

# SOIL SURVEY OF THE PONTIAC AREA, MICHIGAN.

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## LOCATION AND BOUNDARIES OF THE AREA.

Oakland County is in the southeastern part of the lower peninsula of Michigan, midway between Saginaw Bay and Lake Erie, and a few miles west of Lake St. Clair. A rectangular area of 324 square miles (land area about 307 square miles), which comprises the nine southeast-

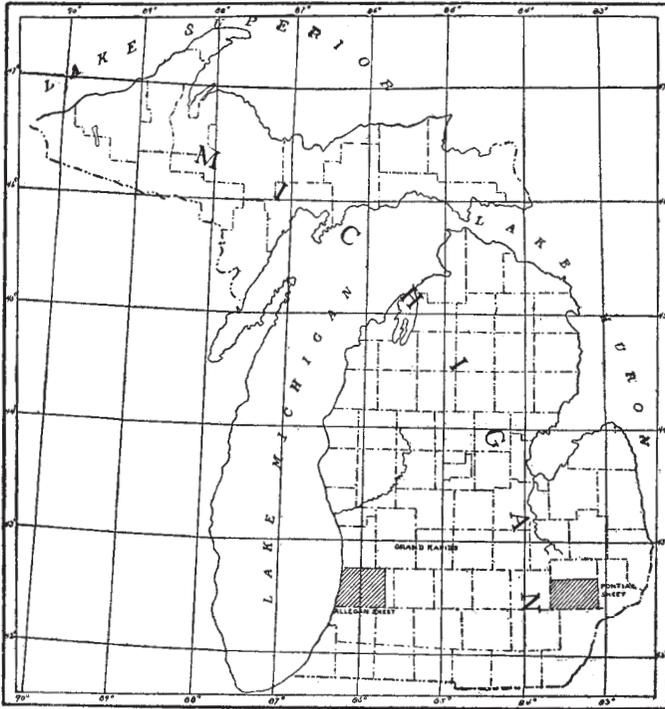


FIG. 32.—Sketch map showing location of the Pontiac area, Michigan.

ern townships of the county, was surveyed. This area, which is included between latitude  $42^{\circ} 25'$  and  $42^{\circ} 40'$  north, and longitude  $83^{\circ} 5.8'$  and  $83^{\circ} 26.6'$  west, has an extent of 18 miles from east to west and an equal length from north to south.

## HISTORY OF SETTLEMENT AND AGRICULTURAL DEVELOPMENT.

The historical material included in this report is taken chiefly from Durant's History of Oakland County.

In 1816 United States surveyors ventured beyond the swampy belt that encircled Detroit to explore the interior territory. The first permanent settlement was made in 1817, in the township now known as Avon. During the following two years settlements were made at Birmingham, Royaloak, and Waterford, and within a few years thereafter the other townships of the county were settled. Oakland was the first county in the interior of the State to be settled. It was organized in 1819, and its early inhabitants came largely from New England, New York, New Jersey, and Pennsylvania. These people found the Indians still occupying the country, but in general they were peaceably inclined, and gradually they disappeared.

The passage by Congress of the act establishing the price of public lands at \$1.25 an acre was followed by large immigration into Michigan, and the growth of the white population of the county was comparatively rapid, notwithstanding the fact that thirty days were required to make the journey from New England and eastern New York, and that as late as 1841 twelve days were needed for the transportation of mail from Washington.

In 1825 the population of the county was 1,362; in 1835 it had increased to 7,390, and in 1870 to 48,689; but in 1900 it had decreased to 42,668.

Oakland County passed through the various transitions incident to a territorial form of government until Michigan was admitted to the Union as a State, in 1837.

The early inhabitants found the land nearly all forested, and the first settlements were made in the small "oak openings."

On the uplands deciduous trees prevailed, consisting chiefly of oak, hickory, walnut, and poplar, while the wet or swampy conditions of the lower lying areas adapted them to the tamarack, aspen, elm, willow, cedar, basswood, and maple.

Timber was of no value, and as fast as the trees could be cut they were burned and the land was prepared for planting. The stumps were left standing until the natural processes of decay should make their removal an easier matter.

As soon as the land could be cleared a system of general agriculture was developed. Wheat was the leading crop at first, but the danger of continuous cropping was early recognized, and consequently the land did not deteriorate to such an extent as has been the case in many places, by producing successive crops of that grain. Corn was introduced early, and its acreage soon reached two-thirds that of wheat.

Oats, rye, and potatoes were the secondary crops, and stock raising soon became an important industry of the county.

When the first settlers came they found a peach orchard on the island in Orchard Lake. This is supposed to have been started by early French traders and was the precursor of the fruit interests which since have been extensively developed.

#### CLIMATE.

Climatological data for this section are given in the following table, which shows the normal monthly and annual temperature and precipitation, so far as available in the records of the Weather Bureau stations located at Ball Mountain and Birmingham:

*Normal monthly and annual temperature and precipitation.*

Month.	Ball Mountain.		Birmingham.		Month.	Ball Mountain.		Birmingham.	
	Temperature.	Precipitation.	Temperature.	Precipitation.		Temperature.	Precipitation.	Temperature.	Precipitation.
	° F.	Inches.	° F.	Inches.		° F.	Inches.	° F.	Inches.
January .....	22.5	1.75	23.0	1.99	August.....	68.0	2.64	68.2	2.71
February....	22.1	2.00	23.8	2.10	September..	61.8	2.68	60.5	2.16
March.....	29.1	2.04	30.5	2.08	October.....	49.6	2.69	49.6	2.65
April.....	45.2	2.13	46.1	2.77	November..	36.0	2.88	36.9	3.20
May.....	56.0	3.53	57.0	3.48	December...	27.3	2.14	27.4	2.01
June.....	66.8	3.23	69.1	3.36	Year..	46.2	30.09	47.0	31.12
July.....	70.6	2.38	71.8	2.61					

#### PHYSIOGRAPHY AND GEOLOGY.

The Pontiac area has the characteristic features of a glacial region. The surface is rolling or hilly, and though the rounded hills and ridges never attain a very great height above the surrounding country there are no large areas of level land. The area lies on the southeastern slope of the somewhat indefinite watershed which extends in a southwesterly direction from Port Austin, at the head of Saginaw Bay, to the southern boundary of the State, near the line between Ohio and Indiana. This watershed reaches an elevation of 500 feet above the Great Lakes in some parts of the area, but the general surface has an elevation of only 300 or 400 feet above the water level of the lakes. The general ascent from Lake Erie and Lake St. Clair to the top of this watershed is so gradual that it is scarcely discernible for much of the distance.

Glacial lakes are of frequent occurrence throughout the area, but are most numerous in Waterford and West Bloomfield townships. In the latter township Cass Lake and Orchard Lake, which are but a few rods apart, cover a combined area of more than 2,050 acres, and the total area of the lakes of that township is 4,000 acres. Oakland

County is said to contain more than 450 lakes, which are estimated to include a total area of 20,000 acres.

The overflow from the group of lakes lying to the west of Pontiac gives rise to the Clinton and Huron rivers, which, with their numerous branches, drain almost the entire area, and flow respectively into the Detroit River and Lake Erie.

Low-lying areas and innumerable depressions of greater or lesser extent mark a feature of glacial topography similar to that of the lakes above mentioned. Tamarack swamps and muck areas exhibit the more or less complete drainage of these basins. Bog iron ore and beds of peat are often found in the swampy depressions, and shell marls occur in the bottoms of many of the lakes.

Geologists state that the surface formation of the entire area is composed of glacial drift, and that this is so deep that there are no exposures of the underlying rock formations which can be investigated. Well borings at Pontiac show the drift at that point to have a depth of 320 feet, but that is more than the average depth over the area. Underneath this drift the Waverly group is represented to a depth of about 1,000 feet by a series of shales, sandstone, and limestone, which in turn rests upon clay.

Following the glacial period the land must have been submerged for a long time. This is proved by the existence of a series of terraces composed of stratified drift sand mixed with pebbles. These terraces mark the temporary shore lines of the waters as they receded. Both the terraces and the older glacial drift are made up of an orderless mass of sand, gravel, and boulders derived from crystalline and metamorphic rocks.

A moraine enters the county near Novi and extends in a north-easterly direction to Rochester, where it turns northward.

#### SOILS.

The several soil types as mapped occur in a series of strips extending from northeast to southwest across the area. Beginning at the northwestern corner of the area, in Waterford Township, is a strip of sand and gravelly sandy loams. This is superseded in regular sequence by a series of clay loams extending through Pontiac, West Bloomfield, and Farmington townships; sandy loams extending through Avon, Bloomfield, and Southfield townships; clay loams through Troy, the northeastern part of Southfield, and the northwestern part of Royal Oak townships; and a final strip of sand and sandy loams through southeastern Troy and central Royal Oak townships.

The presence of the clay loams in the extreme southeastern part of Troy would seem to indicate that another strip of heavy soils enters the area at that point, but this is intercepted by a broad expanse of Miami sand in the township of Royal Oak.

The following table shows the extent of each of the soil types represented in the area:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Miami clay loam.....	56,384	28.7	Muck .....	3,904	2.0
Miami sandy loam .....	34,368	17.5	Clyde sand.....	2,880	1.5
Miami sand.....	30,592	15.6	Plainwell stony loam.....	1,472	.7
Oakland sandy loam .....	25,984	13.2	Miami loam.....	1,152	.6
Marshall gravel .....	15,104	7.7	Miami gravelly loam .....	1,088	.6
Miami black clay loam .....	11,840	6.0	Swamp.....	704	.4
Allegan gravelly loam .....	6,912	3.5	Total.....	196,416	.....
Meadow .....	4,032	2.0			

#### MIAMI CLAY LOAM.

The soil of the Miami clay loam is a heavy loam, or clay loam, from 10 to 14 inches deep. This is underlain by extremely stiff clay loam or clay to a depth of 36 inches. Both soil and subsoil are either brown or drab in color.

This soil is termed locally "black-walnut land," because of the prevalence of that kind of timber in the original growth. This was interspersed with other varieties of the hardwoods, of which hickory, beech, maple, ash, and several species of oak were the most common.

The Miami clay loam occupies two large areas which conform to the general occurrence of the soil types of this section. The first area begins about 1 mile south of Rochester and, in a band from 2 to 3 miles wide, extends southwesterly to the center of Southfield Township, where it is intercepted by the Miami sandy loam. The other large area lies parallel to this in the townships of West Bloomfield and Farmington. In direct line with this area, in the township of Pontiac, there are considerable areas of the same soil, which, though separated east of Cass Lake by a series of sandy loams, seem, judging from field observations, to belong to the same formation as the large area in West Bloomfield. Aside from these main areas the Miami clay loam occurs as detached knolls and rounded hills throughout the area, and is believed to underlie nearly the entire region. Many road cuts, sharp and steep slopes due to stream erosion, and various excavations all disclose this heavy underlying clay at no great depth from the surface. With the sandy loams it is generally but a few feet from the surface, and in some cases this holds true with the Miami sand, but at Drayton Plains, and the part of Utica Plains which lies within the area, it is buried beneath many feet of sand.

All of the larger bodies of the Miami clay loam are moderately rolling upland. This general surface configuration is marked now and then by steep knolls and sharp ridges. Formerly scattered areas were strewn with stones and bowlders, but most of these have been piled in

heaps or removed from the cultivated fields altogether. So numerous were these stones that the land could not be worked until they were removed, and instances were noted where as many as 15 large piles were seen on fields of 20 or 30 acres. The natural productiveness of the soil, however, fully warrants the removal of these stones.

The topographic features of the Miami clay loam would naturally secure good surface drainage, but the physical characteristics of the soil are such that drainage presents a serious problem. When wet the surface soil is very heavy, sticky, and unworkable, and the subsoil is so impervious to moisture that often after a rain the soil does not become sufficiently dry to work before it rains again. The soil can be worked to advantage only within a narrow range of moisture conditions. If too dry the soil is so stiff that it is well-nigh impossible to work it, but if too wet it forms large clods which when dried by exposure to the sun and wind become so hard and intractable that they can seldom be reduced during the growing season, but must await the action of the winter rains and frosts.

Tile drains are of inestimable value to this soil and should be constructed where possible. Owing to the extreme stiffness of the subsoil when dry the construction of suitable drains is both tedious and costly, but where this has been done the moisture conditions have been controlled to such degree that the soil is in workable condition a much greater part of the time, the tilth is vastly improved, and the productiveness of the soil notably increased.

The most troublesome feature of this soil is the stiff clay knolls which, though most common in the Miami clay loam, are scattered quite generally among the sandy and gravelly loams throughout the area. The soil of these areas is very stiff clay, which is underlain at a depth of a few inches by a heavy clay even stiffer than the soil. Exposures of this kind vary in extent from 2 or 3 square rods to several acres. Frequently they occur on the slopes, but more often they occupy entire knolls and ridges of small extent.

These areas, although very difficult to manage when associated with the Miami clay loam, are particularly annoying when they occur in the sandy loams, because they require cultural methods so much at variance with the greater part of the field in which they are found. If plowed when moisture conditions are in the least unfavorable the soil bakes into clods which seldom can be overcome during the growing season, although moisture conditions might be highly favorable for working at least 90 per cent of the field.

Usually these areas are so small that specific culture hardly would be profitable, and in this case they will have to be endured as a probably necessary evil; but where of sufficient area the tilth could be improved materially by plowing under rye or some similar crop. This should be continued until the physical conditions are so improved

that a good stand of clover could be secured. Until this is done clover can not be successfully grown, because of the probability of destruction by heaving of the soil during the winter. Heavy applications of strawy stable manure also would prove highly beneficial, and this treatment could be applied as well where the areas are of small extent. This system unquestionably would overcome to a considerable degree the difficulty with these knolls, and the increased returns therefrom in many instances would immediately repay any expense which might be incurred.

The Miami clay loam is, in general, the typical clay upland of the glacial drift which overspread this region.

General farming is almost universal upon this soil. The crop yields are very variable and depend largely upon the cultural methods used. Corn yields from 50 to 60 bushels, wheat 20 bushels, rye 25 bushels, oats 50 bushels, and hay from 1½ to 3 tons per acre.

The Miami clay loam is best adapted to dairying, and this interest should be steadily extended. Where a satisfactory market for dairy products can not be secured or developed stock raising should be increased. The soil is also well adapted to grain farming.

The texture of the soil and subsoil of the Miami clay loam is indicated in the following table:

*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 0.0001 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>
9596	Sec. 5, Troy Tp.....	Clay loam, 0 to 12 inches.	2.21	1.16	4.06	5.70	17.24	12.20	40.22	19.42
9598	Sec. 17, Pontiac Tp..	Heavy loam, 0 to 10 inches.	.75	1.98	4.76	5.48	19.06	16.34	28.38	23.88
9600	Sec. 30, Farmington Tp.	Heavy clay loam, 0 to 8 inches.	1.80	.78	3.96	5.06	14.80	12.36	34.22	28.78
9597	Subsoil of 9596.....	Clay loam, 12 to 36 inches.	.10	.70	2.60	3.60	12.74	15.20	34.36	30.68
9599	Subsoil of 9598.....	Clay loam, 10 to 36 inches.	Tr.	1.04	3.20	4.04	13.68	14.18	32.40	31.06
9601	Subsoil of 9600.....	Stiff clay loam, 8 to 36 inches.	.34	1.04	2.16	2.36	8.10	9.50	31.02	45.72

The following samples contained more than one-half per cent of calcium carbonate (CaCO<sub>3</sub>): No. 9599, 10.58 per cent; No. 9601, 6.96 per cent.

MIAMI SANDY LOAM.

The surface soil of the Miami sandy loam is a light to dark brown sandy loam, with a depth of from 10 to 14 inches. The sand generally

is medium and fine in texture, with which a little of coarser texture is intermingled. This material grades into medium sand, which usually is several feet deep, but sometimes the heavy clay, which underlies the entire region, lies within 5 or 6 feet of the surface.

The subsoil usually contains a low percentage of clay, which, although almost insignificant in amount, is sufficient to cause the material to stand up well in banks and cuts.

Gravel is common in both soil and subsoil. The surface gravel is of all grades—fine, medium, and coarse—and may be scattered over large fields, but more often it is confined to limited areas. Where gravel is found in the surface soil similar grades of gravel may occur throughout the subsoil. Frequently the subsoil is underlain at 30 inches or more by a gravel bed. On the greater part of the type the gravel is not in sufficient quantity to interfere with cultivation or to change the crop value of the land. Over small and detached areas surface stones and small bowlders are somewhat troublesome, but there are considerable areas of this soil which are entirely free from both gravel and stones.

When worked under unfavorable moisture conditions clods often form in the more loamy phases of this soil, but with this exception it is mellow and easily worked.

The Miami sandy loam is the most extensive of the sandy types of soil which extend across the area from northeast to southwest, alternating with the clay loams. The most important area of this type is the broad and irregular band which extends from Rochester southwest to Farmington, and in its course is the most extensive soil type in the townships of Avon, Bloomfield, and the northern part of Southfield. Areas of lesser extent are associated with the large areas of Miami sand which crosses Royal Oak and enters the township of Troy from the south; with the band of sandy and gravelly soils which extends across the townships of Waterford and West Bloomfield, and with the irregular band of sandy soils which extends from Pontiac to Orchard Lake, thus intersecting the large strip of Miami clay loam and connecting the above-mentioned sandy loam areas of Waterford and Bloomfield townships.

The surface features of the Miami sandy loam have a much diversified aspect. The greater part of the type is rolling, and broken by many low hills, knolls, and ridges. These elevations for the most part are small, and sometimes vary from the true soil type. It is not uncommon to find interspersed in this type a hill or knoll either of Miami sand, Oakland sandy loam, or the stiffest phase of the Miami clay loam.

In the western and northwestern part of Avon Township the type is very broken and hilly, and there, too, stones and gravel are more com-

mon than is general with the type. The large area west of Birmingham, however, is a comparatively level plain.

The physiographic features of the Miami sandy loam, coupled with the open character of the immediate subsoil, secure for this type excellent drainage conditions.

The entire upland portion of the type owes its origin to glacial action, and some of the most stony and gravelly phases represent morainic material. Limited areas of this soil along the Clinton and Rouge rivers are of sedimentary origin.

The main part of the Miami sandy loam is devoted to general farming, and it has always been considered a desirable soil for this purpose, although it is not as productive as the Oakland sandy loam. Corn yields from 20 to 35 bushels, wheat 10 to 25 bushels, oats 30 to 65 bushels, rye 12 to 30 bushels, buckwheat 15 to 20 bushels, beans 10 to 18 bushels, and hay from 1 to 2 tons per acre.

Peaches thrive on this soil and yield particularly well near the larger lakes of the area. The small fruits give abundant returns, but have not received the attention which they deserve.

In the western part of Avon Township the surface of the Miami sandy loam is so broken, hilly, and, in some places, stony that its value for crops which require much cultivation is somewhat impaired. This section could be devoted advantageously to the production of apples, as it is well adapted to their growth. The soil is well drained, and the underlying subsoil of clay loam is sufficiently near the surface—often only 4 feet below—to insure a vigorous growth of tree.

The texture of typical fine-earth samples of both soil and subsoil of the Miami sandy loam is given in the subjoined table:

*Mechanical analyses of Miami sandy 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 0.06 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>
9606	Sec. 21, Avon Tp..	Loamy sand, 0 to 16 inches.	2.06	8.42	11.78	15.00	33.22	14.72	14.42	7.26
9610	N. sec. 22, South-field Tp.	Sandy loam, 0 to 10 inches.	.79	2.16	8.04	15.86	37.80	14.70	13.08	8.34
9608	Sec. 16, Bloom-field Tp.	Medium sandy loam, 0 to 12 inches.	1.10	1.88	7.44	11.26	25.06	20.36	25.16	8.60
9607	Subsoil of 9606....	Sand, 16 to 36 inches.	1.69	5.22	13.82	15.92	30.08	15.28	13.04	6.56
9611	Subsoil of 9610....	Sand, 10 to 36 inches.	.71	1.40	6.36	14.28	42.12	16.30	12.28	6.70
9609	Subsoil of 9608....	Medium sand, 12 to 36 inches.	.20	2.20	8.62	11.60	25.80	20.94	22.64	8.20

## OAKLAND SANDY LOAM.

The Oakland sandy loam consists of loose, loamy, brown sand, or sandy loam, varying in depth from 10 to 30 inches. In typical areas sand particles of medium size predominate, but in certain localities the finer grades of sand prevail. The surface soil is similar to that of the Miami sandy loam, but the subsoil marks an essential difference, in that it is much heavier. The subsoil of the Oakland sandy loam is a clay loam or sticky sandy loam. Where contiguous to the Miami clay loam it closely resembles the stiff clay subsoils of that type, and in some cases represents the underlying clay with a shallow covering of sand.

Throughout the type, but more often in those sections where the underlying clay lies near the surface, the sandy covering is absent from small hills, and the stiff clay is exposed. It was noted that this variation occurs chiefly where the surrounding subsoil is a stiff clay loam, and but rarely where the soil is underlain by the heavy, sticky, sandy loam. These clay knolls are described more fully under Miami clay loam.

Sometimes the typical soil is underlain at a depth of 10 inches by medium and fine sand, which grades into the typical subsoil at varying depths. This variation is most common in Pontiac Township, and where found the underlying subsoil is usually more plastic than in typical areas. In this phase, though totally different in formation, it closely resembles in texture the Collington sandy loam of the Atlantic Coastal Plain. South of Loon Lake, in Waterford Township, the soil is a loamy fine sand.

The type is very generally associated with the Miami sandy loam, and in many cases occupies the gradation zone between Miami clay loam and the more sandy types of the area, but it does not follow the general direction of soil-type occurrence so definitely as the other important types.

The physiographic characteristics, also, of the Oakland sandy loam are similar to those of the Miami sandy loam, except that there are no steep, sharp knolls and hills. The type is generally rolling, and often occupies large, rounded hills and ridges.

Excellent drainage is afforded throughout the type by the nature of its surface. This feature, combined with the open character of the soil, prevents excess of moisture at the surface, while the underlying clay retains sufficient moisture to keep crops in a thrifty condition during a period of drought. These fortunate conditions of drainage make this the safest soil of the area.

The origin of the soil is traced to the action of glaciers, with the relatively unimportant exception of small areas formed by the slight wash from sandy knolls and ridges over the surrounding clay.

The Oakland sandy loam is nearly all devoted to the general system

of agriculture which prevails throughout the area. Corn is the leading cultivated crop, and when well farmed gives excellent returns, but 40 bushels probably represents the average yield. Under a more intensive system of farming the yield easily could be increased. Wheat yields from 10 to 30 bushels, oats from 35 to 75 bushels, rye from 15 to 30 bushels, and hay from 1½ to 2 tons per acre.

The Oakland sandy loam is recognized as a good soil for general farming, but its adaptability to the production of special crops is not realized. Medium and late truck crops do particularly well, and fruits of excellent quality are easily produced.

The following table shows the texture of fine earth of both soil and subsoil of this type:

*Mechanical analyses of Oakland sandy 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.	
9624	Sec. 27, Waterford Tp.	Sandy loam, 0 to 10 inches.	P. ct. 1.77	P. ct. 1.33	P. ct. 6.92	P. ct. 11.02	P. ct. 28.22	P. ct. 13.84	P. ct. 26.80	P. ct. 10.92	
9626	Sec. 10, Bloomfield Tp.	Sandy loam, 0 to 15 inches.	1.73	1.58	5.12	7.78	25.38	15.24	32.26	12.40	
9628	Sec. 27, Pontiac Tp.	Heavy sandy loam, 0 to 10 inches.	2.54	1.06	3.96	8.16	25.02	12.62	34.42	14.74	
9627	Subsoil of 9626.....	Clay loam, 15 to 36 inches.	.94	1.72	4.22	7.30	24.72	12.92	30.88	18.16	
9625	Subsoil of 9624.....	Clay loam, 10 to 36 inches.	.62	2.00	6.52	7.00	19.54	11.74	28.44	24.32	
9629	Subsoil of 9628.....	Clay loam, 10 to 36 inches.	1.17	1.12	2.88	4.10	13.80	9.24	35.24	33.20	

MIAMI SAND.

The soil of the Miami sand areas is light to dark brown medium and fine sand, with a depth of from 6 to 9 inches. The surface soil is more or less loamy, depending upon the cultural methods which have been practiced upon it.

The subsoil to a depth of 36 inches consists of medium and fine yellow or reddish-yellow sand. Fine gravel is of frequent occurrence on small areas of this soil, and small stones are found in a few places.

On the low ridge extending from the northeast corner of section 17 into section 9 of Royal Oak Township, the soil is underlain at 18 inches by a band of fine gravel. Near the boundaries of the Miami sand, with soils possessing a heavy subsoil, this type is underlain by clay loam. Where such subsoil occurs at a depth greater than 30 inches the soil has been mapped as Miami sand, but where the heavy

subsoil is found at a depth of less than 30 inches Oakland sandy loam has been mapped. Near the southern boundary of Southfield Township the sand is black, and is often underlain by quicksand. This phase of the type is poor, and the yields of crops on the scattering areas cultivated are very low.

The principal area of Miami sand is a band from 1 to 3 miles wide, which crosses Royal Oak Township from north to south. At the northern boundary of the township this band deflects slightly to the northeast, and extends in this direction through the township of Troy. The area of second importance in extent occupies the southern part of Southfield Township, and a third area is associated with the Marshall gravel near Drayton Plains. Isolated areas are scattered among the sandy loams throughout the district surveyed.

The Royal Oak area of this type is a low ridge, of which the top is comparatively level. The tract at Drayton Plains and Clintonville is level or gently rolling upland, and the detached areas associated with the sandy loams usually occur as knolls and ridges.

The soil is well drained, with the exception of narrow bands in close proximity to some of the muck areas and that which lies adjacent to Lake Angelus. In the lower lying areas which border several of the lakes the water table is near the surface, and in some places the subsoil is permanently wet at a depth of 3 or 4 feet.

On the larger areas of the Miami sand farming interests are not well developed. The same crops have been cultivated as on the heavier types of soil. This manifestly was poor management, for, as the soil did not possess the same degree of fertility, it was soon exhausted.

The inability, under this system, to withstand the competition of the more productive types of soil and the failure to adopt more intensive methods of farming have led either to the acceptance of the meager returns afforded by out-of-date, and consequently poor, management, or to the gradual abandonment of this soil. Much of this type lies fallow from one to three years at a time. Rye yields from 6 to 15 bushels, and corn from 10 to 25 bushels per acre. Notwithstanding these conditions, this soil is held at a high price when compared with similar soils elsewhere.

The Miami sand is quick to respond to better methods of management, and fortunately there are several local instances which illustrate its possibilities. It is unfortunate that such methods are not more generally adopted. An instance at Royal Oak may be cited, where by the adoption of intensive methods coupled with careful management, typical Miami sand has been brought from a state of exhaustion to a degree of productiveness such that it yields an average crop of 50 bushels of corn, 20 bushels of rye, 100 bushels of potatoes, and 1½ tons of hay per acre. This increased rate of production has been attended by a constantly increasing rate of profit.

The Miami sand is admirably adapted to small fruits and truck crops, and should be devoted to their production.

The following table gives the mechanical analyses of typical samples of fine earth of both soil and subsoil:

*Mechanical analyses of Miami sand.*

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>
9618	Sec. 10, Waterford Tp.	Sand, 0 to 8 inches..	0.64	0.96	8.30	23.50	48.80	6.70	7.32	4.20
9614	Cent. sec. 36, Farmington Tp.	Fine sand, 0 to 8 inches.	2.21	1.62	5.86	13.30	44.46	20.30	7.96	6.12
9616	NE. cor. sec. 22, Royaloak Tp.	Medium sand, 0 to 10 inches.	1.63	3.10	18.10	29.24	28.24	5.30	9.72	6.30
9615	Subsoil of 9614....	Fine sand, 8 to 36 inches.	.50	.26	.98	2.90	46.82	40.66	5.22	3.00
9619	Subsoil of 9618....	Sand, 8 to 36 inches.	.16	1.40	8.16	19.42	53.48	7.52	6.36	3.24
9617	Subsoil of 9616....	Sand, 10 to 36 inches.	.53	3.54	19.46	32.42	27.66	5.02	7.04	4.84

MARSHALL GRAVEL.

The soil of the Marshall gravel to a depth of 8 inches consists of coarse and medium sand containing from 5 to 20 per cent of fine, water-worn gravel and small pebbles. In some places the soil is slightly loamy for a few inches at the surface.

The subsoil is coarse yellow sand, which usually contains rather more fine gravel than the soil, and occasionally is underlain by a gravel bed at a depth of 3 or 4 feet.

The most important area of the Marshall gravel begins near the center of the northern boundary of Waterford Township, extends southwesterly through Drayton Plains, and occupies the northwestern part of the township of West Bloomfield. In this area it is generally level, but often is marked by low swells which may extend for a long distance. In southern Bloomfield Township are a few scattered areas associated with the Miami sandy loam and Allegan gravelly loam. From an important area in the northwestern part of Southfield Township a low, narrow ridge extends for several miles into Troy Township and is known locally as "the gravel ridge." This ridge undoubtedly marks a former lake shore line.

Both the soil and the subsoil of the Marshall gravel are so loose that they are very susceptible to drought. Because this characteristic is so marked satisfactory crops are obtained only in abnormally wet seasons.

The soil is so porous that the limited supply of organic matter stored previous to cultivation was soon exhausted, and the methods of agriculture practiced were such that it was no longer profitable to work this soil extensively. This fact is forcibly illustrated by the many dilapidated and abandoned farm buildings which are found on this type of soil.

Considerable areas of this soil are allowed to lie fallow for three or four years, after which period a crop of rye, yielding from 8 to 15 bushels per acre, may be obtained.

The more loamy phases of the Marshall gravel, when well managed, produce fairly good crops. Rye yields from 10 to 20 bushels, beans from 8 to 12 bushels, corn from 10 to 30 bushels, potatoes from 60 to 125 bushels, and hay from 1 to 1½ tons per acre. The yield of wheat has decreased until very little is grown.

The soil is adapted to small fruits, cherries, early truck crops, and light farming, and in some sections to peaches.

The texture of samples of the fine earth of Marshall gravel is given in the following table:

*Mechanical analyses of Marshall gravel.*

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>
9590	Sec. 24, Avon Tp..	Sandy gravelly loam, 0 to 8 inches.	1.31	5.68	25.31	24.20	23.60	3.08	12.72	5.34
9592	Sec. 10, Waterford Tp.	Gravelly sand, 0 to 8 inches.	.92	3.10	17.88	25.62	28.88	5.96	12.94	5.46
9593	Subsoil of 9592.....	Sand, 8 to 36 inches.	.37	3.48	20.60	26.84	26.20	6.48	11.04	4.76
9591	Subsoil of 9590.....	Sand, 8 to 36 inches.	.47	3.22	21.46	25.80	26.98	3.48	12.16	6.90

ALLEGAN GRAVELLY LOAM.

The surface soil of the Allegan gravelly loam, to a depth of 9 inches, consists of sandy gravelly loam. The gravel varies in quantity from 25 to 60 per cent of the soil mass, and in diameter from one-half inch to 6 inches. Small quantities of finer gravel are found only in exceptional cases.

The soil is underlain by gravelly sand, of which the coarse and medium grades prevail. The gravel content increases with the depth, and usually forms a sticky, iron-stained hardpan at a depth of from 18 to 30 inches.

The greater part of this type lies in an irregular and much broken area which extends diagonally across Bloomfield Township, touches

the southeast corner of West Bloomfield Township, and enters Farmington Township at the northeast corner. A second area is found in the northwestern part of Waterford Township, and a third area north of Upper Straits Lake, in the township of West Bloomfield. Small and scattering areas occur as knolls and ridges in the other types of soil.

The largest areas of Allegan gravelly loam are only moderately rolling when compared with the other types, and in the southwestern part of Bloomfield Township there is a considerable area which is comparatively level.

The topographic features of this type of soil, combined with its physical characteristics, secure excellent natural drainage.

The Allegan gravelly loam is all of glacial origin, and part of it represents morainic material.

General farming is practiced on much of the type, and fair crops are produced. Near Williams Lake, in Waterford Township, Allegan gravelly loam which is well farmed produces an average yield of 16 bushels of beans, 37 bushels of oats, 45 bushels of corn, and 1¼ tons of hay per acre. Very little wheat is grown on this soil at present.

In favorable localities peaches do well on this soil, and it is well adapted to light farming and to the production of small fruits.

The following mechanical analyses show the texture of typical samples of fine earth of the Allegan gravelly loam:

*Mechanical analyses of Allegan gravelly 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.
9583	Sec. 9, Waterford Tp.	Sandy loam, 0 to 9 inches.	0.95	2.76	9.84	13.72	27.12	13.18	26.94	6.30
9585	Sec. 17, Waterford Tp.	Sandy loam, 0 to 9 inches.	1.09	2.86	14.88	11.78	16.10	10.84	35.68	7.60
9586	Subsoil of 9585....	Sand and gravel 9 to 36 inches.	.60	5.88	14.68	15.30	16.78	8.74	30.80	7.82
9584	Subsoil of 9583....	Sandy loam, 9 to 36 inches.	.37	2.58	15.08	11.30	24.70	9.70	21.90	14.30

MIAMI BLACK CLAY LOAM.

The soil of the Miami black clay loam is a black clay loam from 8 to 12 inches deep. When wet it is very sticky, but in dry seasons it is apt to crack open.

The subsoil is sticky, drab-colored clay loam or clay slightly heavier and more tenacious than the soil. Near the line of contact between

the Miami clay loam and the Miami black clay loam the latter type is underlain, usually at a depth of 2 feet, by the stiff subsoil of the Miami clay loam. The entire type, in fact, probably is underlain but a few feet beneath the surface by the same material.

The Miami black clay loam occurs, in areas large enough to map, only in the southeastern part of the area. In this region there are two important areas, each of which contains several square miles, and many scattered areas of lesser extent. This type also occupies occasional unimportant depressions in many of the Miami clay loam areas.

The Miami black clay loam is found only in low-lying areas, and consequently the best results with crops never can be attained until the soil has been drained thoroughly by artificial means. The general level of the southeastern part of the county is so low in many places that section drains are necessary. Such drains are termed "county ditches," because the county shares the expense of digging them with the town or towns concerned and the adjoining landowners. Into these open county ditches the neighboring landholders may direct any drains which they care to lay. When this system is maintained properly it affords a considerable measure of relief, and, on the whole, is efficient for the service it is supposed to perform; but the ditches are necessarily long, often several miles in extent, and frequently pass through small areas containing quicksand. Such areas, though for the most part small, are exceedingly troublesome because of their tendency to clog the ditches.

These broad, open drains, moreover, aside from the annoying patches of quicksand, must tend to fill gradually all along their course, and failure to keep them cleaned properly leaves many large fields too wet for tilled crops and fit only for pasturage.

The Miami black clay loam of this area was formed, through incomplete drainage, in surface depressions where impervious clay lay near the surface. Such conditions favored the accumulation of the organic matter which has given the characteristic dark color to the soil. In some cases this feature has been accentuated by a slight wash from the higher ground which always adjoins or surrounds this type.

A few variations of the Miami black clay loam require brief mention. In the northwestern part of section 35 of Troy Township this soil is underlain at 12 inches by a band of sandy loam from 8 to 10 inches thick. This, in turn, is underlain by the typical subsoil. In the large area in the southeastern part of Troy Township small patches of sandy loam, which sometimes are underlain by gravel, occur. These areas vary from a few rods to an acre or more in extent. In section 20 of Royal Oak Township the typical soil is underlain at 12 inches by quicksand, which, in turn, is underlain at 18 or 20 inches by the typical clay loam subsoil. Beds of gravel rarely occur in the subsoil at this place.

On the well-drained parts of the Miami black clay loam good crops are grown. Corn, the leading crop, gives an average yield of 50 bushels; wheat, 22 bushels; oats, 45 bushels; hay, 2 tons, and sugar beets, 11 tons per acre.

The Miami black clay loam is excellent for corn, hay, and sugar beets, and also is well adapted to the production of small grains.

The results of the mechanical analyses of soil and subsoil appear in the following table:

*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 0.06 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
9604	Sec. 26, Troy Tp ....	Black clay loam, 0 to 10 inches.	<i>P. ct.</i> 3.59	<i>P. ct.</i> 1.46	<i>P. ct.</i> 3.54	<i>P. ct.</i> 4.62	<i>P. ct.</i> 16.34	<i>P. ct.</i> 15.20	<i>P. ct.</i> 33.74	<i>P. ct.</i> 25.04
9605	Subsoil of 9604.....	Drab clay loam, 10 to 36 inches.	1.45	.50	2.76	3.52	12.74	16.70	34.74	28.90

CLYDE SAND.

The soil of the Clyde sand consists of black medium and fine sandy loam, with a depth of from 10 to 16 inches. The soil may contain sufficient clay to render it slightly sticky, or, again, it may be little more than black sand. This material is underlain by medium gray and white sand. At 30 inches clay often occurs, but in portions of the areas the soil is underlain by quicksand to a depth of several feet.

The chief occurrence of this type is in Royal Oak Township, where it occupies depressions in the large area of Miami sand, and also forms a border between Miami sand and the lower lying areas of muck and Miami black clay loam.

In its natural swampy condition this soil is practically worthless, but if properly drained the areas underlain by clay are very productive. Artificial drainage is always necessary with the Clyde sand, and a general system of county ditches has been dug along the section lines in the most poorly drained parts of the area.

In the southern part of Royal Oak Township limited areas of this soil are underlain by quicksand to a depth of several feet. Attempts to drain such soil are of little avail, because either tiles or open ditches will clog and soon are rendered useless. Undrained this soil is so wet and cold that it is unsuitable for agricultural purposes, and much of it lies waste.

Adjoining the muck areas the Clyde sand sometimes is overlapped by muck to a depth of a few inches. If drained the muck becomes dry and inflammable, and small areas have been burned over, leaving the residue upon white sand.

Where the Clyde sand is underlain by clay at 30 inches, and drained artificially, excellent yields of corn, grass, potatoes, and truck crops are produced, and the soil is best adapted to these crops. Average yields are 40 bushels of corn, 40 bushels of oats, 25 bushels of rye, 150 bushels of potatoes, and 1½ tons of hay per acre, while exceptional conditions and care bring much higher yields. Sugar beets have been grown successfully.

The mechanical analyses of both soil and subsoil are given in the following table:

*Mechanical analyses of Clyde sand.*

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.
9588	Sec. 2, Troy Tp.....	Black sandy loam, 0 to 8 inches.	2.24	0.74	2.02	2.70	39.80	37.92	14.88	1.66
9589	Subsoil of 9588.....	White fine sand, 8 to 36 inches.	2.17	.00	.56	.92	21.68	60.90	12.36	3.30

MIAMI LOAM.

The soil of the Miami loam is a black or dark-brown medium loam, or heavy, fine sandy loam, from 8 to 14 inches deep. The subsoil consists of a variety of material, but for the most part is a plastic mixture of clay and medium sand. This material gives way now and then to heavy sandy loam, or to light-colored medium loam with gravel. Where gravel occurs in the subsoil it is always less than an inch in diameter, and is insufficient in quantity to produce any marked effect on the productiveness of the land.

The Miami loam occupies small, flat areas, which are well drained, and slight depressions which often need artificial drainage.

The type is formed of glacial material somewhat modified by the agency of water. In the well-drained areas this soil is very productive, giving good yields of all farm crops.

The following table gives mechanical analyses of the soil and subsoil of this type:

*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.
			<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>
9594	Sec. 18, Troy Tp ....	Light loam, 0 to 10 inches.	2.22	1.96	5.68	7.74	19.60	12.74	41.00	11.28
9595	Subsoil of 9594.....	Heavy loam, 10 to 36 inches.	.74	1.92	5.02	7.10	17.52	12.92	46.18	8.58

#### MIAMI GRAVELLY LOAM.

The soil of the Miami gravelly loam consists of brown or reddish-brown loam to a depth of 12 inches. The stones, which formerly were numerous, have been removed to a large extent, but there is from 10 to 40 per cent of rounded gravel on the surface.

The subsoil is stiff, tenacious, brown clay loam, which rests upon a bed of gravel at 30 inches.

The only occurrence of this type is in the vicinity of Walnut Lake, where it covers an area of less than 2 square miles. At that point it occupies the slopes adjacent to the lake. Beyond these slopes it is generally rolling in character.

The Miami gravelly loam is a well-drained soil formed by glacial deposit. The same crops are grown as on the Miami clay loam and the yields do not differ materially, except in seasons of excessive rainfall, when the Miami gravelly loam has the advantage, because of its superior drainage.

#### PLAINWELL STONY LOAM.

The surface soil of the Plainwell stony loam is loose yellow sandy loam to a depth of 8 inches. The subsoil, to a depth of 3 feet or more, consists of loose yellow medium and fine sand.

The type is found only in the northwestern part of the area, in Waterford Township, where it is associated with the Allegan gravelly loam, and in sections 19 and 20 of Bloomfield Township.

The Plainwell stony loam is found only on steep hills and ridges, and their adjacent slopes. It is well drained, and liable to suffer from drought.

The soil is derived from morainic material; is strewn with stones and boulders, and is so rough and uneven that its agricultural value is very low. Rye, buckwheat, corn, and grass are grown on small

and irregular fields of this type, but the yields are small. Permanent pastures are maintained to a considerable extent, and in wet seasons furnish satisfactory grazing. By far the greater part of the type is covered with sprouts and saplings, and is best adapted to forestry.

The following mechanical analyses of the fine earth of the Plainwell stony loam show its texture:

*Mechanical analyses of Plainwell stony loam.*

No.	Locality.	Description.	Organic matter.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0. 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>
9622	Sec. 6, Waterford Tp.	Loose sandy loam, 0 to 8 inches.	1.43	10.80	21.88	13.60	17.00	7.78	18.52	10.10
9623	Subsoil of 9622....	Loose medium sand, 8 to 36 inches.	.28	7.00	12.20	11.26	22.38	9.84	26.74	10.10

#### MUCK.

Organic matter in varying stages of decomposition, accumulated to a depth of 8 inches or more and mixed with earth, constitutes the material which has been mapped as Muck. This material may be many feet deep, but more often it is underlain by clay at no great depth. Small areas of such soil have been drained and burned over, leaving very productive Miami black clay loam. In the southern part of Royal Oak Township, however, the greater part of the Muck is underlain by quicksand. In section 25, Troy Township, and in section 32, Avon Township, the Muck is underlain in places at depths varying from 15 to 24 inches by marl. Beds of peat also occur.

The more important areas of Muck lie in the lake region, and in them many of the streams have their source.

None of the Muck areas can be utilized for crops until artificially drained. Successful efforts have been made to drain certain areas which are underlain by clay, but drains require exceeding care in construction, because the fall in such areas often is very slight.

Much of the Muck is still swampy and usually is covered with tamarack trees. This condition has given rise to the locally well-known term, "tamarack swamp." Certain portions, where the clay lies near the surface, on which the original tree growth was chiefly black ash and elm, were designated as "black ash and elm swamps."

In the Muck areas which are underlain by quicksand the soil dries out at the first approach of dry weather and nothing can be grown on it. When the Muck is thoroughly dried fire starts in it readily and

large areas have been burned over, leaving nothing but the underlying white sand, which is worthless for agricultural purposes.

Certain areas of Muck, underlain by clay at a depth of about 2 feet and drained artificially, probably give larger yields of corn and grass than any other soil of the area, but corn is liable to suffer from early frosts. All forage and root crops produce abundantly, though sugar beets are not a success, because of inferior quality. Infrequent fields of onions, which produce from 500 to 800 bushels per acre, indicate the possible development of a profitable industry. Similar "garden spots" of celery create surprise that this crop has received so little attention.

#### MEADOW.

Narrow, low lying, and usually flat areas adjacent to the streams which have deposited them in times of overflow have been mapped as Meadow.

The material which constitutes these formations is too variable to admit of definite classification. In some cases fertile sandy loams and clay loams are found, but as frequently sand and gravel predominate, and often former stream courses may be traced by partially covered deposits of gravel.

Along the Clinton and Rouge rivers small fields of corn and grass may be seen on these soils, but more often they are kept as permanent pasture, to which use they seem better fitted.

Small areas north of Lake Angelus and west of Cass Lake are so wet that they are constantly in a swampy condition.

#### AGRICULTURAL METHODS.

On the sandy types of soil the methods of cultivation practiced are fairly well developed. These soils are worked easily, and exacting attention to details is not required to effect moderately successful returns. Such is not the case, however, with the Miami clay loam, which requires almost infinite care in cultivation to obtain the best results. Absolute crop failure, when worked under unfavorable conditions, has compelled farmers to observe a certain amount of care in handling this important soil, but much more care given to its physical condition is the most needed prerequisite for increased crop returns.

The general unevenness of the surface, the presence of stones and boulders, the extreme stiffness of the heavy phases, and the frequency of rigid clay knolls in lighter types of soil, all combine against the adoption of sulky gang plows, and consequently most of the land is broken by a single plow drawn by two or three horses.

The texture of the sands and of the sandy loams is such that little labor is required to prepare them properly for planting, but conditions diametrically opposite to these make thorough cultivation, under favor-

able moisture conditions, a necessity with the heavy clay loams. Unfortunately thorough methods of tillage with this soil are altogether too rare, and much loss is occasioned thereby.

Corn, with the exception of that grown for the silo, is planted so that it may be cultivated both ways. It is said that in seasons with normal rainfall crops are cultivated at intervals so frequent that weeds are kept down; but during the present season (1903), which was abnormally wet in June and July, many fields were overrun with weeds. Little, if anything, is done to prevent the spread of the seeds of noxious weeds, and there seems to be no feeling of personal responsibility in this matter. Hedgerows overgrown with weeds are left undisturbed. Canada thistles are widespread, and on a windy day in autumn the downy seed can be seen flying in all directions.

Farms in general are well equipped with all the modern machinery which is well adapted to the conditions of the area, and in this particular feature Oakland County farmers are notably progressive. This is particularly true of harvesting machinery.

Favorable conditions, as yet not altogether understood, have rendered the soils of the area more productive under the methods of cropping practiced than naturally could be expected. For example, wheat has been the chief crop for nearly seventy-five years; grown successively for a long time, the continuity was broken later by an occasional crop of some other grain, and, in the course of time, regular crop rotations were adopted. Until the ravages of the Hessian fly became so destructive, which has occurred within the last few years, fine yields of wheat were produced.

The damage to the wheat crop by the Hessian fly within recent years has caused more attention to be given to other crops, especially to corn, which is now the chief cereal crop, and to oats. Rye is an important crop on "the plains," and also on the lighter types of soil throughout the area. It has also been tried in place of wheat, to be followed by seeding with grass, but is not very satisfactory, and at present is little sown for this purpose. Barley is a secondary crop, and buckwheat is grown to a limited extent. On the sandy soils beans are grown extensively, and for many farmers they are the chief money crop.

In the early days of settlement, and for a long time thereafter, very little stock was kept, and almost no use was made of the little manure which was available. In the course of time gradual decrease in crop yields made it necessary to save and utilize all the manure. Very little commercial fertilizer is used, but within the last few years considerable stable manure has been hauled by farm teams from Detroit to the portion of the area which lies within 15 miles of that city. When labor on the farm is pressing this manure may be had for the hauling, but at leisure times the demand is greater than the supply, and the price ranges from 25 to 50 cents per load. Land seldom receives more

than one application of manure in a crop rotation of five years; more often the period is longer, and fields are not rare which never have been manured.

The advantage to be derived from variation of crop production was recognized comparatively early in this area, and hence the soils did not become so exhausted by successive cropping with wheat as has been the case in many sections. At first the continuity of wheat production was broken by an occasional crop of oats and corn, and from this beginning carefully planned crop rotations were developed, which have been systematically followed for some time.

The most common rotation practiced at present covers a period of five years, and consists of corn or potatoes, followed by oats, wheat, and hay for two years.

The decrease in the acreage of wheat has necessitated certain changes in rotation, and where this grain has been eliminated the usual sequence is corn, oats, and hay for two years.

#### AGRICULTURAL CONDITIONS.

The Pontiac area, considered as a whole, exhibits a degree of thrift and prosperity seldom attained. This condition of prosperity is general on the heavy types of soil, and is broken only in the "plains regions," in certain sand areas along the southern boundary of the county, and in scattered hilly areas of Marshall gravel and Miami sand.

Favored by equable climate and sufficient rainfall, at least moderate yields of the crops are assured every season. Total crop failures are unknown, and years of unprofitable crop production, under good management, are almost as rare. The variety of soils on many farms of the area naturally adapts them to diversified farming, and thus less dependence is placed upon a single crop. Such conditions have favored a growth steady, sure, and safe, and hence the agricultural conditions of the area have not been subjected to the vicissitudes of less favored sections.

The farm buildings and shelters which were erected in the early days of settlement were not adequate to warrant extensive improvement as the country developed, and so they have been replaced gradually by desirable dwellings and barns which are both neat and commodious. The majority of these modern barns are so arranged that all stock is kept in the well-constructed and well-lighted basement, while the superstructure is all reserved for hay and grain. The barns are kept well painted and are constructed usually with a gambrel roof, which admits of free and convenient use of the various devices for unloading hay and grain. Windmills for pumping water are in general use, though a few artesian wells are found. Natural gas has been

found in a few instances under the Miami black clay loam, and has been utilized for both fuel and lights. Neat wire fences prevail, and they are replacing gradually the few remaining rail and board fences of the early days. All of these evidences of prosperity of the farmers, coupled with their consequent financial stability, have warranted the full and safe extension of credit which has been accorded to them.

For actual farming purposes the better types of soil are worth at present about \$50 per acre, and should yield 4 per cent on the investment at that price. A few exceptional cases have netted the above rate on the basis of \$70 per acre. Along the electric lines which lead out from Detroit, of which there are three traversing the area, land is held at a price ranging from \$100 to \$300 per acre, irrespective of agricultural value, and depending only upon proximity to the electric railway. Such fictitious prices are due to "land booms," which have caused unstable speculation and consequent loss.

It is estimated that about 70 per cent of the farms of the area are tilled by the owners who live upon them. Nearly three-fourths of these farms are subject to an average mortgage of 45 per cent of their actual value. The majority of the remaining 30 per cent of the farms are rented to tenants who live in the local villages. There are two general systems of renting farms. By the first method a stated cash sum is paid. This amount is usually the equivalent of \$2 to \$2.50 per acre. By the other method the farm is rented on shares, but this system is so variable that no general form of agreement can be stated.

The farms of the area vary in size from 40 acres to 200 acres, with a probable average of 80 acres.

Labor presents no problems peculiar to this area, and the conditions which obtain are similar to those found throughout the Middle West. It is usually possible for responsible farmers to secure competent farm labor at a price ranging from \$20 to \$25 per month with board, but at times it is difficult to obtain help at any price. Labor organizations are plentiful in the large towns, and the desire to live in a village or city tends to attract laborers from the surrounding country. Difficulty in securing reliable help is often quoted as a serious handicap to the development of more extensive dairy interests, or to the production of special crops which require more labor than general farm crops.

In order to place sufficient contracts for the production of sugar beets, a beet sugar company has undertaken to guarantee to furnish sufficient help for the care of the beets, and no considerable difficulty has been encountered by them in carrying out this plan. For this purpose they have organized a kind of labor bureau in Detroit, which obtains from that city and sends to the country as many men, women, and children as may be desired. The method seems satisfactory to all concerned.

The only notable change which is taking place in the character of the principal products of the area is that necessitated by the unprofitableness of wheat and the consequent readjustment of farm management. Until a few years ago wheat was a lucrative and important crop, but it could not withstand the recent competition of new land farther west. In spite of profits diminished or altogether lacking, many farmers continued to sow wheat because they were so firmly wedded to the erroneous impression that wheat was the only crop which advantageously could precede grass. The damage wrought by the Hessian fly within the last few years has compelled decreased acreage of this grain, and has thus changed the character of farm products to a considerable degree. No wheat of first quality is produced in this area. It is estimated that about two-thirds of the crop should be graded as No. 2 and one-third as No. 3.

Corn does not yield as heavily as in the States lying south of Michigan, but it is the most important crop, and has been utilized largely in the production of beef. Inability to cope with localities which can produce corn more cheaply has lessened materially the amount of fattening done in the area, and as a natural result dairy interests have increased rapidly. These interests are about equally divided in the production of butter, cheese, and milk for the wholesale market in Detroit. In the southwestern part of the area considerable milk is hauled to the local cheese factories, which continue in operation from March 15 to January 1. This forms an important industry, and Oakland County cheese has gained favorable reputation in the southern half of the lower peninsula, where most of it is sold. Large quantities of milk are shipped to Detroit to the wholesale market. This system is attended by more or less dissatisfaction, because of the disposition of any so-called "surplus milk." Some farmers ship their milk to reliable milk retailers in Detroit, thus avoiding the commission of the wholesale dealer. In this case it is stipulated that the farmers shall send a steady supply from a stated number of cows. It is said that reliable milk retailers are not difficult to find, and this is undoubtedly the most satisfactory disposition of milk when it is not manufactured into butter or cheese. A limited amount of high-grade Jersey milk is bottled and sold to a special trade in Detroit.

Homemade butter probably explains the disposition of one-third of the entire milk product of the area. The chief part of such butter is sold at local grocery stores, but its variation in quality militates against high prices. A few farmers manufacture butter at home, employing the most improved methods. This product is sold to private customers in Detroit at remunerative prices, and although this system requires exacting attention, it illustrates, nevertheless, the possibility of profitable extension.

Oats are sown almost universally in the crop rotations practiced,

and a good quality of grain is produced. Rye and barley grow well, but are used generally as catch crops. Large quantities of potatoes and beans are raised, and in portions of the area are the principal money crops. Hay is one of the most important crops, and good yields of excellent quality are obtained from all soil types except the light sands.

Canning factories have been in operation within the area for the past two years, but the excessive rainfall covering this period has been so detrimental to canning crops that at present farmers are unwilling to venture far in the extension of this industry.

A large and well-equipped factory for the manufacture of sugar from sugar beets was erected at Rochester in 1899. The sugar company contracts with farmers during the winter for the production of a certain acreage of beets.

Contracts for 7,550 acres made with 1,200 farmers within a radius of 30 miles were written this year. The largest amount of beets is grown in the township of Troy, which has 516 acres this year. The greater part of these are on the Miami black clay loam, which is considered the best soil in the area for this purpose, and yields from 8 to 18 tons per acre, with a probable average of from 10 to 12 tons per acre.

The Oakland sandy loam is also good for sugar beets. The average yield on this soil is only 6 or 7 tons, but if properly manured the yield would be much increased, and the beets have a sugar content relatively high.

The Clyde sand, where the underlying clay is sufficiently near the surface, should produce large yields of beets, but its possibilities have not been demonstrated in this vicinity.

An important feature of this area is its fruit interests. Of these, peaches have received the largest share of attention. The most extensive orchards are located on the Miami sandy loam, but they are found on all of the sandy types of soil. The constant extension of orchards shows clearly that the crop has been profitable. Apple orchards are numerous, but taken as a whole they receive little care, and consequently the yield is lessened and the quality of fruit is impaired. That orchards look so well, notwithstanding neglect, indicates, in some measure, the possibilities of the profitable extension of this industry, but the actual existence of a few large orchards which, conducted on the basis of modern principles of orcharding, are proving highly profitable should direct attention to the scientific production of apples on a commercial scale.

Cherries, plums, pears, and grapes are produced on a small scale, and small fruits are grown to a considerable extent on the sandy types of soil.

Until recent years little attention was given to the adaptation of soils to crops. Wheat was sown on all soils until decreased produc-

tion compelled the selection for that crop of the soils best adapted to it. Reduced productivity in like manner has demonstrated the desirability of certain broad distinctions which should be observed in planning for general farm crops. The introduction of the sugar-beet industry showed at once, by analyses of the beets, the soils which were adapted to the profitable production of that crop.

A leading orchardist has proved conclusively that the Oakland sandy loam is very desirable for the production of apples, both on account of satisfactory growth of tree and the quality and color of fruit. Apples grown on the Miami clay loam have less color. The Miami sand produces fruit of excellent color, but the growth of tree is inferior to that on heavier types.

The transportation facilities of the area are good. Two lines of railway, which intersect at Pontiac, cross the area diagonally. Triangular lines of the Detroit United Electric Railway connect Pontiac and Farmington with Detroit, and the Flint division extends from Royal Oak through Rochester, in the northeastern corner of Avon Township. The electric road is so well constructed that it can run heavy cars at a high rate of speed, and its franchise permits the carriage of freight.

The proximity to Detroit, which is but 10 miles from the southeastern corner of the area and 26 miles from Pontiac, and the numerous lines of connection with that city make an excellent market easy of access, while Pontiac, a manufacturing city of 15,000 inhabitants, lies near the center of the area.

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