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WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

W. O. HOTCHKISS, Director and State Geologist.
A. R. WHITSON, In Charge, Division of Soils

SOIL SURVEY IN COOPERATION WITH THE COLLEGE OF AGRICULTURE
H. L. RUSSELL, Dean

BULLETIN NO. 56-A SOIL SERIES NO. 28

SOIL SURVEY

OF

MILWAUKEE COUNTY

WISCONSIN

BY

A. R. WHITSON, W. J. GEIB AND T. J. DUNNEWALD

OF THE

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Wisconsin Geological and Natural History Survey

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INTRODUCTION

Before the greatest success in agriculture can be reached, it is necessary that the farmer should have a thorough knowledge of the soil upon his own farm. A soil may be well adapted to one crop, and poorly adapted to another crop. Clover will produce a vigorous growth and profitable yields on the average loam soil which contains lime and is in a sweet condition; but on a sandy soil which is sour, or in an acid condition, clover will not make a satisfactory growth. We may say, therefore, that failure is certain to be invited when such important facts are disregarded, or overlooked. The degree of success which it is possible to win on any farm is in direct proportion to the practical knowledge possessed by the farmer concerning the soil and its adaptation to crops. A thorough knowledge of the soil is as essential to the farmer as a knowledge of merchandise and business methods is to the merchant.

The State of Wisconsin, working in coöperation with the United States Department of Agriculture, is making a careful study of soils and agricultural conditions throughout Wisconsin, and is preparing soil maps and soil reports of all counties in the State. A soil map shows the location and extent of the different kinds of soil. Tracts of 10 acres and over are mapped, but often areas of even smaller extent are shown. The soil map is prepared by trained men, who go over a county thoroughly, and examine the soil by making a sufficient number of borings to a depth of 36 inches to keep account of all variations. A report is also made, to accompany and explain the map, and this is based upon a careful study of the soils within the region surveyed, and upon such other features as have a direct bearing upon the agriculture of the area.

It is the object of this survey to make an inventory of the soils of the State, and to be of practical help to farmers by lo-

cating and describing the different soils, by determining their physical character and chemical composition, and by offering suggestions for their management, based upon the work of the Soil Survey within the area, covered in the report, and upon the results of field tests made by the Experiment Station.

Soil fertility depends upon two factors: first, upon the physical characteristics of the soil, such as water holding ca pacity, workability, etc., and second, upon the chemical composition of the material composing the soil. The chemical composition depends upon the mode of origin of the soil, and the source of material from which the soil is derived.

Water holding capacity and other physical properties of soil all depend chiefly upon *texture,* which refers to the size of the individual soil grains, or particles. A coarse sandy soil, for example, will not retain moisture so long as a loam soil, or clay loam, because the finer the soil grains, the greater will be the total soil-grain surface area to which moisture may adhere. Texture is determined in the field by rubbing the soil between the thumb and fingers, and with experience one soon becomes expert at judging the size of soil grains. This field judgment is verified in the laboratory by a *mechanical analysis,* which is made by a simple method of separating soil grains into different groups, of which there are seven. These are known as clay silt, very fine sand, fine sand, medium sand, coarse sand, and fine gravel.

A chemical analysis is also made of the soil to determine the amounts of various essential plant-food elements which are present. A chemical analysis shows whether the soil contains a large store of plant food, or only a small quantity, and it indicates which kinds of plant food will probably be needed first. The amount of organic matter in the soil is also determined, and tests are made to show conditions relative to soil acidity.

SOIL CLASSIFICATION

Soils are grouped according to texture into soil classes, a soil class being made up of soils having the same texture, though differing in other respects. A fine sand, for example, may be light colored and of alluvial origin, while another fine sand may be dark in color and of residual origin, while a third fine sand may have been blown into sand dunes by the wind, yet all of these soils would belong to the same class, because the greater proportion of the soil grains have the same size or texture. Thus we may have different kinds of clays, loams, sands, etc., and the class to which any soil will belong depends upon the size of the individual soil grains of which it is composed, and not upon its color, origin, topographic position, or agricultural value.

SOIL CLASSES

Soils Containing Less Than 20% Silt and Clay

Coarse sand.—Over 25% fine gravel and coarse sand, and less than 50% of any other grade of sand.
Sand.—Over 25% fine gravel, coarse and medium sand, and less than 50% fine sand.
Fine sand.—Over 50% fine sand, or less than 25% fine gravel, coarse and medium sand.
Very fine sand.—Over 50% very fine sand.

Soils Containing Between 20–50% of Silt and Clay

Sandy loam.—Over 25% fine gravel, coarse and medium sand.
Fine sandy loam.—Over 50% fine sand, or less than 25% fine gravel, coarse and medium sand.
Sandy clay.—Less than 20% silt.

Soils Containing over 50% of Silt and Clay

Loam.—Less than 20% clay, and less than 50% silt.
Silt loam.—Less than 20% clay, and over 50% silt.
Clay loam.—Between 20 and 30% clay, and less than 50% silt.
Silty clay loam.—Between 20 and 30% clay, and over 50% silt.
Clay.—Over 30% clay.

Soils may be grouped in another way. Where soils are closely related through similar sources of the material from which derived, mode of origin, topographic position, etc., so that the

different soils constitute merely a gradation in texture of otherwise uniform material, such a group is called a *soil series.* It corresponds to the family which is made up of different individuals having the same parentage. The Miami series, for example, includes light colored, glacial material where the soils have been derived largely from the underlying limestone, and the soils in the series range in texture from a clay loam to sand and gravel. The Plainfield series includes light colored soils in regions where no limestone is present, where the parent rock was largely sandstone, and where the material occurs as outwash or stream terraces. The soils in this series also have a wide range in texture. The name used for a soil series usually indicates the locality where that particular series was first recognized and mapped by the Soil Survey. By uniting the soil class with the soil series we get the *soil type* which is the basis or unit of classifying and mapping soils. A *soil type* thus, is a soil which is uniform throughout its entire extent in texture, color, topographic position, and other physical properties, and having a distinct agricultural unty, that is, being adapted to the same crops, and requiring the same treatment. It is also uniform in the source of material from which it is derived, and the mode of origin which, taken together, determine the chemical composition. Since the soil type is the unit in classifying and mapping soils, and the basis upon which experimental work should be conducted, every farmer should be familiar with the soil types on his farm, and their leading characteristics.

SOIL SURVEY OF MILWAUKEE COUNTY, WISCONSIN

CHAPTER I. DESCRIPTION OF THE AREA

Milwaukee County is located in the southeastern part of Wisconsin. It is bounded on the north by Ozaukee County, on the east by Lake Michigan, on the south by Racine County, and on

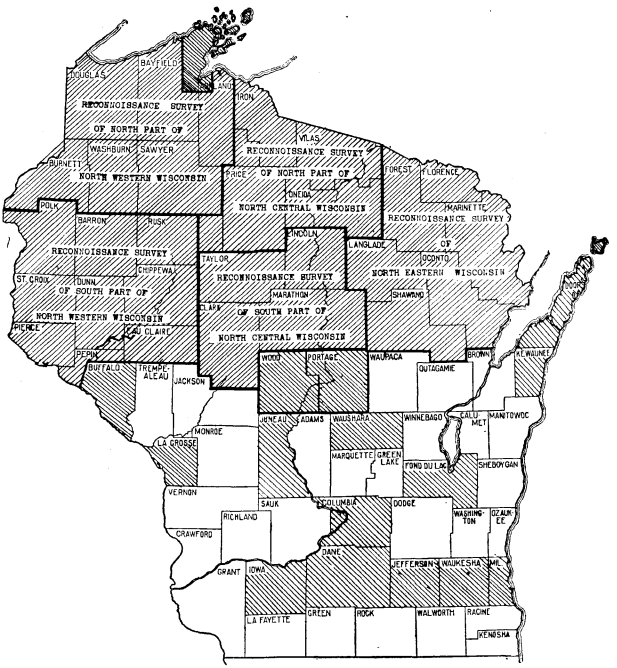

FIG. 1.—Sketch map showing area surveyed.

the west by Waukesha County. The city of Milwaukee is in the east-central part. The county varies from 8 to 12 miles in width east and west and is 24 miles long. It has a total area of 241 square miles, or 154,240 acres.

The topography of Milwaukee County consists of three low, broad, flat-topped, but rather distinct ridges running north and south parallel to the lake shore and separated by two shallow, narrow, lowland belts. All the ridges curve with the indentation of the coast line at Milwaukee, but elsewhere do not trend with the details of the coast line. Half of the first ridge has been removed between Milwaukee and the southern line of the county by the landward sapping of the lake, so that the lake shore lies approximately along the crest of the ridge, the height of the lake cliff, therefore, varying with the height of the ridge. North of Milwaukee the lake seems to have cut away about half of the ridge also. The remaining part of this ridge has a maximum width of about 3 miles in the northern part of the city of Milwaukee and at the northern boundary of the county. Elsewhere the width is half that or less.

The width of the first lowland ranges from a quarter mile locally at several places to expansions of more than a mile, as in the area of Peat west of Ryan, another southwest of Cudahy, and one near North Milwaukee. It lies about 40 feet lower than the top of the first ridge.

The second ridge has a width of about 5 miles throughout its course in the county. Its maximum elevation is about 140 feet and its general elevation about 80 feet above the lowland east of it. Its surface is undulating to rolling, owing to the existence of a number of subordinate ridges with the same trend as that of the main ridge.

The second lowland belt has a width about the same as that of the first belt. It lies about 100 feet below the general level of the top of the second ridge.

The third ridge, only the eastern part of which lies within the county, is essentially like the second.

The drainage system of the county consists of a number of small streams following the lowland belts and a few larger streams following the lowland belts in part and in part cutting their way across the ridges. In a few instances the small streams have cut valleys across low parts of the ridges. The Milwaukee River has cut a narrow valley across the western part of the first ridge west of Fox Point and across the eastern part in the northern part of the city of Milwaukee. The Menominee River has cut a narrow valley across the second ridge between Wauwatosa and the western part of the city of

Milwaukee and a broader one across the eastern ridge within the city. The Root River has cut a narrow valley across the second ridge where it runs in an eastward course along the southern boundary of the county, and Oak Creek crosses the first ridge in South Milwaukee. In those parts of their courses not mentioned above these streams occupy the lowland belts in a misfit way just like the small streams. The lawland belts were made before the existing streams were formed and by other forces. The local drainage is mainly into small basins, lakes, and ponds, and occasionally into the existing streams described above. The natural provision for the surface drainage of the county is very incomplete.

Milwaukee County was created in 1836. It then included a large area to the north, west, and south of the present county, and was not reduced to its present size until 1846.

The first settlers in the county were mainly English and French. Later German settlers largely occupied the northern and western sections. Subsequently German settlement spread to the southern part of the county, which had been occupied mainly by Irish. While the present population is largely German (about 60 per cent), it comprises many other nationalities. Many of the gardeners, especially south of Milwaukee, are of Polish descent.

The total population of Milwaukee County is reported in the 1910 census as 433,187. The rural population is given as 39,556, or about 9 per cent of the total, averaging about 168 per square mile. The density of the rural population of Milwaukee County is greater than that of any other county in the State. The density of population is greatest along the lake.

Milwaukee, with a population of 373,857, according to the 1910 census, is the county seat. Whitefish Bay, North Milwaukee, and Granville, in the northwestern corner of the county, Wauwatosa and West Allis, to the west of the city, and Bayview, St. Francis, Cudahy, South Milwaukee, and Carrollville, to the south of the city, are important towns. Hales Corners and St. Martins are located in the southwestern part of the county.

All the towns are connected directly by steam or electric railway with Milwaukee. The Chicago, Milwaukee & St. Paul Railroad has a double-track line from the city southward, and the Waukesha, Watertown, Fond du Lac, and Green Bay

branches running west and north. The Chicago & North Western has two double-track lines, one freight and one passenger, running south, and the Madison, La Crosse, Fond du Lac, and Manitowoc branches extending west and north from the city.

Of the electric interurban lines the Racine line of the Milwaukee Electric Railroad & Light Co. and the Chicago, Northshore & Milwaukee Electric Railway extend southward from the city, and the Troy and Muskego Lake lines of the former system westward to West Allis and south through Hales Corners and St. Martins. The Waukesha & Watertown line of the same system runs west and the Milwaukee Northern Electric Railway north from the city.

Owing to the heavy, clayey nature of the soil over the greater part of the county, the roads in their natural condition are very bad in wet weather, and with the rapid increase in the use of the automobile it became necessary to build roads capable of withstanding the heavy traffic in the vicinity of the city. In the last few years nearly all the main roads and many of the crossroads have been surfaced. A report of the Milwaukee highway department published in January, 1916, indicates that nearly 100 miles of permanent road had been completed outside the city, 86 per cent being concrete, 7 per cent asphalt, 2 per cent brick and blocks, and 5 per cent macadam. The cost is met by direct taxation, about one-third being borne by the State. About $2,000,000 has been expended. The road improvements have had a marked effect in increasing land values.

The city of Milwaukee is the chief market for all garden crops and many other products, such as milk, butter, meat, hay, grain, potatoes, etc. Sugar beets, some of the milk, cabbage, and other products are shipped to outside markets.

SOILS

Milwaukee County lies entirely within the glaciated area, and the surface formation consists of glacial deposits, ranging in thickness from a few feet to almost 200 feet. The soils have been derived, through weathering, from the drift materials, either in the position in which they were left by the ice or after transportation and redeposition by water.

With the exception of a small strip along the lake shore north of Milwaukee, the county is covered by drift deposited during

the late Wisconsin stage of glaciation. This material was laid down in long gentle ridges parallel to the lake shore, with intervening narrow lowland belts and inclosed depressions, which exist as poorly drained areas and marshes. A study of the rock fragments found in the drift shows that 80 to 90 per cent is of limestone similar to the rocks underlying the drift. The remaining 10 to 20 per cent is composed of rock fragments wholly foreign to this part of Wisconsin. This small quantity of foreign material is made up of rocks brought from localities farther north and similar to those now exposed in the Lake Superior region, including Archaen crystalline rocks and the older sandstones and quartzites. The drift as originally deposited was for the most part unassorted and consisted of a blue, gray, or brown clay or silty clay in which sand, gravel, and bowlders of various sizes were embedded. It was highly calcareous, being derived largely from limestone.

Since the final recession of the ice this material has been subjected to the process of weathering, giving rise to productive soils. The principal changes that have taken place are the leaching from the surface soil of the lime and other readily soluble constituents, and the incorporation of organic matter. Leaching has proceeded so far in many places that the surface soil is neutral or even acid. In most cases, however, there is a larger quantity of lime in the subsoil. The color of the upper part of the drift below the dark surface soil has been changed to a yellowish brown by oxidation. The surface soil has been darkened to a greater or less extent by the incorporation of organic matter. The drift soils are classed with two soil series—the Miami and the Carrington.

North of Milwaukee, lying between the Milwaukee River and the lake shore, there is a deposit of red material which differs strikingly from the other surface deposits of the county. The exact time and manner of its deposition has not been fully determined. Its position overlying the drift and stratification in places indicate deposition in comparatively still water, but the source of the red material is not known. The thickness of this deposit varies from about 1 foot to 80 feet, with an average of about 25 feet. It occurs as a series of broad, gently undulating ridges. The unweathered material is a silty clay varying in color from light red to brownish or purplish red. In places many bowlders are present, but as a rule these are less abundant

than in the other surface materials of the county, and over considerable areas they are rarely encountered. Weathering does not extend to so great a depth as in the other materials, and organic matter does not seem to accumulate so rapidly in the surface soil. The soils of the Superior series are derived from this deposit.

The terrace soils are principally derived from deposits that were laid down as outwash plains by swollen streams from the melting glaciers. The most extensive terraces occur along Milwaukee River just north of Milwaukee. Similar terraces border other large streams in the county. The surface covering of the terraces ranges from a clay loam to sand, beneath which lie coarser materials. During the ice invasion some areas, principally along stream valleys, were ponded by the drift, and the lowlands thus formed were filled at the time or later by alluvial material. Through work of streams these valleys have been trenched and the remnants left as well-drained terraces or only partially drained areas and poorly drained tracts or marshes where more or less vegetable matter has accumulated. Several series of soils are represented.

The various soils are grouped, on the basis of origin and formation, color, topography and drainage, and other features, into soil series. The series is subdivided into types on the basis of texture. Sixteen types, included in eight series, exclusive of Peat, are mapped in Milwaukee County.

The soils of the Miami series are grayish brown, and the subsoils yellowish brown. The subsoils are heavier in texture than the soils, but the lower subsoils and substrata may be gravelly and sandy. These soils are derived from drift, and bowlders, mainly of limestone, occur in the soil and subsoil. The surface soil may be neutral or even slightly acid, but the subsoil usually is calcareous. In this county five types are mapped, the fine sandy loam, loam, silty clay loam, gravelly clay loam, and clay loam.

The soils of the Clyde series are dark gray or dark brown to black; the subsoil is gray or drab, mottled with yellow. The Clyde soils are poorly drained and occur along streams and marshes within areas of the Miami series. They represent gracial-drift material reworked in part by streams and weathered under poor conditions of drainage. In this county the loam and clay loam types are mapped.

The soils of the Carrington series are dark brown to black. The subsoil is yellow to light brown. The series is derived by weathering from glacial till. The topography is undulating to rolling. Neither the soil nor the subsoil is highly calcareous. The series is represented in this county by a single type, the silt loam.

The soils of the Superior series are brown to reddish-brown at the surface with red subsoils. The series has been derived largely from red lacustrine material which was reworked by glacial action after its deposition by water. The topography varies from level to rolling. Two phases were recognized and mapped, the only difference being in topography. The level phase is level, and consequently somewhat deficient in natural drainage, while the rolling phase has fair to good natural drainage. The Superior clay loam, rolling phase, and the Superior fine sandy loam were the types mapped.

The soils of the Poygan series are black. They contain large quantities of organic matter. The subsoil is red and similar in character to that of the Superior series. As a rule, these soils are poorly drained. In this county the series is represented by only one type, the clay loam.

The Fox series includes grayish-brown soils with yellow or yellowish-brown subsoils, heavier in texture than the surface. Layers of sand and gravel, composed mainly of limestone, often occur below about 30 inches. These soils occupy level terraces. They lie above overflow, and drainage usually is good. In this county the Fox fine sandy loam and silt are mapped.

The Waukesha soils are dark brown to almost black, with light-brown or yellow subsoils. Layers of sand and gravel are encountered in places in the deep subsoil or substratum. The soils of this series occur on level or gently undulating terraces and are well drained. The sandy loam and loam types are mapped in Milwaukee County.

The Plainfield series includes brown surface soils with light-brown sandy and gravelly subsoils. These are productive terrace soils, but are somewhat droughty in very dry seasons. The Plainfield fine sand is mapped in this area. It is not typical, but is made to include all the sand areas in the county.

Peat, as mapped in this county, consists of a dark-brown to black spongy mass of organic matter made up of partly decayed vegetation. The peaty material varies greatly in depth,

and a shallow phase of the type is separated. The depth of the peaty material in the shallow phase ranges from about 3 to 18 inches; in the typical areas it is more than 18 inches deep.

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

Areas of different soils.

Soil	Acres.	Per cent.	Soil	Acres	Per cent.
Miami silty clay loam...	55,296	37.7	Carrington silk loam...	1,408	.9
Level phase.....	2,752		Clyde loam.....	1,152	.7
Miami clay loam.....	38,528	30 3	Miami gravelly clay loam.....	1,088	.7
Level phase.....	8,384		Waukesha loam.....	1,024	.7
Clyde clay loam.....	19,392	12.6	Fox fine sandy loam....	832	.5
Superior clay loam, rolling phase.....	9,280	6.0	Fox silt loam.....	576	.4
Miami loam.....	5,248	3.4	Superior fine sandy loam	448	.3
Peat.....	2,880	2.2	Poygan clay loam.....	384	.2
Shallow phase.....	448		Plainfield fine sand.....	64	.1
Miami fine sandy loam..	3,200	2.1	Total.....	154,240	.....
Waukesha sandy loam...	1,856	1.2			

CHAPTER II.

GROUP OF HEAVY SOILS

Miami Clay Loam

Extent and distribution. The Miami clay loam is the second most extensive soil in Milwaukee County. It covers 30.3 per cent of the county or a total of 46,912 acres.

This soil as mapped includes a large part of the upland of the north half of the county. It includes the undulating to rolling upland south of the Menominee River and the more rolling ridges west of Wauwatosa and along the east side of the Underwood Creek Valley.

Description. The Miami clay loam consists of 4 to 8 inches of grayish-brown, compact clay loam or silty clay loam, overlying yellowish-brown to reddish-yellow heavy clay loam or clay. Yellowish-brown sandy clay loam or loam occurs at depths of 22 to 30 inches. From 30 to 36 inches the material contains some gravel and often considerable sand. On the knolls the gravel may be nearer the surface with a sticky gravelly clay or loamy clay surface soil. Depressions and level areas have a deeper silty surface soil.

Areas to the south, where the surface silty material is uniformly deeper over the clay loam subsoil, are mapped as the Miami silty clay loam. In general the clay loam occupies the more rolling ridges, but the separation of the clay loam and silty clay loam types is difficult, and the boundary between the two is in many cases largely arbitrary. The difference in the soil is most noticeable in wet weather when the rolling ridge land, where the surface silty clay is shallower, often becomes difficult to work. In dry weather the difference is not so marked and the separation of the types on the basis of the depth of the silty surface layer is difficult.

Topography and drainage. The surface of this soil varies from undulating to rolling, and the natural surface drainage is in most cases good. There are some level and very gently undulating tracts within the type, and where of sufficient extent these have been separated and shown on the soil map as a level phase of the type. Over these areas the natural drainage is somewhat deficient on account of the heavy subsoil, and tile drains could be used to advantage in such places.

Origin. This soil is of glacial origin, having been derived largely from the underlying limestone through the action of weathering and ice movements. While most of the material came from limestone the surface is thoroughly leached, and a slightly acid condition frequently prevails. In the subsoil, however, it is common to find varying amounts of lime carbonate.

Native vegetation. The original forest growth consisted of oak, maple, elm, ash, beech, and some hickory and walnut. But little of the valuable timber is left.

*Present agricultural development.** This is an extensive and highly developed soil. The soil is strong and productive, and except for small woodlots it is practically all under cultivation. The original forest growth consisted of oak, maple, elm, ash, beech, and some hickory and walnut, but little of the valuable timber is left. The type is used mainly for dairying and general farming combined. In trucking and gardening sections and along some of the main roads leading into Milwaukee garden crops are produced. The general farm crops include corn, oats, barley, hay, potatoes, cabbage, and sugar beets, with some alfalfa.

Corn yields 80 to 100 bushels, oats 60 to 70 bushels, barley 40 to 50 bushels, potatoes 125 to 150 bushels, sugar beets and cabbage 15 to 20 tons, and alfalfa 3 to 4 tons of hay per acre. Alfalfa is not grown on many farms, but its acreage is increasing. No great difficulty seems to be experienced in getting a good stand where proper methods are employed. Cabbage, potatoes, and sugar beets are the cash, or special crops on this type. Little hay, corn, or grain is sold, most of these crops being fed to cows, hogs, and other stock.

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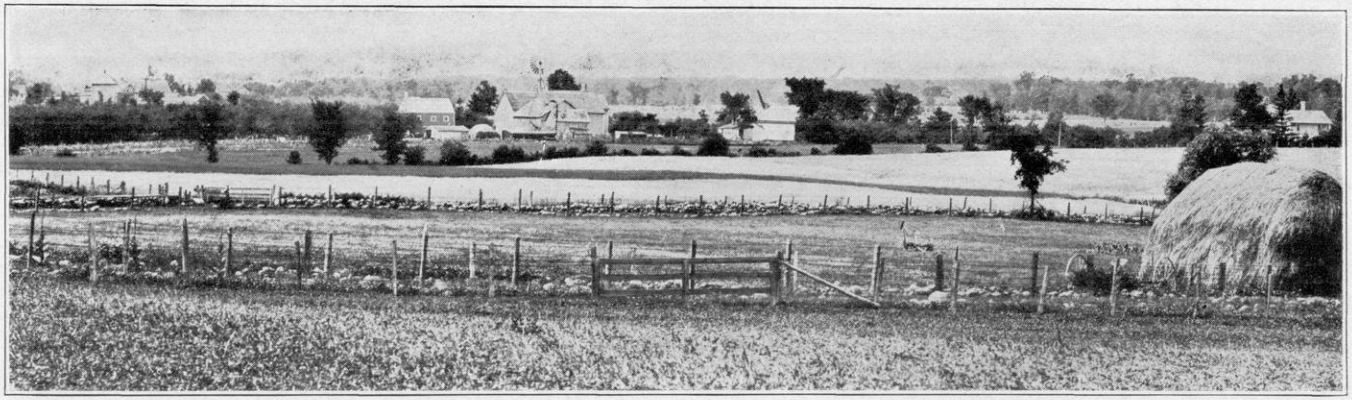
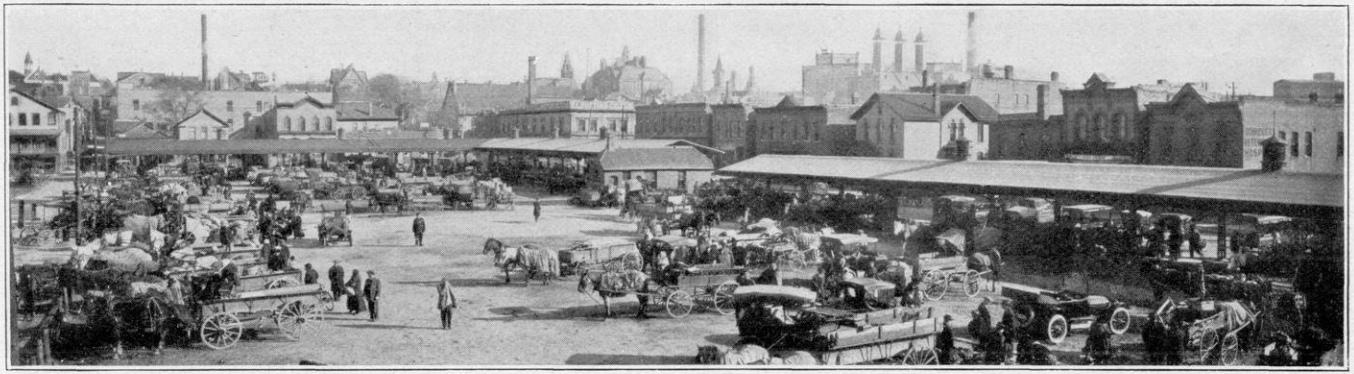
* For chemical composition and improvement see page 29.



VIEW REPRESENTING THE SURFACE FEATURES OF MIAMI CLAY LOAM AND MIAMI SILTY CLAY LOAM

These are the two most extensive and important soils in Milwaukee County, there being a total of over 100,000 acres.



VIEW OF THE NORTH SIDE OR POPLAR STREET MARKET, MILWAUKEE.

There are four such markets in the city which do a total business during the summer six months of over $650,000.00.

Barnyard manure is applied to this soil, and manure spreaders are in common use. Very little commercial fertilizer is used but a gradually increasing number of farmers are testing it out with results which are certain to lead to an increased use of these fertilizers.

This land sells for $200 to $400 or more an acre, depending upon location and improvement.

Miami clay loam, level phase. This phase includes areas of the Miami clay loam having a nearly flat topography. The soil consists of 6 to 8 inches of grayish-brown silty clay loam overlying a yellowish-brown or mottled yellow clay or clay loam. Sandy clay loam with some limestone fragments is reached at about 30 to 36 inches.

This phase occupies irregular areas in the broad valleys or depressions between the ridges, and generally borders a stream or marsh. It occurs mainly in the north half of the county.

The surface is generally flat, and while some areas have fair drainage, others after periods of wet weather remain much too wet for cultivation. The poor drainage is partly due to seepage from surrounding higher land.

Practically all this phase is cultivated or pastured, about the same crops being grown as on the main type. Yields are somewhat lighter, and cultivation is often delayed in the more level areas. For its improvement this soil requires drainage, generally by means of tiling, and in some places liming is essential.

Miami Silty Clay Loam

Extent and distribution. This soil is the most extensive in Milwaukee County, covering 37.7 per cent of the county or a total of 58,048 acres. It is confined almost entirely to the south half of the county where it is the predominating soil.

Description. The Miami silty clay loam consists of dark grayish-brown, compact silt loam, 6 to 10 inches deep, and sometimes containing a relatively large proportion of very fine sand, resting on a subsoil of yellowish-brown clay loam. The material is reddish-brown and contains limestone fragments below a depth of 24 to 36 inches. Small areas in which the silty soil is about 8 inches deep and which might for that reason be mapped as a silt loam are included.

In a few places limestone rock occurs at 5 to 10 feet below the surface, but it is usually much deeper. Some stony spots occur in the southwestern part of the county and are indicated by symbols. In the southeastern corner of the county the land is said originally to have been stony, but the stones have largely been removed and only a few bowlders remain on the surface.

Topography and drainage. The surface of this soil is gently rolling and the natural surface drainage is good. In some places the surface is level to very gently undulating and in such places this condition has been indicated on the soil map as a level phase. Over this portion of the type the natural drainage is somewhat deficient. Tile drains could in many cases be used to advantage.

Origin. The material forming this soil is of the glacial origin and has been derived largely from the underlying limestone through weathering and glacial action. The subsoil contains varying amounts of lime carbonate, but in most cases this has been quite thoroughly leached from the surface soil, and frequently a slight acid condition has developed.

Native vegetation. Most of the type in its native state was forested with a heavy growth of hardwood, with "oak openings," or areas of scattered trees, in places. The timber remains only in small woodlots, and practically all the type is under cultivation.

*Present agricultural development.** The Miami silty clay loam is used mainly for dairying and general farming, but along Kilbourn and New Roads and Howell Avenue south from Milwaukee, and also along Janesville Plank and Loomis Roads considerable gardening is done. Hillside slopes, where the soil is often slightly loamy, sandy, or gravelly, and small strips of darker soil at the heads of drainage ways or bordering creeks and marshes, are preferred for the garden and truck crops. The farms are generally smaller and the land higher priced along these main roads.

On the dairy farms the most important crops are corn, barley, oats, hay, clover, and potatoes, with some alfalfa. Corn yields 80 to 100 bushels, oats 40 to 60 bushels, and potatoes 100 to 150 bushels per acre. Most of these crops are fed to the cows. The cash products include milk and butter, calves, hogs, and small quantities of grain, corn, and hay.

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* For chemical composition and improvement see page 29.

The crops are grown in rotation, the usual plan being as follows: (1) Clover hay, (2) clover and timothy hay, (3) corn or potatoes, and (4) grain, seeding the land to clover and timothy. Barnyard manure is relied upon to maintain the soil in productive condition. A few farmers are beginning to use commercial fertilizers though the practice is not at all common as yet. Some of the farmers combine dairying and gardening, keeping a few cows and raising some garden crops with enough field crops to feed the stock.

Land of this type varies widely in price, garden farms along the main roads selling for $300 to $500 an acre, while dairy farm and lands in more remote areas sell for $100 to $300 an acre, depending upon improvements, character of the surface, and the condition of the land.

Miami silty clay loam, level phase. The surface soil of this phase consists of a grayish-brown heavy silt loam or silty clay, underlain at 6 to 10 inches by yellowish-brown clay loam. A sandy gravelly clay or sandy loam is encountered at 30 to 40 inches. The topography is very gently undulating to level. This phase does not include so much wet land as the level phase of the Miami clay loam, and as a whole is better drained.

Practically all the phase is under cultivation. It is used for the production of general farm crops. Corn yields 60 to 70 bushels, oats 50 to 70 bushels, and potatoes 150 to 200 bushels per acre. Alfalfa does well, although in wet seasons it may become weedy.

Land of this phase sells for $125 to $300 an acre.

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

Mechanical analyses of Miami silty clay loam.

Description	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Soil	1.5	4.2	4.0	20.0	10.9	48.7	10.6
Subsoil	.8	3.6	3.8	20.1	10.5	43.7	17.5

Mechanical analyses of Miami Silty clay loam.

Miami Gravelly Clay Loam

This soil covers only .7 per cent of the county or a total area of 1,088 acres.

Most of the type occurs in a nearly continuous, gravelly morainic area extending from Lake Michigan, one-half mile north of Cudahy, in a northwesterly direction through St. Francis to a point west of Bay View. Another area lies south of the Menominee River, near the west end of the viaduct just west of Milwaukee. A few small areas occur in other parts of the county.

The Miami gravelly clay loam is somewhat variable in texture. The soil prevailingly is a grayish-brown or yellowish-brown, sticky or compact clay loam or sandy clay loam, containing varying quantities of sand and gravel. The subsoil is generally a compact clay loam or sandy clay loam carrying some gravel. Gravelly sandy loam occurs in places at 20 to 36 inches, and in some areas gravel is strewn thickly over the surface.

Areas of sandy gravelly loam, too small to be mapped separately, are included with this type. They occur on small, scattered knolls in the moraine south of Bay View.

The topography is generally undulating to rolling or bumpy, and the drainage is good to excessive.

The material forming this soil is found chiefly in the form of a moraine, and consists of a mixture of clay, sand, and gravel, much of which has been derived from the underlying limestone rock. Considerable lime carbonate is found in the subsoil and also in the soil and the type is not acid.

This soil was originally timbered with hardwoods common to the region, but most of the timber has been removed and the land improved. In a few instances woodlots still remain.

Areas of this soil near the city are used for gardening and for the production of the general farm crops. The soil is very productive. It is often rather difficult to work because of the gravel, and much of it farther removed from the city is used for pasture or woodlots. Near Milwaukee a number of gravel and sand pits are worked in areas of this type.*

* For chemical composition and improvement see page 29.

Superior Clay Loam, Rolling Phase

Extent and distribution. This soil is one of the important types in Milwaukee County. It covers 6 per cent of the area, or a total of 9,280 acres. It occurs as a continuous body, lying mainly between Milwaukee River and Lake Michigan. This area is about 3 miles wide along the north county line and tapers rapidly to the south. At Whitefish Bay the area extends less than one-fourth mile back from Lake Michigan, but it widens again farther south. It is cut by the valley of the Milwaukee River. A small isolated area lies on the lake a short distance north of Cudahy.

Description. The surface soil of this type consists of grayish-red or reddish-brown clay loam from 3 to 6 inches deep, containing a fair percentage of organic matter and varying quantities of gritty sand or fine sand. The subsoil is a red, sticky, compact clay loam, which continues throughout the 3-foot section and contains varying quantities of limestone fragments and gravel. Where the land is slightly undulating the soil of the knolls has a pink or reddish color, while grayish material predominates in the level areas. The knolls and undulating areas, although having better drainage, are often as hard to work in wet seasons as the level areas where the surface material has greater depth.

Topography and drainage. Most of the type has a gently undulating topography. Along the east side of the Milwaukee River Valley the surface is distinctly rolling, and an abrupt bluff extends 100 to 120 feet down to the lake. A few deep ravines extend back one-half to 1 mile from the lake. Some areas of the type are nearly level. Shallow swales and narrow depressions occur along the drainage ways, and some small undrained depressions and flat areas occur, in which the surface has become dark from the accumulation of organic matter. This undrained soil, where of sufficient extent to be shown separately on the soil map, is classed with the Poygan clay loam. Drainage is poorest in the widest part of the area just below the north county line. The dense clay subsoil makes the soil rather cold and late, especially in wet seasons, where the topography is not distinctly undulating or rolling.

Origin. The Superior clay loam is largely of lacustrine origin having been deposited in quiet waters, probably during

interglacial times, and later reworked by glacial ice. The movement of the ice ground up much of the underlying limestone and mixed this with the material which had been deposited by water, so that this soil, especially in the lower portions is well supplied with lime carbonate. The surface soil, having been leached quite thoroughly, has in places developed a slightly acid condition.

Native vegetation. The original timber growth consisted of oak, maple, elm, beech, with some hickory and a little walnut. Only a few wood lots remain and even from these the best timber has been removed.

*Present agricultural development.** Practically all the type is under cultivation or used for pasture. Grain, corn, and hay are the chief crops. Dairying is important. On some of the small farms a few cows are kept and butter is sold, while the larger farms with more cows sell whole milk. A number of farms, especially those including low areas of dark soil, produce truck crops to some extent. Cabbage, tomatoes, potatoes, and other garden crops are grown, although the soil as a whole is not well adapted to gardening, being too heavy to work easily and too slow in drying after rains.

Corn is not extensively grown, and in most years only the earliest varieties mature well, because planting in the spring is often delayed. Replanting is frequently necessary in wet seasons. Forty to fifty bushels per acre is considered a good yield of corn. Oats yield 30 to 40 bushels, potatoes 60 to 80 bushels, rye 15 to 20 bushels, timothy about 1½ tons, and timothy and clover mixed 1½ to 2½ tons per acre. Irish potatoes are grown for home use, but the industry has not been developed on a commercial scale. The type is better adapted to other crops than to potatoes. Considerable difficulty is experienced in obtaining and keeping a stand of clover, and over some sections little clover is grown.

The Superior clay loam is somewhat difficult to cultivate, and requires heavy stock and implements to handle it efficiently. When plowed too wet it is likely to puddle. On knolls of heavier soil large clods are sometimes turned up which are quite difficult to pulverize. The poorly drained areas are more difficult to handle than where the drainage is good. The best re-

* For chemical composition and improvement see page 29.

sults are obtained where the land is plowed in the fall, but fall plowing is not always practicable. Stable manure is applied to this soil, but green manuring is not common. Commercial fertilizer is used only to a limited extent at present.

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

Mechanical analyses of Superior clay loam, rolling phase.

Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*	*Per cent.*
Soil	0.3	1.7	2.6	13.9	11.0	39.8	30.6
Subsoil	.4	1.6	1.9	12.0	11.6	38.5	34.2

CARRINGTON SILT LOAM

This type of soil occupies only .9 per cent of the county or a total of 1,408 acres. It is confined to the southwestern part of the county in Franklin Township and joins a much larger tract in Racine County to the south.

The Carrington silt loam consists of 10 to 16 inches of dark-brown or black heavy silt loam overlying a buff or grayish-brown clay loam. The subsoil contains small quantities of fine sand and gravel, and is light yellow below about 24 to 30 inches. White streaks of limy or marly material are present in a few places in the deeper subsoil. The soil is mapped in the southern part of the county.

The topography is undulating to gently rolling. The type includes lower-lying areas near the streams and steep slopes rising to the highland. Although there is considerable variation in the topography, the drainage is generally deficient, and tile drainage is required over a large part of the type to bring it to its highest state of productiveness. Small grassy swales and depressions are numerous, and because of the dense clay subsoil and the lack of natural drainage outlets, the type includes considerable wet and cold waste land that can be reclaimed only by drainage. Even land with considerable slope may be too wet for satisfactory cultivation. Probably 50 per cent of the type would be benefited by the installation of tile drains.

Notwithstanding the deficient drainage of this type, it is a productive and valuable soil. All of it is used for some purpose, the wet land for hay or pasture. Little if any of the original forest remains.

General dairy farming is practiced, and some truck crops are grown. The most important crops are corn, barley, hay, potatoes, and cabbage. Corn yields 60 to 100 bushels per acre, barley 25 to 40 bushels, hay about 2 tons, potatoes 100 to 150 bushels, and cabbage 12 to 15 tons.

A sufficient number of cows is generally kept on the farm to supply the cultivated land with barnyard manure. No commercial fertilizers are used either on the general farm crops or on the truck crops.*

Fox Silt Loam

The Fox silt loam is of very limited extent in this County, covering only .4 per cent of the area, or a total of about 576 acres. This soil occurs chiefly along the Root River in the southern and southwestern portion of the County.

The Fox silt loam consists of 8 to 12 inches of grayish-brown silt loam, underlain by yellowish-brown, compact silty clay loam containing some gravel. Yellowish-brown sandy loam occurs at 24 to 36 inches or at greater depths.

As mapped, this type includes areas of loam, which are not sufficiently extensive to be mapped separately. The loam occupies the areas along Root River and the greater part of the area on Underwood Creek west of the State Fair Grounds. The surface soil consists of 8 to 12 inches of grayish-brown loam to silty loam, containing varying quantities of sand and some gravel. The subsoil is a yellowish or reddish-brown, sticky sandy clay loam or loam. A reddish-brown sandy gravelly loam occurs at 24 to 30 inches, and this is underlain by gravel and sand.

The surface is level, or having only a gentle slope toward the stream along which it occurs. In most cases the natural drainage is fair to good, though in a few places tile drains could be installed to advantage.

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* Chemical composition and improvement of this soil discussed on page 29.

This is an alluvial soil and was deposited largely by the streams when much higher than at present. The parent material is of glacial limestone origin, but the surface soil has been leached to such an extent that the lime carbonate has been removed and an acid condition has developed in places.

This soil is used chiefly for general farming, and all of the general farm crops common to the region are grown upon it with success. Land of this kind sells for from $150 to $300 per acre depending upon its location and improvements. The areas near Milwaukee would of course have a much higher value.

Chemical Composition and Improvement of Group of Heavy Soils

There are a number of types in this County which are so closely related in texture, structure, and agricultural possibilities, that from the standpoint of improvement and management they may be considered in groups, rather than as individual types.

The types of soil in this group are much alike in certain chemical respects, though each has its individual characteristics in other respects. They run rather high in the mineral elements, potassium, calcium, and magnesium. The surface 8 inches will average about 1,100 pounds of phosphorus per acre, which is higher than in the sandy and sandy loam groups of soils, but it is considerable lower than it is desirable to maintain in a highly productive soil.

In potassium there is considerable variation. These types, especially in the subsoil are very rich in this element. The average amount in the surface 8 inches per acre is approximately 53,000 pounds. Fox silt loam is somewhat lower; but all have sufficiently abundant supplies of this element to supply all heavy crops when the soil contains the necessary amount of actively decomposing organic matter to render it available.

In nitrogen and organic matter there is more variation. Most of these soils have a rather small amount of organic matter and consequently small amounts of nitrogen, the average being less than 3,000 pounds per acre in the surface 8 inches. Carrington silt loam, on the other hand, as its color indicates, has a much larger amount of organic matter and nitrogen, the average being somewhat more than twice that in the other types

of soil. It must be remembered, that even dark prairie soils which have been cultivated for a number of years without the use of manure or other vegetable matter will lose the most active part of their organic matter, and even though they still retain enough to give them a good dark color, the organic matter is of a resistant character, and the nitrogen and inorganic matter—phosphorus, potassium, and calcium—do not become available to crops with sufficient rapidity. Moreover, the large crops which these soils have usually produced for a number of years after being first broken have frequently exhausted the more readily available phosphorus to such an extent that the development of a high degree of fertility in them now requires the use of some form of phosphate fertilizer as well as the use of a system of rotation and manuring which will supply the necessary active organic matter.

The supply of calcium carbonate in all of these types of soil was originally very large on account of their formation in large part from limestone rock by the grinding action of glaciers. Their subsoils still contain large amounts of lime and magnesium carbonate, with the exception of that of the Fox silt loam, which has in the subsoil only moderate amounts of this material. The surface of these types, hwever, have been subjected to leaching for thousands of years and this has, to a considerable extent, removed the carbonate from the surface 6 to 12 inches, so that acidity has developed in patches over this entire section. This is particularly true of the Carrington silt loam, the larger amount of organic matter of which has caused a larger solution of the carbonate than occurred in other soils containing smaller amounts of vegetable matter. Farmers having difficulty in getting a good catch of clover or alfalfa should test their soil for acidity. The large supply of lime carbonate existing in the subsoils of practically all of the area covered by the four types named will undoubtedly greatly lessen the amount of time which may be needed to maintain them in a sweet condition.

In the management of these types it should be kept in mind that, with the exception of the Carrington, the surface soil of all of the types in this group is light colored and deficient in organic matter. An effort should be made to gradually increase the supply of organic matter by supplementing the stable manure with green manuring crops. Legumes are best for this purpose. The plowing under of such crops will tend to loosen

the heavy soil, and more nitrogen will be supplied than if other crops are used.

Wherever an acid condition is sufficiently marked to interfere with the growing of crops, ground limestone should be applied at the rate of from 2 to 3 tons per acre. These types will also respond to applications of rock phosphate. This may be applied at the rate of 500 to 600 pounds per acre for the first application, and about half this amount once during each rotation.

Where the raw rock phosphate is used it should be applied along with manure or a green manuring crop. It may be spread upon the top of a loaded manure spreader, and applied in this way, or the row rock may be scattered in the stables behind the cattle and mixed with the manure in this way. Acid phosphate may also be used, and is much more quickly available to the growing plants. This may be applied through a fertilizer attachment to a grain drill or corn planter or it may be applied with the manure as a top dressing, but it should not be plowed under. From 200 to 300 pounds per acre is considered a good application for general farm crops. Where it is desired to give grain or other crops a quick start a mixed fertilizer containing nitrogen may well be used. A fertilizer analyzing 2–10–0 or 2–12–0 is well suited to this purpose. In normal times some potash may be added to this formula with profit.

Where trucking is carried on on these soils very large amounts of stable manure are commonly used. This manure is not in itself a well balanced fertilizer, being deficient in both phosphorus and potassium. Equal or better results could be secured, and secured more economically, by using a smaller amount of the manure and supplementing this with mixed fertilizers containing all three of the elements, nitrogen, phosphorus, and potassium. Under intensive methods from 500 to 1,000 pounds of commercial fertilizer can be used with profit, and in many trucking regions even greater amounts are used. Rotation of crops in trucking is necessary as it checks and tends to prevent the spread of disease. The rotation should include a legume crop that is plowed under. This will increase the nitrogen and organic matter supply and reduce the necessity for large applications of manure, through which many weed seeds are often brought to the farm.

Careful attention should also be given to crop rotations when general farming is practiced, and efforts should be made to follow only such a system as will tend to increase, or at least maintain, the soil fertility. Thorough cultivation is more important on these heavy types than on the lighter soils of the county. Fall plowing, especially of sod, is advisable where there is no danger of erosion. The seed bed should always be carefully prepared, and with intertilled crops, such as corn, a good mulch should be kept, to check the loss of soil moisture. The growing of alfalfa could be profitably extended, and some special crops, including peas, could well be raised more extensively.

CHAPTER III.

GROUP OF LOAMS AND FINE SANDY LOAMS

Miami Loam

The Miami loam covers 3.4 per cent of Milwaukee County or 5,248 acres. It is found in nearly all parts of the county in small patches. The largest tract occurs at Bay View, just south of Milwaukee. Another area is found at South Milwaukee.

The surface soil consists of 6 to 10 inches of yellowish or brownish-gray loam to fine sandy loam, and the subsoil differs very little from the soil. At 24 to 30 inches the material is a more compact, sticky yellowish-brown sandy clay loam or loam. Gravelly sandy loam is often encountered at 30 to 36 inches. The soil is slightly variable, being a sticky sandy clay loam in some places and a more open sandy loam in others. Gravel sometimes occurs on sharp knolls, and bowlders originally were quite numerous, though most of these have been removed. This soil is intimately associated with the Miami clay loam and silty clay loam, and in places the boundary is arbitrary.

The type occupies undulating to rolling tracts of land, and is frequently found as knolls and narrow strips or projections of high land bordering streams or marshes. The larger areas are undulating to rolling, and the natural drainage is almost always good. On account of varying amounts of coarse material in the subsoil in the form of fine gravel and particles of sand, water moves through the subsoil more readily than through the subsoil of the Miami clay loam, and silty clay loam, and the internal drainage is therefore better.

As indicated elsewhere this soil has been formed from glacial material which was derived largely from the underlying limestone. Because of its origin the soil is usually not acid, though a slight degree of acidity is sometimes found in the surface soil. The subsoil contains considerable amounts of lime carbonate.

A few areas are still forested but the greater portion of this soil is under cultivation and highly improved. Where not occupied by city buildings, the type is devoted to general farming, and some truck growing. It is a good soil and is better suited to trucking than the Miami clay loam and silty clay loam soils. The general farm crops are most commonly grown and average yields secured are corn 50 to 70 bushels, oats 40 to 50 bushel, potatoes 100 to 150 bushels and hay 1½ to 2 tons per acre. Barley, and a small amount of wheat are also grown, good yields are secured. Barnyard manure is the chief fertilizer used, though more consideration is now being given to the use of commercial fertilizers.*

The selling price of this land varies widely. Some of it near Milwaukee sells for as much as $600 to $1,000 an acre, while in more remote areas it can be bought for $100 to $200 an acre.

Miami Fine Sandy Loam

This soil covers 2.1 per cent of the county or a total of 3,200 acres. This type occurs in isolated areas in all parts of the county. The areas vary in size from a few acres to a square mile or more. The largest areas are near St. Francis, northeast of South Milwaukee, near and west of the Blue Mounds Country Club, and just east of North Milwaukee.

The surface soil of the Miami fine sandy loam consists of 8 or 10 inches of grayish-brown to yellowish-brown fine sandy loam overlying yellowish-brown, sticky sandy clay loam or sandy loam. Gravelly sandy loam or sandy clay loam is encountered at a depth of 24 to 30 inches. The gravel occurs at or near the surface on the knolls, while in the depressions the surface soil is deeper and heavier than the average.

A sandy loam variation occurs along the Kinnikinnic River in the Southwestern part of Milwaukee and along Underwood Creek, near the western county boundary.

The topography is generally undulating to rolling, and the drainage is good. On the sharpest knolls where gravel occurs near the surface crops may suffer from drought in continued dry spells, but the soil in general holds moisture well and produces good crops.

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* For chemical composition and improvement see page 37.

As with other types of the Miami series this soil is of glacial origin, having been derived largely from the underlying limestone, and possibly in part from glacial material transported from the north, and coming from other sources than limestone. While some limestone gravel is found the surface soil has been leached to such an extent that practically all of the lime carbonate has been removed, and an acid condition has developed over a considerable porion of the soil.

This soil was originally timbered, chiefly to hardwoods. Practically all of the timber has been removed and the soil improved. Most of the type near the more thickly settled sections is used for trucking and gardening, and is well suited to that purpose, as it is easily worked and well drained. Its uneven topography and lack of organic matter, however, make it somewhat inferior to the Clyde and Waukesha soils. In addition to garden and truck crops, it produces good yields of sugar beets, oats, potatoes, and corn. Liberal applications of manure are needed on this soil and are usually given. The use of the commercial fertilizers is not a common practice, but the satisfactory results secured in an experimental way on this and other soils tend to gradually increase the use of commercial fertilizers.*

Superior Fine Sandy Loam

The Superior fine sandy loam is of very limited extent and of minor importance. It occupies only .3 per cent of the county or a total of about 448 acres. It occupies a strip about ¼ mile wide along the Lake Michigan shore just south of Milwaukee.

The surface soil of the Superior fine sandy loam, to an average depth of about 12 inches, usually consists of a brown or yellowish-brown fine sandy loam, the color becoming lighter with depth. The texture varies somewhat, and in local areas may be a sandy loam or sand. The upper subsoil has about the same texture as the soil, but a stiff red clay is encountered at depths of 20 to 40 inches. The surface is gently undulating, and the natural drainage is good. Because of the heavy subsoil moisture is retained well by this type.

The heavy red clay subsoil of this type is of lacustrine origin, and has doubtless been influenced to some degree by glacial

* Discussion of chemical composition and improvement of this soil on page 37.

action. The surface sandy material was probably carried from a greater distance by the ice sheet and deposited over the red clay when the ice receded. The soil was originally timbered chiefly to hardwoods, but practically all of this timber has been removed.

Much of the type is now used for building sites. Where cultivated, it is utilized chiefly for general farm crops—corn, oats, barley, rye and potatoes. But little hay is grown. Good yields of these crops are secured, but because of the sandy nature of the surface, and the location this soil is better suited to the raising of truck crops. It should be devoted entirely to intensive methods of farming. Because of its location the entire type will doubtless be used in time for building sites.*

Fox Fine Sandy Loam

This is also one of the limited soil types of the area. It has a total extent of only 832 acres. It occurs chiefly along the Milwaukee River north of Milwaukee, and along the Root River in the southwestern quarter of the county. There is also one tract along Oak Creek near South Milwaukee.

The surface soil of the Fox fine sandy loam consists of 8 to 10 inches of dark grayish-brown fine sandy loam. This overlies a yellowish-brown, sticky sandy clay loam. The subsoil becomes more compact at depths of 24 to 36 inches, where layers of gravel and sand are encountered. Some gravel is scattered over the surface.

The surface of the type is level or has a very gentle slope toward the stream along which it occurs. It is all above the flood plain of the streams, and the natural drainage is generally good.

The material forming this soil is of alluvial origin and is found as terraces or as outwash material. The parent material is of glacial origin, chiefly from the underlying limestone. In some places an acid condition has developed in the surface soil, but the subsoil is seldom acid, in fact it frequently contains considerable lime carbonate in the form of limestone gravel or fine earth particles.

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* See page 37 for discussion of chemical composition and improvement of this soil.

This is considered to be a valuable soil. Where the location permits, the trucking industry has been developed, and it is especially well adapted to this type of farming. Where the location is not suitable for trucking, it is devoted to general farming and good yields of the general farm crops are secured. It is easier to handle than the heavy soils of the region.

For general farming this land sells for $150 to $200 an acre. In the gardening section it sells for higher prices.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Fox fine sandy loam:

Mechanical analyses of Fox fine sandy loam.

Description.	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Soil	1.4	6.1	9.2	32.6	11.1	31.1	8 4
Subsoil	2.0	7.3	9.0	34.5	8.7	26.4	12.0

Chemical Composition and Improvement of Loams and Fine Sandy Loams

The types of soil in this group, while differing somewhat in texture, and in origin, are quite similar in their chemical composition. The Miami loam which is the heaviest of the group has a somewhat larger supply of the mineral plant food elements than the more sandy soils of the group. It has on the average about 900 or 1,000 pounds of phosphorus in the surface 8 inches, about 35,000 pounds of potassium, and about 2,000 pounds of nitrogen. The fine sandy loam soils have about 800 to 900 pounds of phosphorus, from 25,000 to 35,000 pounds of potassium, and about 1,300 pounds of nitrogen.

All of these types are light colored, and are deficient in humus and organic matter. In the improvement of these soils, one of the first steps should be to increase the organic matter content. This can best be done by supplementing the available supply of stable manure with green manuring crops of which legumes are best.

The lime content of these soils was originally high, the coarser particles being made up of limestone. The surface soils have, however, been to a considerable extent leached, so that they are usually acid, even though the subsoil frequently contains the

larger part of its original supply of limestone. Each farmer should, therefore, test for acidity on his own fields, to determine the need of lime, especially for the growth of clover and alfalfa. Where a medium degree of acidity is found from 2 to 3 tons of ground limestone per acre should be applied.

The use of stable manure alone, even though available in liberal amounts, will not maintain the proper balance in the mineral plant food elements in the soil. Manure is comparatively low in its content of phosphorus and potassium. This group of soils is also low in phosphorus, and this deficiency can best be made up by supplementing the stable manure with commercial fertilizers. The phosphorus can be supplied in the form of raw rock phosphate, in which form it is very slowly available, or it may be applied as acid phosphate or in a mixed fertilizer. Where the supply of organic matter and nitrogen are low a mixed fertilizer (2–10–0 or 2–12–0) can be used to advantage for general farm crops. In normal times a small amount of potash may be added. Its addition even under abnormal conditions will usually be profitable, but many hestitate to purchase it at high prices especially when not familiar with its use. Applications of from 200 to 300 pounds of commercial fertilizer per acre are usually made to general farm crops, and this may be applied by a regular fertilizer distributor, by the fertilizer attachment to a corn planter, or through the fertilizer sower attached to a grain drill.

Where trucking is carried on, much larger amounts of the mineral fertilizers can be used with profit than on the general farm crops. From 500 to 1,000 pounds are often used per acre in addition to 10 or 12 tons of stable manure.

It is important to give these types thorough cultivation, though they are not so difficult to handle as the clay loam and silt loam types. The question of selecting the most suitable crop rotations should be given careful consideration, and only such systems followed as will tend to increase the productivity of the soil. Corn one year, followed by a small grain crop one or two years, and then seeding to clover, is a rotation which gives good results. Where the acidity is corrected, and the soil inoculated, alfalfa can be grown, and this crop should be more commonly raised and introduced into the crop rotation.

The question of liming to correct acidity, inoculating for the best growth of legumes, and the rotating of crops both where

general farming and trucking are carried on, should be given careful consideration in order that the fertility of the soil may be gradually increased, and the spread of plant diseases reduced to the minimum.

CHAPTER IV.

GROUP OF POORLY DRAINED AND MISCELLANEOUS SOILS

Clyde Clay Loam

The Clyde clay loam occupies 12.6 per cent of the county or a total of 19,392 acres. This soil occurs in shallow depressions in the upland and as long strips bordering the streams and marshes. Areas varying in size from 3 or 4 acres to a square mile are found in various parts of the county. Of the larger areas, one occurs a mile west of Whitefish Bay, one just west of North Milwaukee, one just west of Cudahy, and another near the southwest corner of the county south of Heelyton.

The Clyde clay loam consists of 12 to 16 inches of a dark gray or black sticky loam to silty clay loam overlying a blue or mottled yellow compact clay loam. In places the mottled subsoil contains some fine sand and gravel below a depth of 30 to 36 inches. The soil is quite uniform throughout its extent, is stone free, very high in its content of organic matter, and from the standpoint of the plant food which it contains it is a very well balanced soil.

The surface is low, level, and naturally very poorly drained. Most of it is so situated that it can be drained by open ditches or tile drains, or by a combination of both. Numerous tracts have been drained and placed under cultivation with excellent results.

This soil is partly of alluvial origin where it occurs along streams, and in part lacustrine. Some of the larger tracts were doubtless at one time old lake beds. The parent material was largely limestone which may have been first acted upon by the ice, and later deposited by running or quiet waters. The high organic matter content is due to the growth and decay of large amounts of vegetable matter under moist conditions. Since much of the earthy material came from limestone, and as the

waters flowing into these low areas carry varying amounts of lime this soil is not acid. The subsoil in particular contains considerable amounts of lime carbonate.

The native growth on this soil consisted of elm, ash, willows, coarse grasses and other water loving plants. Most of the valuable timber has been removed, but because of the poor drainage considerable amounts of this soil are still unimproved.

This soil is being quite rapidly improved by the use of tile drains and open ditches, and where thorough drainage is provided excellent crops are being secured. Near Milwaukee the soil is used for trucking crops with good results. Farther out more of the land is utilized for general farming purposes and such crops as corn, hay, sugar beets, potatoes, and even small grains are grown. The quality of grain, however, is not as good as where grown on light colored upland soils of this region. This is excellent corn land, except for danger of frosts.*

The selling price of this land varies greatly, depending mainly upon location. Some farms sell for $500 to $600 an acre, while much of the type farther from Milwaukee and from good roads can be bought for $100 to $200 an acre.

Clyde Loam

Clyde loam occupies only .7 per cent of Milwaukee County, or a total of 1,152 acres. It occurs in rather small detached areas in all parts of the county, and is closely associated with Clyde clay loam and Peat.

The surface soil of the Clyde loam consists of dark-brown to black fine sandy loam, about 8 to 12 inches deep. The upper subsoil is a grayish-yellow or mottled sandy loam containing considerable gravel. The material below 24 to 30 inches is variable, but is generally a sticky clay or yellowish sandy clay loam. A small area of sandy loam is included with this type. This soil differs from the loam only in texture and in having better drainage. It occurs on the terrace bordering the Milwaukee River west of Whitefish Bay, and is a valuable soil for market gardening.

The surface of this soil is level or nearly so, and the natural drainage is poor. It has a somewhat higher position, however,

* See page 42 for chemical composition and improvement of this soil.

than much of the Clyde clay loam, and is therefore more easily drained. Numerous areas of this class of land have been drained by means of tile or open ditches and placed under cultivation.

The material forming this soil is partly alluvial, and in places probably in part lacustrine. The dark color is due to the growth and decay of vegetation under very moist conditions. The earthy material has come largely from limestone, and as the waters flowing into the low lands carry varying amounts of lime carbonate this soil is not acid.

The native vegetation on this soil consisted of elm, ash, willows, coarse grasses, and other water loving plants.

When thoroughly drained this makes an excellent soil. It is better suited to truck crops than is the clay loam, and as it contains considerable amounts of sand and large amounts of organic matter it is easy to cultivate. The garden crops grown include onions, potatoes, melons, tomatoes, celery, beets, etc. In a number of places general farm crops are also grown. When small grains are grown they are apt to lodge, and the grain is not as well filled, as heavy nor of as good quality as grain grown on the upland soils. It is an excellent corn soil.

Methods of Improvement for Clyde Clay Loam and Clyde Loam

Since these soils are formed along the border line between upland light colored soils and peaty and muck marsh soils, they are intermediate in chemical composition between these two extremes. Moreover, their position is such that they have received a considerable deposition of fine silt from the higher land with its larger content of plant food. These soils have in the surface 8 inches approximately 2,000 pounds of phosphorus per acre; from 30,000 to 40,000 pounds of potassium; and approximately 10,000 pounds of nitrogen. Since they are surrounded by highland, the subsoils of which are rich in ground limestone which is being continuously dissolved and carried to the lower lands by percolating waters, they are as a rule not acid, and in fact usually contain considerable quantities of lime carbonate.

In spite of their large content of both phosphorus and potassium, it is not infrequently true that these soils show low

availability of these elements, especially of potassium. This is probably due to the inert condition of much of the organic matter which protects the earthy part of the soil. Where thoroughly good artificial drainage has been developed and nevertheless poor crops secured, this result will usually be found to be due to lack of available potassium and in some cases also of phosphorus. A direct experiment should be made in these cases with potassium and phosphate fertilizers, as suggested in the bulletins of the Experiment Station.

The most important question in the improvement and management of these soils is one of drainage. Practically all areas are in need of drainage, and tile drains will be found most practical in the majority of cases. When properly drained and well managed, very satisfactory yields can be secured. Cabbage, onions, and sugar beets are some special crops which can be successfully raised on these soils, aside from the general farm crops, such as timothy, alsike, clover, and corn.

Where the location is favorable the trucking industry could be extended on drained areas of these types, especially on the loam, as this is somewhat easier to work than the clay loam.

Waukesha Loam

This type occupies only .7 per cent of the county or a total of amout 1,024 acres. It is confined to the region north of Milwaukee along the Milwaukee River west of Whitefish Bay. Here it is associated with the Waukesha sandy loam.

The Waukesha loam consists of a very dark chocolate-brown to black or grayish-black fine sandy loam to loam, underlain at about 8 to 16 inches by a gray or yellowish sandy loam or sand. In places this sand is iron stained. Occasionally a thin layer of compact sandy clay, 1 inch to 6 inches in thickness, occurs at 18 to 30 inches from the surface. The deep subsoil is sandy or gravelly.

The surface of the type is level or nearly so, though there are a few slight undulations. The natural drainage, especially over the tract just west of the town of Whitefish Bay, is somewhat deficient. Over the remainder of the type the drainage is fair, though a considerable proportion of this soil would be greatly improved by tile drains. In dry seasons the soil can be cultivated readily, but in wet seasons, owing to the flat sur-

face and the accumulation of seepage water from the higher lands adjoining, some parts of the type are too moist for good results with garden crops.

As mapped the Waukesha loam includes a small area of gravelly clay loam. This occupies a high terrace position. The soil consists of 6 to 10 inches of dark-brown to chocolate-brown, heavy gravelly clay loam, containing some coarse sand and overlying reddish chocolate-brown, compact, sticky clay loam. Gravelly sandy clay loam, carrying coarse gravel, occurs at 24 to 36 inches, with layers of coarse gravel and sand in the deep subsoil. Small gravel one-half inch to 2 inches in diameter thickly covers the surface in places. The clay content of the surface soil makes it rather heavy for the best gardening conditions, and it does not dry out as quickly after rains as the more sandy soils about it, so that it is used more extensively for general farm crops than for garden and truck crops, which are produced extensively in this vicinity. Potatoes, corn, rye, oats, clover, alfalfa, and some truck and garden crops are grown. The soil is strong and productive.

The Waukesha loam, with the exception of the gravelly clay areas, is used for trucking, a wide variety of truck crops being grown. Horse manure hauled from the city is applied, but little commercial fertilizer is used.*

The value of this type ranges from $350 to $1,000 an acre, depending mainly upon location, improvements, and value for gardening.

Waukesha Sandy Loam

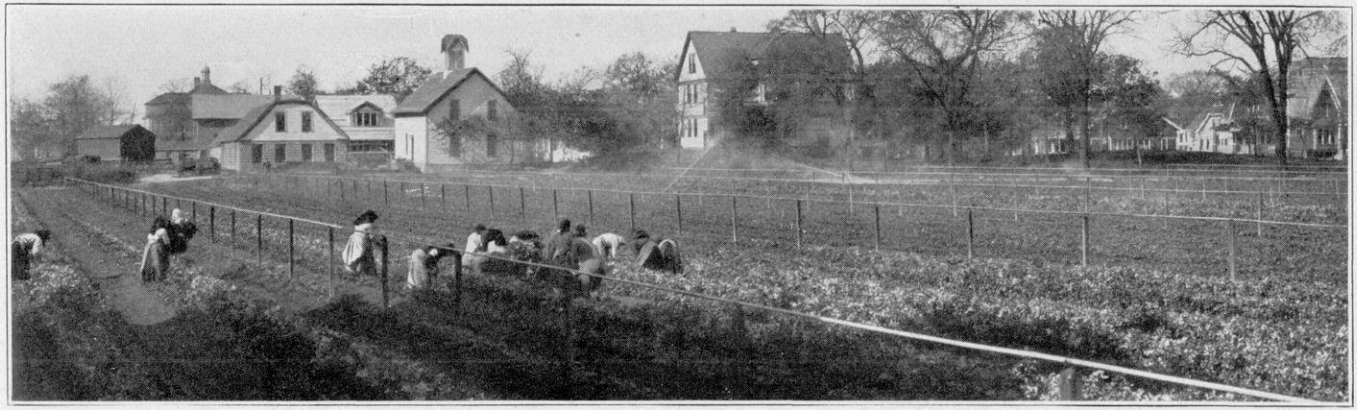
This soil occupies 1.2 per cent of Milwaukee County, or a total of about 1,856 acres. It occurs along streams as terraces. The largest tract is found along the Milwaukee River in the vicinity of Silver Springs. Other areas occur along the Menominee River west of Milwaukee.

The Waukesha sandy loam consists of 8 to 12 inches of dark-brown sandy loam to fine sandy loam overlying the yellowish-brown sandy loam or sand. The subsoil is variable, containing layers of coase sandy loam with some gravel or fine yellow sand. In some places a sticky coarse sandy clay loam layer, 2 to 6

* For a discussion of methods to improve this soil see page 46.

WAUKESHA SANDY LOAM NORTH OF MILWAUKEE.

The surface features here are representative of the Fox, Waukesha and Plainfield soils. The farms are small and most of them are intensively cultivated.



RAISING CELERY ON PEAT LAND WITHIN THE CITY LIMITS OF MILWAUKEE.

This land was originally a tamarack swamp, which was reclaimed about 45 years ago. For the past 40 years it has been devoted to celery growing almost exclusively. Large amounts of stable manure are used each year.

inches deep, is encountered at 20 to 30 inches. Sand and gravel are present in the deeper subsoil.

The surface is level, and being elevated from 5 to 20 feet above the streams, the natural drainage is good. It is not subject to flooding at any time. In prolonged dry spells crops may suffer to some extent from the lack of sufficient moisture.

The Waukesha sandy loam is a terrace formation and was deposited by stream action during and following the glacial period. The material is largely of glacial limestone origin, though the sandy particles may have come in part from regions where other rocks than limestone occur. The soil is acid in practically all cases, and responds well to the use of lime.

This type occurs along the streams as terraces lying 5 to 20 feet above the stream beds. The larger areas occur along the Milwaukee River in the vicinity of Silver Spring and west of Whitefish Bay. The soil is not extensive. The surface is nearly level. Being usually well elevated above the streams and having a porous, open subsoil, the type has good drainage. In prolonged dry periods crops suffer to some extent for lack of moisture.

Practically all the type is under cultivation. It is used for gardening, for which it has a high value, owing to its location near the city. On the whole this is one of the best trucking and gardening soils; while it has the disadvantage of a somewhat lower organic-matter content and water-holding capacity than some of the other trucking soils, it possesses certain advantages. It is easily worked, can be cultivated very early in the spring and almost immediately after moderate rains, responds quickly to manuring, and is quite easily kept free from weeds.

Practically all this soil is used for the production of garden crops. Two crops and sometimes three of the rapidly growing sorts may be grown on the same plot in a season. Many different vegetables are grown. The truck farms range in size from 3 to 20 acres. Very few of the farmers specialize, but grow a variety of crops. Some of the garden farmers practice a general rotation of field crops, such as corn, clover, potatoes, or grain, with garden or truck crops, while others produce truck crops continuously, varying the succession of crops in their various plots. Stable manure hauled from the city is applied to the land, usually at the rate of about 20 loads per acre.

Commercial fertilizers, while not commonly used, are being tried by an increasing number of farmers, and with good results.

Some of this land sells for $250 to $400 an acre, but much of it on the main roads and lying near Milwaukee is held at $600 to $1,000 an acre.

Methods for the Improvement of Waukesha Loam and Waukesha Sandy Loam

In the improvement of these soils the establishment of thorough drainage is of prime importance. The use of lime to correct the acidity is also advisable, since this will not only make possible the growing of the best legumes, but it will also help to increase the yields of practically all truck crops. The types are somewhat deficient in phosphorus, and the use of acid phosphate or a mixed fertilizer containing this element will be found profitable. Where trucking is carried on a mixed fertilizer containing nitrogen, phosphoric acid and potash can be used with profit. Applications of from 500 to 1,000 pounds per acre are common in many trucking districts. This may be used alone or in addition to 10 to 12 loads of manure per acre.

Peat

Peat consists of dark-brown to black, spongy organic material derived from the partial decay of water-loving vegetation in wet areas. The material is finely divided as a rule and fairly well decomposed. It is 18 inches or more in depth. There are often thin mossy layers in the surface material which are less well decomposed. The subsoil, or bottom, of the undrained areas and marshes is generally a bluish, dense clay or mottled reddish and yellowish clay loam or sandy clay loam. The surface covering of organic material varies in depth. The extent of decomposition and the quantity of mineral matter mixed with it vary somewhat.

In a few cases this material might properly be mapped as Muck, but prevailingly it is well-decomposed, finely divided Peat. It may be slightly or even markedly acid to litmus paper. The only marl deposit encountered is in sec. 18, T. 6 N., north of the Beloit Road and near the Waukesha County line. This deposit is less than one-half acre in extent and consists of rather impure marl.

The Peat occurs in small depressions ranging from about 5 to 80 acres in extent. These areas are widely distributed through the county, and are especially numerous in the southwestern corner southeast of St. Martins. The Peat occurs also along stream courses, as in the area west of Carrollville in the southeastern corner of the county, drained by Oak Creek.

The Peat areas are generally marshy and support an open growth of grass or brush. Occasionally there is a growth of elm, ash, or tamarack trees.

Peat areas in many cases, especially near the city of Milwaukee, have been drained and used for growing truck crops, especially celery. Some of the oldest celery farms on the south side of the city have been used as building sites, and in some cases the growers have started new celery farms farther out. Celery has been grown for 40 years on the same field in some cases. Stable manure is used, as much as 30 to 40 loads per acre often being applied yearly. Onions, cauliflower, potatoes, cabbage, and garden vegetables are also produced and sold at the city markets.

Peat suitable for gardening sells for $75 to $200 an acre, depending upon location and improvement. The tracts whose values are influenced by their proximity to Milwaukee have a much higher selling value.

Peat, shallow phase. In mapping Peat a separation is made on the basis of depth of the peaty material, and a shallow phase is separated. In this phase the clay subsoil is encountered at depths of 3 to 18 inches. In other respects the phase is like the main body of the type, although it often carries more mineral matter—silt, clay, and sand—and the organic material itself may be more thoroughly decomposed.

Methods of Improvement*

Peat has been largely formed by the accumulation of vegetable matter, particularly sphagnum moss and certain sedges and grasses. It is very low in earthy matter, running from 80 to 95 per cent. of organic matter. The amount of the mineral elements is consequently low, the total weight of phosphorus being approximately 600 pounds per acre to a depth of 8 inches,

* Wisconsin Experiment Station, Bulletin 205, Management of Marsh Soils.

and of potassium, 700 pounds. It will be seen, on comparison of these statements with those made on the composition of such soils as Miami clay and silt loams, that the total amount of potassium, in particular, is extremely small, the amount in Peat being often less than 2 per cent. of that found in the upland silt and clay loam soils. While the total amount is small, a large proportion of it is available to plants, especially if the surface has been burnt over, and the supply may be sufficient for from 1 to 3 crops. It is to be expected, therefore, that profitable cropping is possible over a long period of years, only by the use of some form of potassium fertilizer, either barnyard manure, wood ashes, or the usual commercial fertilizers containing this element. The total supply of phosphorus is rather low, though the difference between the amounts present in Peat and upland soils is very much less than in the case of potassium. In view of the enormous quantity of nitrogen contained in these soils, the average amount of which is over 15,000 pounds per acre 8 inches, it is unnecessary to use stable manure, the most valuable element of which is the nitrogen, so that, on farms including both Peat land and upland soils, the stable manure should be used on the upland, and commercial fertilizer containing phosphorus and potash on the lower land, unless, indeed, there is sufficient manure for the entire farm. These marsh soils are rarely acid on account of the percolation of lime-containing water from higher lands, though occasionally patches of acid Peat are found on the larger marshes. This acidity, however, is not so detrimental in the case of marsh lands as in the case of sand and clay soils, since the chief objection to acidity is that it interferes with the growth of those legumes, such as clover and alfalfa, which are needed on the higher lands to secure nitrogen, but which are not needed on the marsh soils for this purpose, and to the growth of which, indeed, the marsh soils are not physically so well adapted.

In the improvement of Peat the question of drainage is the first step to be considered. Both open ditches and tile drains can be utilized in reclaiming the marshy tracts. The major portion of the Peat can be profitably drained and improved. When properly handled the Peat will produce profitable crops of corn, alsike clover, timothy, and a number of other general farm crops, as well as special crops such as peppermint, celery, etc.

While the trucking industry is highly developed on some of the tracts of Peat, there is room for the extension of this type of farming, as rapidly as thorough drainage can be provided. The reduction of the amount of stable manure commonly used and the introduction of the use of mixed fertilizers replacing the manure, or supplementing smaller applications, it is thought, will result in larger yields and more economical production.

Poygan Clay Loam

This type occupies only .2 per cent of the county or about 384 acres. The type occurs in scattered patches and is confined to the northeastern corner of the county where it is associated with the Superior clay loam, rolling phase.

The Poygan clay loam consists of 6 to 14 inches of dark-brown to black, sticky clay loam with a mottled or bluish, tight clay subsoil which often grades into read heavy clay at varying depths below 3 feet. Large quantities of sand and some gravel are sometimes present in the subsoil, the material being a bluish gravelly clay or sandy clay below about 24 or 36 inches.

The narrow strip of this soil bordering Lake Michigan just south of Fox Point consists of a series of fans of clay loam eroded from gullies in the red clay above and deposited over the beach sand along the lake. A part of it is poorly drained, being kept wet by seepage. The type lies 3 to 15 feet above the lake level.

The surface of this type is low, level, and naturally poorly drained. It occupies saucer shaped depressions in the upland or is found bordering water courses. It is so situated that in most cases it can be drained by the use of tile.

The material forming this soil is largely lacustrine. The subsoil is the same as that of Superior clay loam, but to the surface there has been added a large amount of organic matter from the growth and decay of vegetation under moist conditions. This soil is not acid. The subsoil contains a considerable amount of lime carbonate.

While the original timber has nearly all been removed only a small part of this soil has been drained and placed under cultivation. At present its chief use is for hay and pasture. When drained it makes an excellent soil, well adapted to a wide

range of general farm crops, as well as to cabbage, sugar beets, etc.

In the improvement of this soil the first step is that of providing thorough drainage. With this supplied excellent crops can be grown. The type is well supplied with all of the necessary plant food elements.

Plainfield Fine Sand

This is the most limited soil in Milwaukee County, covering only about 64 acres. The Plainfield fine sand, as mapped in this county, includes all the sand areas. It occurs in only a few small bodies. Two areas, one at the mouth of Oak Creek opposite South Milwaukee, and the other just north of Fox Point, consist of deposits of beach sand. They occur as narrow strips of sand lying between the lake and the bluff. No agricultural use is made of these deposits.

Another area includes small knolls or ridges on the terraces west of the Milwaukee River and northwest of Whitefish Bay. The soil consists of yellowish-brown fine sand, and the subsoil is a yellow fine sand. Both soil and subsoil contain some gravel. This soil is used for trucking, to which it seems fairly well adapted, but it requires heavy applications of manure and is subject to drought to some extent in dry periods.

Another small area of fine sand occurs between Bay View and St. Francis. The topography is nearly level. This area is used in part for gardening and in part for general farm crops. The soil is badly run down and in need of improvement.

CHAPTER V.

GENERAL AGRICULTURE OF MILWAUKEE COUNTY

The type of agriculture in Milwaukee County from about 1830 to 1850 was general farming. Land was cheap, the population was scattered, and the prices received for farm products were much lower than at present. Grain, hay, and livestock were the chief products. By 1860 wheat, oats, and corn had become the important crops. The first cargo of wheat is said to have been shipped from Milwaukee in 1841. With the increase in population in the county, both urban and rural, the demand for garden products became greater, the price of land advanced rapidly, and the number of farms increased, with a decrease in the average size. Owing to low prices and decreased yields, wheat production steadily declined after about 1870, while the production of market-garden and orchard crops increased. Small market gardens and truck farms in recent years have taken the place of the larger dairy and general farms near the city of Milwaukee. There has also been an increase in the number of tenant farms.

At the present time, aside from trucking and market gardening, the agriculture of the county consists of combined general farming and dairying. Special crops, such as cabbage, sugar beets, or potatoes, are grown by many farmers, but a majority depend mainly upon the products of the dairy, and most of their crops are produced for feeding live stock.

There are only three creameries in operation in the county, two of which are in Milwaukee, and most of the milk and cream is hauled or shipped to this city and a large part of it is consumed as fresh milk. Many farmers sell whole milk, others separate the cream and sell it or make butter, which is sold in the city. The advantage of the latter method is that the young calves can be raised on the farm, while with the former the calves must generally be disposed of and cows bought to maintain the

herd. Small quantities of hay and grain and small numbers of calves and hogs are sold by these farmers.

The following table, compiled from the 1910 census, gives the number of live stock in the county and the sales of farm animals, by classes:

Number of domestic animals sold or slaughtered and number on farms

Domestic animals on farms:		Domestic animals sold or slaughtered:	
Milch cows	11,131	Calves, sold or slaughtered	6,093
All other cattle	3,633	Other cattle, sold or slaughtered	3,810
Horses	6,679	Horses and mules sold	188
Hogs	7,241	Swine, sold or slaughtered	7,461
Sheep	367	Sheep and goats, sold or slaughtered	80

From the reports of assessors for 1917 it is found that the number of cows was practically the same as in 1909. The total number of all cattle, and the number of hogs, and sheep also remained about the same.

In the 1910 census oats is reported as the leading grain crop, with a production of 548,110 bushels from 15,368 acres. Corn is reported on 10,015 acres, with a production of 397,882 bushels; barley on 3,668 acres, with a production of 112,089 bushels; and rye on 1,234 acres, with a production of 24,448 bushels. Wheat is reported on somewhat less than 500 acres, producing about 10,000 bushels. Tame and cultivated grasses are reported on 28,808 acres, producing 43,531 tons of hay, and about 4,500 acres are reported in wild grasses and forage crops, with a production of about 12,000 tons. Potatoes occupied 6,905 acres, with a production of 803,595 bushels, and all other vegetables a total of 4,400 acres. There were 571 acres devoted to sugar beets, producing 6,948 tons. A total of 77,799 apple trees and about 3,000 grapevines are reported in the county. Strawberries are grown on about 100 acres.

In the following table a comparison is made of the acreage devoted to general farm crops in 1909, and in 1917.

Crop	1909 (Census) Acres	1917 (Assessors) Acres	Yield per acre 1917
Oats	15,368	16,000	46
Corn	10,015	11,000	
Corn, % cut for silo		69%	
Winter wheat	205	275	21
Spring wheat	239	1,200	20
Barley	3,668	2,800	30
Rye	1,234	1,000	21
Buckwheat	18	15	20
Clover and timothy	27,474	25,500	1.4T
Wild hay	3,378	3,500	1.4T
Alfalfa	383	530	2.1
Cabbage		1,335	6 T
Potatoes	6,905	6,800	92 Bu.

It will be noted that in most cases the acreage of the various crops has remained about the same. The greatest increase in proportion to the total acreage has been in spring wheat. This was due largely to the greatly increased demand for wheat owing to the war.

The following table gives the value of the various farm products, as reported in the 1910 census:

Value of farm products, arranged by classes

Product	Value	Product	Value
	Dollars	Live stock and products:	*Dollars*
Cereals	588,502	Animals sold and slaughtered	346,498
Other grains and seeds	19,442	Dairy products, excluding home use	675,178
Hay and forage	642,359	Poultry and eggs	188,44[7]
Vegetables	853,902	Wool, mohair, and goat hair	340
Fruits and nuts	67,397	Total value	3,740,293
All other crops	358,228		

While the acreage of most of the general farm crops has remained about the same since 1909, the value of all farm produce has greatly increased. In many cases it has more than doubled.

The garden crops are of many different kinds. Among the most important products are celery, berries, lettuce, radishes, onions, melons, sweet corn, asparagus, tomatoes, cabbage, cauliflower, cucumbers, and peppers. With the improvement of the roads, gardening is spreading to cheaper and more favorable soils and into areas 15 to 20 miles distant from Milwaukee. The products are hauled by team or motor and sold at the public markets, to wholesale produce dealers and commission merchants, or peddled to regular customers in the city. The interurban railways run express cars which carry milk and garden produce to the city. From Hales Corners the cost is 20 cents per hundred pounds, and crates, cans, etc., are returned free to the owner's nearest station. Records in Milwaukee show that in the months of May, June, July, August, September, and October, 1916, a total of 18,357 loads of products was delivered to the public markets. The estimated value of each load is $35.

A general recognition of the adaptation of the various soils to certain crops is represented by the local grouping of the soils into three classes—celery land, garden soil, and clay soil. The drained Peat is the soil referred to as celery land, the sandy terrace soils and the dark-colored soils as garden soil, and the general upland clay and silty clay loam, which are used for dairying and general farming, as clay soils.

With the exception of trucking and market gardening, the most specialized agriculture is the production of celery, sugar beets, and cabbage. The sugar beets and cabbage are generally grown on the larger dairy farms as cash crops, while celery growing is a separate industry. The young celery plants are grown in beds under glass, transplanted by hand to shallow trenches made in the Peat field, and the rows gradually hilled or ridged up as the plants develop. The young cabbage plants are grown in open beds and transplanted in rows, generally with the aid of a planter, and are merely hoed and cultivated until mature. Fifteen to twenty-five tons of cabbage per acre is considered a good yield. Sugar beets are often grown in cooperation with a beet-sugar company, the nearest one being at Menominee Falls in Waukesha County. Under a labor contract the seed and all hand work, such as hoeing, weeding, thinning, topping, and loading, are provided by the sugar company for $21 per acre, while the farmer does all team work, such as plowing, seeding, cultivating, and hauling to the ship-

ping point. Fifteen to twenty tons per acre is considered a good yield.

Most of the farms in the county have good houses, barns, and other buildings, and these are well cared for. In general, the best improvements are found in the northern half of the county. Silos are in general use in all parts of the county. On most of the general farms from 3 to 5 horses and 5 to 30 head of other stock are kept.

A number of farms have buildings somewhat resembling silos, but not so high and of greater diameter, for the storage of dry distillers' or brewers' grains. This product is used quite extensively, especially in the southern half of the county, as a supplementary feed for cattle and hogs. Most farmers haul the grains in a wet condition direct from the brewery or distillery in a large, tight box or a large barrel, of a capacity four or five times that of an ordinary barrel, and mounted on wheels. From 85 cents to $3.20 per load is paid for this wet grain mash, depending upon the size of the container. This material is fed to the stock in a wet condition. The dry brewer's grain which is frequently stored by the farmers as above indicated, is considerable higher in price.

A common rotation on the dairy and general farms consists of hay 2 years, corn 1 year, and grain 1 year, with perhaps another cultivated crop 1 year. Where alfalfa is grown—and this crop is being gradually introduced—such a rotation is necessarily altered or abandoned, as alfalfa occupies the land for several years. Alfalfa is not not grown generally or in large quantities, although it is said that little trouble is experienced in getting a good stand.

The trucking industry in Milwaukee County has reached considerable proportions. As concrete roads are being extended so that the automobile can be more economically used, the area throughout which truck crops can be successfully grown and easily marketed is also rapidly extending.

In the development of the trucking industry there are several factors which should be kept clearly in mind. The rotation of crops where trucking is carried on is just as important, or even more so, than where general farming is practiced. At intervals it is wise to plow under a legume crop. This practice, together with the other changes from year to year in the crops grown will greatly check and tend to prevent the spread of

plant diseases. In most cases large amounts of stable manure from Milwaukee are used. This practice brings to the farm many weed seeds. Where a green crop is plowed under, this reduces the need for so much manure.

The supply of stable manure, even when the city supply is considered, is not sufficient to meet the fertilizer needs of the soils of the county. It is therefore necessary to supplement the manure with other sources of plant food. The green manuring crops make up one source which should be more commonly drawn upon. This fertilizer is produced at home and its use greatly reduces the danger from the introduction of weed seeds.

But neither stable manure nor green manuring crops fully meet the needs of the crops which are usually grown. These fertilizing materials as well as most of the soils of the county are deficient in their phosphorus supply, and before maximum crop yields can be secured most economically it is necessary to provide this element. Acid phosphate is the form in which it is most readily available. This may be used on general farm crops at the rate of 200 to 300 pounds per acre, or to trucking crops up to 1,200 or even more pounds per acre. It may be applied along with the stable manure as a top dressing, or it may be sown with a fertilizer attachment to a grain drill at the time of seeding a small grain. On some truck crops small applications are sometimes made at intervals during the period of growth. Where the amount of manure is limited and green crops are not plowed under the use of a complete fertilizer will be found profitable, especially where trucking is carried on.

In Milwaukee County the use of commercial fetilizers is not common, but the amount being used is gradually increasing. In general farming and trucking more consideration is being given this question each year, and quite a number are now making fertilizer trials in a small way. Where properly applied, and where the right kinds are used, very gratifying results are being obtained.

It is difficult to obtain farm labor, and the cost is rapidly increasing. As much as $50–$75 a month with board is sometimes paid for good farm hands. Much of the gardening and the celery and sugar-beet handwork is done by women, girls, and boys, usually members of the farmer's family.

The 1910 census reports a total of 2,443 farms in the county, averaging 47 acres in size. About 77 per cent of the area of

the county is in farms, and of the farm land about 85 per cent, or 40 acres per farm, is reported improved.

Somewhat over one-third of the farms in the county are operated by tenants. The rent varies from $8 to $30 an acre, depending upon the location of the land and the kind of farming practiced. The higher price is paid for the garden land.

Land varies widely in value, ranging from $100 or $125 in the remote parts of the county to $300, $400, and even $1,000 an acre for garden and celery land near the city.

CHAPTER VI.

CLIMATE

The climatic conditions prevailing in Milwaukee County are characteristic of a considerable region in eastern and southeastern Wisconsin immediately bordering Lake Michigan. The mean annual precipitation as reported by the Milwaukee station is 31.40 inches; the total rainfall for the driest year as given by the Weather Bureau is 18.69 inches, while the total for the wettest year is 50.36 inches.

This rainfall is, as a rule, fairly well distributed throughout the year, and especially during the growing season when it is most needed. Frequently, however, there are years when periods of dry weather alternate with periods of unusually heavy rainfall. These may continue from one to four weeks and occasionally longer. Observations made by the weather bureau station at Madison, where the rainfall conditions are very similar, covering a period of 30 years from 1882 to 1911, show that there are on the average three 10-day periods in each growing season in which the rainfall is so light that crops on a reasonably heavy soil suffer from lack of moisture.

The average date for the last killing frost in the spring in Milwaukee County is given by the records as April 27, and the average date of the first killing frost in the fall is given as October 10. This gives a growing season for Milwaukee County of approximately 166 days. The date of the latest killing frost recorded for the spring in Milwaukee County is May 29, and the date of the earliest killing frost in the fall is given as September 25.

The influence of Lake Michigan is quite marked in this county. The large body of water has the effect of delaying the opening of spring, but when warm weather finally begins it has a tendency to keep climatic conditions more uniform than in sections remote from large bodies of water, so that in this region summer frosts and early fall frosts are very rare. While the num-

ber of days between killing frosts is 166, as given, there is a considerable period after the last killing frost in the spring and before good growing weather begins during which the temperature is relatively low, and when such crops as corn will make but little progress. The land immediately bordering the lake and for some 5 or 10 miles back is for this reason not so well adapted to corn as land lying in the same latitude but farther inland. The influence of the lake accounts for more cool nights than are found in the interior of the State, and this of course is not conducive to the rapid growth of corn.

The mean annual temperature of the Milwaukee station is 45.3° F. The highest temperature recorded is 100°, and the lowest —25°.

The following table is compiled from the records of the Weather Bureau station at Milwaukee:

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

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1901)	Total amount for the wettest year (1876)
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	27.0	63	—22	1.92	1.69	2.16
January	19.8	61	—25	2.01	1.33	4.39
February	21.9	60	—24	1.89	1.92	3.63
Winter	22.6	63	—25	5.82	4.94	10.18
March	30.9	81	— 8	2.67	3.62	5.29
April	41.8	86	12	2.70	.47	2.83
May	53.6	94	25	3.42	1.75	8.54
Spring	42.1	94	— 8	8.79	5.84	16.66
June	63.5	98	38	3.67	1.12	4.76
July	69.7	100	47	3.01	2.03	4.39
August	68.7	98	42	2.82	1.50	5.52
Summer	67.3	100	38	9.50	4.65	14.67
September	61.5	96	25	2.92	1.86	3.66
October	50.2	88	15	2.39	.65	1.62
November	36.1	73	—14	1.98	.75	3.57
Fall	49.3	96	—14	7.29	3.26	8.85
Year	45.3	100	—25	31.40	18.69	50.36

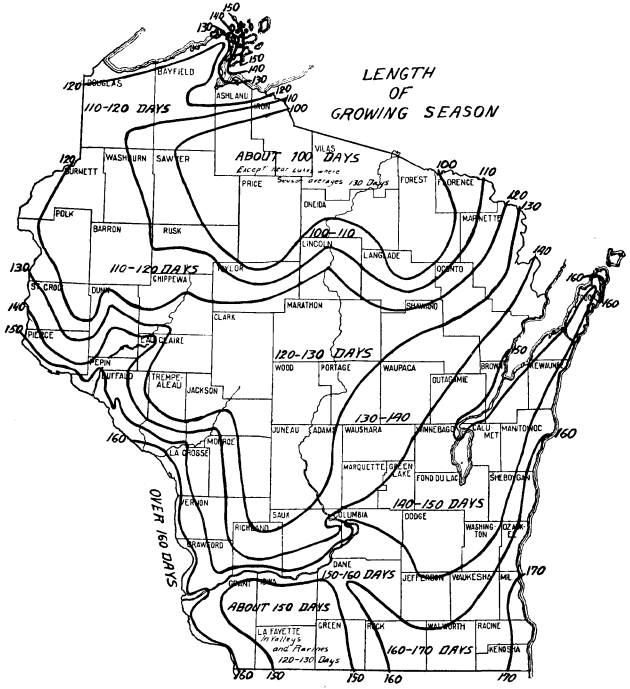


FIG. 2. Map showing length of growing season.

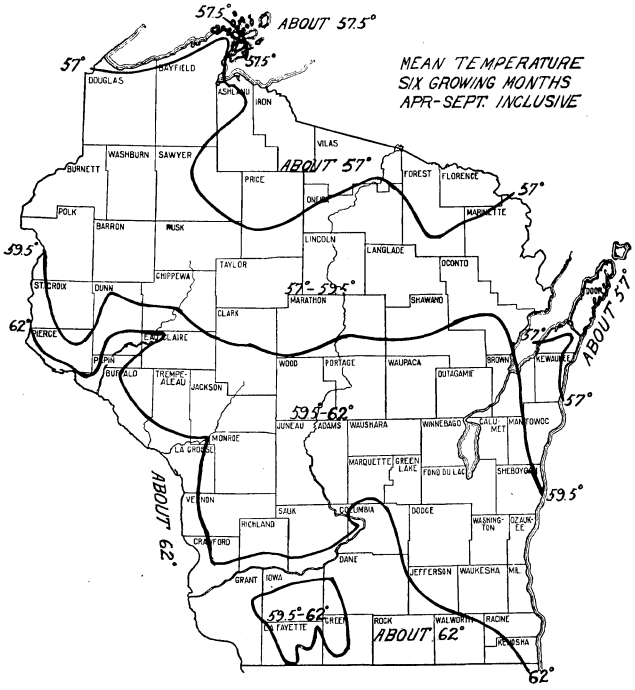


FIG. 3. Sketch map showing mean temperature for six growing months.

SUMMARY

Milwaukee County is near the southeastern corner of Wisconsin adjoining Lake Michigan. It has an area of approximately 241 square miles or 154,240 acres.

The county comprises a series of broad, elongated ridges paralleling the shore of Lake Michigan. The surface in general is undulating to rolling. It rises toward the west and an elevation of 260 feet above the lake, or 840 feet above sea level, is attained in the western part of the county.

Milwaukee County was organized in 1836, and reduced to its present size in 1846. The total population, as reported by the census of 1910, is 433,187, of which about 9 per cent is rural. The density of the rural population is 168 per square mile. Milwaukee City, with a population of about 374,000, is the county seat.

Railroads and electric lines radiate in all directions from Milwaukee, and the county is well supplied with transportation facilities. The county road system is particularly good. Milwaukee is the chief market for the products of the county.

There is very little sandy soil in the county, about 90 per cent of the soil being heavier than loam. Nine soil series, including 16 types, together with 1 miscellaneous type, are mapped in this county. Of these the most important are the Miami soils, which cover over 74 per cent of the county. These are light-colored formerly timbered upland glacial soils, carrying considerable limestone material, especially in the subsoil. Five members of the Miami series are mapped—the fine sandy loam, loam, silty clay loam, gravelly clay loam, and clay loam.

The Clyde series is represented by two types, the loam and clay loam. These are dark-colored soils with poor drainage, occurring along the streams and in depressions within areas of the Miami soils. They are used for pasture, woodlots, and marsh-hay land in their natural condition and for garden crops where drained.

The Carrington series includes dark-colored prairie soils, similar in many respects to the Miami. Only one member of this series, the silt loam, is mapped.

The Superior series includes lacustrine soils which have been reworked by glacial action. These were first deposited in quiet waters. The chief characteristic of this series is the heavy red

subsoil. The series is divided into phases on the basis of topography, and the level phase is considered to be typical. The heavy subsoil makes the level phase somewhat deficient in drainage, and thus rather cold and backward in the spring. The rolling phase has good natural drainage, and is the more desirable soil. The Superior clay loam, rolling phase, and the Superior fine sandy loam were mapped in Milwaukee County.

The Poygan series is represented by only one type, the clay loam. It is of small extent and is relatively unimportant.

The Fox series is represented by two members, the fine sandy loam and silt loam. It includes light-colored terrace soils. These are productive and valuable soils, but are not extensive in this county.

The Waukesha series includes the dark-colored well-drained limestone soils laid down by water as outwash areas or terraces and having stratified gravelly or sandy subsoils. In this county it includes two types, the sandy loam and loam. These soils are used for market gardening.

The Plainfield series is represented by a single type, the fine sand. This type is made to include all the sand areas mapped in the county.

Peat consists of an accumulation of decaying vegetable material overlying clay. Some of the Peat land has been drained and is used for celery culture, gardening, and general farming.

The agriculture of the county consists of general farming and dairying, trucking, and market gardening. The general crops, oats, barley, corn, hay, and alfalfa, are produced on the dairy farms. Special crops, such as sugar beets, cabbage, potatoes, celery, and onions, are grown on the truck farms and smaller dairy farms, and vegetables of all kinds are grown in the market gardens, located mainly in the vicinity of Milwaukee.

The farms, particularly in the northern part of the county, are well improved. In general, farming is in a prosperous condition and the average price for farm land in the county is well above the average price per acre for the State. The adaptation of the soil to certain crops is generally recognized, and some attention is given to crop rotation. Manure is commonly applied to cultivated land, but little commercial fertilizer is used.

According to the 1910 census, there is a total of 2,443 farms in the county, averaging 47 acres in size. About 77 per cent of the area of the county is in farms, and of the farm land about

85 per cent, or 40 acres per farm, is reported improved. Somewhat over one-third of the farms are operated by tenants. The average value of farm land is reported as $197.49 an acre.

The growing season averages 166 days. The mean annual temperature is 45.3° F., and the mean annual rainfall 31.40 inches.

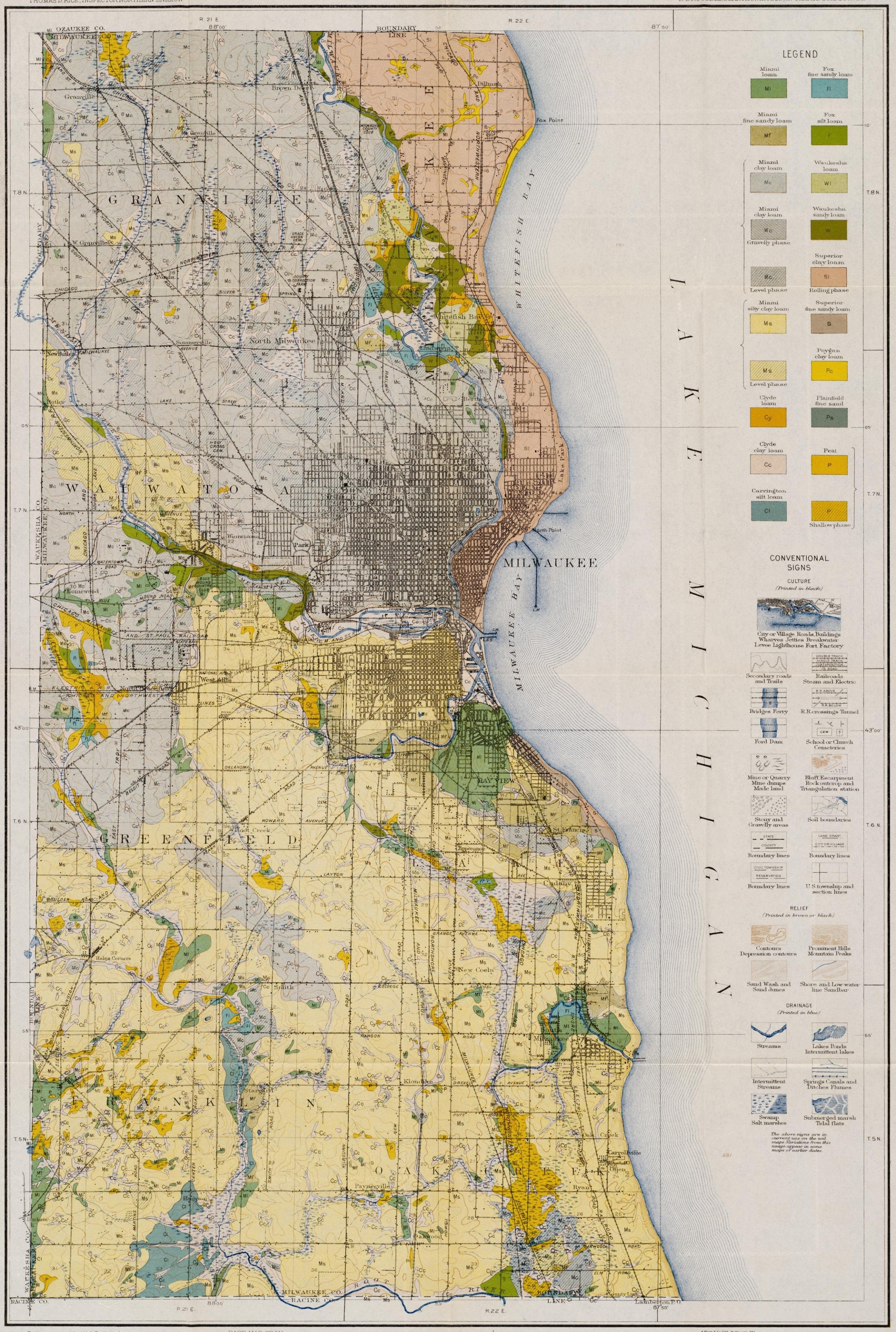
KEEP THE MAP

The Experiment Station will publish bulletins from time to time dealing with the management of the different types of soil mapped, so that some way should be found by each person receiving a copy of this report to keep the map permanently. If the map is folded in such a way as to have the part you are interested in of a convenient size, and then have a simple frame with glass made to hold it, it can be kept indefinitely. Since some of the colors fade after being exposed to strong light for a long time, it would be a good plan to have a protecting flap of dark cloth over the map when not in use.

U. S. DEPT. OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY
THOMAS D. RICE, INSPECTOR NORTHERN DIVISION

SOIL MAP
WISCONSIN
MILWAUKEE COUNTY SHEET

STATE OF WISCONSIN
GEOLOGICAL AND NATURAL HISTORY SURVEY,
E. A. BIRGE, DIRECTOR.
COLLEGE OF AGRICULTURE, UNIVERSITY OF WISCONSIN.
H. L. RUSSELL, DEAN. A. R. WHITSON, IN CHARGE SOIL SURVEY.



LEGEND

Miami loam — MI	Fox fine sandy loam — Fl
Miami fine sandy loam — Mf	Fox silt loam — F
Miami clay loam — Mc	Waukesha loam — Wl
Miami clay loam, Gravelly phase — Mc	Waukesha sandy loam — W
Miami clay loam, Level phase — Mc	Superior clay loam, Rolling phase — Sl
Miami silty clay loam — Ms	Superior fine sandy loam — S
Miami silty clay loam, Level phase — Ms	Poygan clay loam — Pc
Clyde loam — Cy	Plainfield fine sand — Ps
Clyde clay loam — Cc	Peat — P
Carrington silt loam — Cl	Shallow phase — P

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

City or Village Roads, Buildings
Wharves Jetties Breakwater
Levee Lighthouse Fort Factory

Secondary roads and Trails
Railroads Steam and Electric
Bridges Ferry
R.R. crossings Tunnel
Ford Dam
School or Church Cemeteries
Mine or Quarry Mine dumps Made land
Bluff Escarpment Rock outcrop and Triangulation station
Stony and Gravelly areas
Soil boundaries
Boundary lines
Boundary lines
Boundary lines
U. S. township and section lines

RELIEF
(Printed in brown or black)

Contours Depression contours
Prominent Hills Mountain Peaks
Sand Wash and Sand dunes
Shore and Low-water line Sandbar

DRAINAGE
(Printed in blue)

Streams
Lakes Ponds Intermittent lakes
Intermittent Streams
Springs Canals and Ditches Flumes
Swamp Salt marshes
Submerged marsh Tidal flats

The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

Soils surveyed by W. J. Geib and T. J. Dunnewald of the Wisconsin Geological and Natural History Survey

BASE MAP FROM U. S. GEOLOGICAL SURVEY SHEETS

Scale 1/62500
1 ½ 0 1 2 3 4 Miles
1 ½ 0 1 2 3 4 5 Kilometers

Contour interval 20 feet.
Datum is mean sea level.

A. Hoen & Co. Lith. Baltimore, Md.