range from \$16 to \$20 and by the day during harvest from \$1 to \$2. The labor is usually white, and as

far as quality of work is concerned is more dependable than that available in some parts of the country, but there is a great difficulty in getting men to stay long in one place. The hired-girl problem is not entirely to the satisfaction of the average housewife. Such help is scarce. The wages paid girls range from \$1 to \$3 per week, with board included, of course.

The principal products of the area outside of the zone of city influence are grain, beef, mutton, pork, butter, and cheese. The crop rotation followed is nearly always: (1) corn, (2) grain, either wheat, oats, or rye, and (3) grass, usually a mixture of clover and timothy. As will be noticed, the rotation allows considerable variation in the kind of grain grown, and the farmer also varies the length of time the land is left in grass to suit his needs; but in the main this rotation is followed and has been found essential to keeping the land in good tilth.

In any case the wheat crop represents the direct money crop. It is frequently sold to the local elevators at from 50 to 80 cents a bushel. The yield per acre ranges from 15 to 25 or 30 bushels. The corn and hay crops are also sold direct when not needed for feeding and fattening stock, but generally these crops are turned into beef, dairy products, pork, and mutton. Cattle to be fattened are usually put in pasture during the summer and fall and then fed in the late fall and winter with a liberal ration of corn. Pasture is sometimes supplemented by corn fodder. The herds of beef cattle seen usually number from 6 to 30 head.

The dairy interests are not very extensive. Only four creameries were noticed in the area. Each farmer, however, has from 1 to 6 cows, and in the aggregate the product of milk and homemade butter is considerable. The greater part of this is taken for local consumption. Large herds of dairy cattle are uncommon.

Many flocks of sheep, ranging from 40 to 100 head to the flock, are seen. It is said that the keeping of these is quite profitable. In most cases the sheep are raised chiefly for mutton, but some breeders are producing a mutton sheep with a fine-textured fleece, thus making the wool product more profitable than when a strictly mutton sheep is raised.

Fruit also does well in the district and is fairly well represented on most of the farms. Apples, pears, peaches, raspberries, strawberries, and currants appear to be best adapted to the soils and climate. More attention seems to be given to this industry than formerly. A great many of the apple orchards are old, but young orchards are at present being set out in many places. There is doubtless good profit in rational orcharding upon the soils of this area. One case was found where \$450 net profit in one season was realized from a 3-acre apple orchard. This, of course, is rather exceptional, but it is an index of what may be done in the production of apples in the area surveyed.

The market-gardening interests in the vicinity of the larger towns, especially Columbus, is very large. Great quantities of onions, lettuce, radishes, cabbage, tomatoes, etc., are grown on the various soil types. Such farms range in size from 5 acres to 40 acres, and the gross income varies from \$200 to \$800 per acre. One man is reported to have secured a net income of \$600 per acre for his onion crop. This, too, is merely an index to the profit to be made in producing the truck crops.

The origin of the soil types of the Columbus area is more clearly marked than in some of the other areas surveyed, and the adaptation of these soil types to certain crops seems also more pronounced. The Miami clay loam is the typical wheat and grass land, though as manipulated by some of the more successful farmers most of the staple crops, including even the truck crops, are grown with success. The Miami black clay loam, occurring in the depressions of the clay uplands, is the typical corn land of the area, yielding from 60 to 120 bushels per acre. By reason of its heaving in winter, such crops as the grasses and grains are liable to suffer serious injury, and, moreover, grain is liable to run too much to straw. With good drainage and careful tilling these undesirable features are being gradually modified. The Miami loam, which occurs as the lower-lying terraces along streams, where not leveed as before pointed out, is subject to overflow in the spring. It also is used mainly for corn. Wheat and grass are not grown extensively on this soil because of the danger from floods, while corn is secure, since it is planted after danger of spring freshets has passed. This type contains considerable decaying vegetable matter, but still has sufficient sand to prevent injury to grass and grains by heaving. When leveed good crops of wheat and oats are grown. Some excellent truck crops are grown on the more favored portions of this type near Columbus.

The crops adapted to the Miami gravelly loam are especially truck crops, though this type is also used for general farming. Good sub-drainage is always a feature of this type and hence crops are not apt to suffer from too much rain, while on the other hand plenty of good water is found at a depth of from 8 feet to 20 feet and is thus near at hand for the pump and tank irrigation practiced by the more progressive truck farmers. Where irrigation is not practiced the type is limited in its adaptation, by reason of its droughty character, to crops which mature early, such as grain and some of the small fruits, especially strawberries.

Thus we have before us four soil types showing marked adaptability to certain crops. Under the manipulation of the more progressive farmers these natural adaptabilities have been widened as well as intensified on all the types. Large quantities of manure and fertilizers are added to the soil, especially where truck is grown.

The transportation facilities of the area are very good. Columbus is a notable railroad center. Some twenty or more railroads either enter or have connection with that city. Besides these, a number of excellent trolley lines reach out from Columbus to the smaller cities and towns, and even to some of the more distant cities—Springfield and Dayton, for instance. Farmers located near the trolley lines are able to use them in sending to market fruit, truck, and dairy products. This means of communication, coupled with the ever-extending telephone service, makes possible a ready intercourse for business and pleasure that was unthought of a decade ago. In addition to the already-mentioned means of intercourse and commerce the rapid extension of a daily rural free-delivery mail service, bringing to the farmer his daily papers and business letters, is worthy of special mention. The railroad, the trolley, the telephone, and the daily mail are helping to take the farmer out of that isolation which was formerly his lot here and is still his misfortune in less favored sections of the country, and to bring him in closer touch socially and commercially with the outside world.

Nearly the whole area is reached by good wagon roads. These are often surfaced with gravel or crushed limestone, while the dirt roads are kept in good repair by the occasional use of modern road implements.

Columbus, with its population of about 127,000, is the principal market town of the area. There are in the area about a dozen small towns, with populations ranging from 200 to 1,000, which consume some of the produce of the area and are shipping points, but they may be regarded rather as feeders to the Columbus market. A number of wagons driven about the county in quest of poultry and dairy products were often seen during the progress of the soil survey. On the whole the condition of the area with respect to markets may be considered quite good.

NRCS Accessibility Statement

This document is not accessible by screen-reader software. The Natural Resources Conservation Service (NRCS) is committed to making its information accessible to all of its customers and employees. If you are experiencing accessibility issues and need assistance, please contact our Helpdesk by phone at 1-800-457-3642 or by e-mail at ServiceDesk-FTC@ftc.usda.gov. For assistance with publications that include maps, graphs, or similar forms of information, you may also wish to contact our State or local office. You can locate the correct office and phone number at <http://offices.sc.egov.usda.gov/locator/app>.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotope, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.