Soil survey of Walworth County, Wisconsin. Bulletin No. 56C, Soil Series, No. 30 1924

Whitson, A. R. (Andrew R.), 1870-1945. et al.
Madison, Wis.: The State, 1924

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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. 56C SOIL SERIES NO. 30

SOIL SURVEY

OF

WALWORTH COUNTY

WISCONSIN

BY

A. R. WHITSON, W. J. GEIB, W. H. PIERRE, AND C. B. CLEVENGER, OF THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY, AND L. R. SCHOENMANN AND W. B. COBB, OF THE U. S. DEPARTMENT OF AGRICULTURE, BUREAU OF SOILS

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INTRODUCTION

The State of Wisconsin, working in cooperation 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 locating 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 capacity, 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 MORE THAN 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 graduation 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 with heavy types predominating. The Plainfield series includes light colored soils in regions where no limestone is present, and where the material occurs at outwashed plains or stream terraces. The soils in this series also have a wide range in texture but sandy types predominate. 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 name of the *soil class,* which refers to texture, with the name of the *soil series,* which refers chiefly to origin, 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 extnt in texture, color, topographic position, and other physical properties, and having a distinct agricultural unity, 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 WALWORTH COUNTY WISCONSIN

CHAPTER I.

DESCRIPTION OF THE AREA

Location and boundaries: Walworth County is located in the southeastern part of Wisconsin, and its southern border is the Illinois-Wisconsin State line. Its eastern border is about 24 miles from Lake Michigan. Elkhorn, which is the county seat,

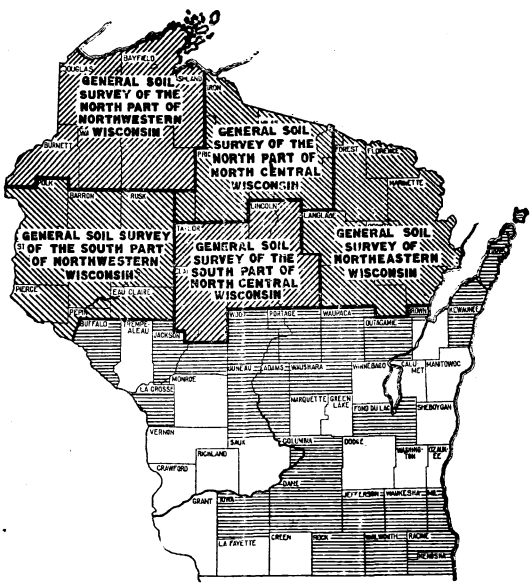


FIG. 1—SKETCH MAP SHOWING AREAS SURVEYED

is 71 miles from Madison and 56 miles from Milwaukee. The county is bordered on the north by Jefferson and Waukesha counties, and on the east by Racine and Kenosha counties, and on the south by McHenry and Boone counties, Illinois, and on the west by Rock county, Wisconsin. The county has the

form of a square, measuring 24 miles on each side. It comprises a total land area of 560 square miles or 358,400 acres. The area of the lakes within the county amounts to approximately 14 square miles.

Topography and surface geology: The most important physiographic feature of the county is the series of moraines which mark the different stages of the glacial ice as it advanced and retreated over this region. This county was traversed by the Delavan lobe of the Lake Michigan glacier and by the Green Bay glacier. Where these two great ice sheets came together there was formed what is known as the Kettle Moraine. This begins near the village of Richmond in the westrn part of Walworth county and extends in a northeasterly direction, terminating in Kewaunee county. This kettle range received its name from the numerous holes and pits resembling large kettles. This range is evidently a gigantic moraine, and it forms the main topographic feature of eastern Wisconsin. It ranges in width from 1¼ to 3 miles and is rough and broken throughout its extent. To the southeast of Whitewater it rises about 200 feet above the surrounding country and forms the most conspicuous feature of the landscape. From the village of Richmond extending to the southeast is the Darien moraine which is the terminal moraine of the Lake Michigan glacier. From 3 to 5 miles back from this is the recessional moraine known as the Elkhorn moraine. Extending west from Richmond is the terminal moraine of the Green Bay glacier known as the Johnstown moraine. From 3 to 5 miles north of this range of hills is the Milton moraine. All of these are merged into the Kettle Moraine which was formed by the two great ice sheets.

The Darien moraine is the most important in Walworth county. It has a width of from ½ to 3 miles and varies considerably in the degree of relief shown. Between Richmond and a point opposite the head of Delavan Lake the relief is only from 20 to 40 feet. Near the village of Walworth it reaches 100 feet, and south of Lake Geneva the long slope rises from 100 to 150 feet above the low areas at the south.

By far the greatest relief is found in the slopes of the Lake Geneva basin. In the western part between Cook's Camp and Camp Colli, the lake reaches its greatest depth which is 152 feet. The elevation of the bottom of the lake is 719 feet above

sea level, over 400 feet lower than the crest of the moraine 1½ miles southeast. This makes the highest point about 258 feet higher than the level of the lake.

From Lake Geneva to Burlington the topography is very irregular. The morainic belt is interrupted by depressions with abrupt surrounding slopes. There is frequently a strongly marked knob and kettle topography. Abrupt knolls and ridges of gravel alternate closely with deep rounded pits and narrow winding depressions.

Outside of these morainic regions the ground moraine has a topography ranging from level to gently undulating. In the region of old glacial drift in Sharon township the surface consists of long gentle slopes. The outwash plains to the north and east of this township are level.

Along the streams which traverse the region there are narrow belts of bottom land subject to overflow, and there are also numerous marshes. These are most abundant in the southeastern quarter of the county and in the northern portion.

Elevations: The general elevation of the county ranges from about 822 to 1004 feet above sea level. The following elevations have been indicated along the railroads: Elkhorn, 996 feet, Darien, 943 feet, Delavan, 938 feet, Lake Geneva, 892 feet, Walworth, 1004 feet, Genoa Junction, 845 feet, Whitewater, 822 feet, and Troy, 891 feet. Probably one of the highest points in the county is 1119 feet above sea level. This is the point indicated above, which is south of Lake Geneva.

Underlying rock formations: The greater part of Walworth County is underlain by limestone formations. As shown on the accompanying sketch map of Walworth County there are two kinds of limestone. In the eastern part of the county the uppermost rock and that which is found directly beneath the layer of glacial drift is known as the Niagara limestone. In the western part of the county the uppermost rock is known as the Galena and Trenton limestones. This group of rocks consists of two closely related limestones often considered together as one formation. Between this and the Niagara limestone formations is a narrow belt of Cincinnati shale. These formations have been acted upon by glacial ice and have contributed to a greater or less degree to the formations of the present day soils.

Water Courses: Walworth County lies on a drainage divide, and there are no large streams crossing the county. The drainage of the western part is carried chiefly by Turtle Creek, one branch of which has its chief source in the marshes in Richmond and Sugar Creek townships. Another portion forms the outlet of Delavan Lake. Turtle Creek flows into Rock River at Beloit and then into the Mississippi after traversing Illinois. In the eastern part of the county White

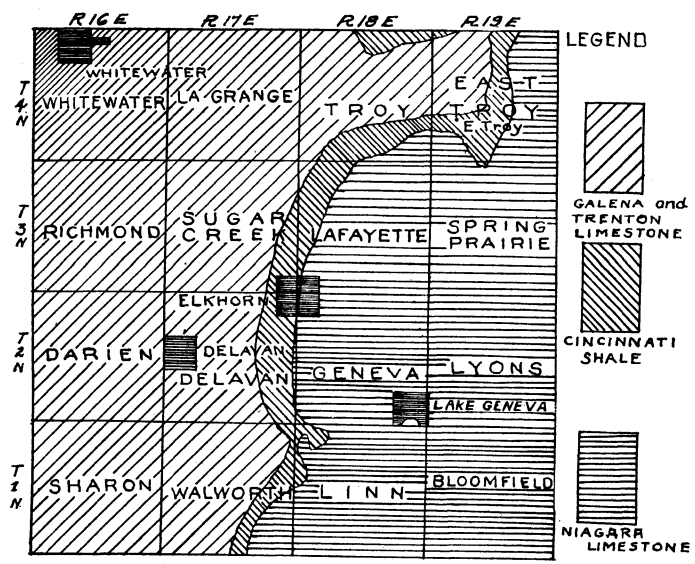


FIG. 2—SKETCH MAP SHOWING THE UNDERLYING ROCK FORMATIONS IN WALWORTH COUNTY

River forms the outlet of Lake Geneva and Lake Como. This stream empties into Fox River at Burlington. Sugar Creek and Honey Creek drain most of the country in the northeastern part of the county and also empty into Fox River. Branches of these various streams form drainage outlets for practically all parts of the county. From a geological standpoint the country is practically new, and streams have not formed deep channels, but are still cutting away their beds. Most of the streams have fairly good fall, and in a few places water power has been developed, but at the present time is not used extensively in any part of the county.

Settlement: The first settlement in Walworth County was made in 1836 in Section 24 town of Spring Prairie. A claim

was staked out at the head of Lake Geneva in 1835 but this was not occupied until later. The county was formed by a territorial act of Wisconsin in 1838 and the county organization began to function in 1839. The early settlers were of Anglo-Saxon descent and came chiefly from New York, Pennsylvania, Illinois, Indiana, and Ohio. Later there was a considerable influx of German, Norwegian, Irish, and English settlers. All parts of the county are now thickly settled and highly developed. The population of the county in 1910 was 29,614. In 1920 the population was 29,327. Elkhorn, the county seat, had a population of 1991 in 1920. Other important towns within the county and their population are: Lake Geneva, 2,632; Delavan, 3016; Whitewater, 3215. Other towns of lesser importance are Sharon, Darien, Walworth, Genoa Junction, Springfield, Lyons, Troy, and East Troy. All of these towns are surrounded by good agricultural country and are distributing points for farm machinery and shipping points for farm produce.

Railways: Walworth County is well supplied with transportation facilities. The Racine and Southwestern Division of the Chicago, Milwaukee and St. Paul crosses the county from east to west, passing through Delavan, Elkhorn, and Springfield. A branch of this line runs north from Elkhorn to Eagle in Waukesha County. The Prairie Du Chien Division of the same road crosses the northwestern part of the county, passing through Whitewater. The main line of the Chicago and Northwestern traverses the extreme southwestern part of the county, passing through Sharon. A branch of this road extends from Chicago to Williams Bay running through Genoa Junction and Lake Geneva. The Milwaukee Electric Light Company has a line extending from Milwaukee southwest to East Troy in this county. Another electric line known as the Chicago, Harvard and Fontana line extends from Harvard, Illinois to Fontana, Wisconsin at the west end of Lake Geneva. These various railroad lines provide adequate transportation for both freight and passenger traffic in all parts of the county.

Highways: Public roads extend into all parts of the county, and most of these are kept in good repair. Under the present system of road development certain roads are being improved as county or state trunk highways. On some of these lines the

roads are constructed of concrete while others are graded and crowned with gravel or crushed rock. A patrol system on all these roads insures their being kept in good repair. These state highways are being supplemented by county highways so that nearly every community is reached by a branch of the improved highway system.

Practically all parts of Walworth County are supplied with rural mail service and also with rural telephones.

Markets: The numerous towns and villages within the county provide a market for a considerable amount of farm produce, but the greater part of the produce is shipped to outside markets, including Milwaukee and Chicago. Numerous shipping organizations have been developed through the work of the Farm Bureau and county agents, and these have resulted in a marked improvement and more profitable handling of live stock and other produce of the farm.

SOILS

The soil material of Walworth County, like that of a considerable area in southeastern Wisconsin, owes its accumulation to several distinct processes, including glacial, alluvial, and possibly loessial. To these may be added the accumulation and decay of vegetable matter and the formation of peat.

The surface of the county as a whole owes its general character to glacial action. Through the action of the ice sheet vast quantities of glacial debris were accumulated, and these were left as the ice sheet melted. Most of the soils of the county have been derived from this glacial debris. As the swollen streams carried quantities of this material away from the glacial ice fields, alluvial deposits were formed. In many of the depressions and partly filled valleys large quantities of organic matter gradually accumulated through the growth and decay of water-loving plants, giving rise to the formation of peat soils. Over a considerable part of the county there is an extremely silty surface soil, which by some authorities is considered to be of loessial or wind-blown origin.

The glaciation which covered most of Walworth County is known as the late Wisconsin. Sharon Town, in the extreme southwestern corner of the county, was not covered by this

glaciation but appears to have been influenced by a much older ice sheet. The few stones and bowlders in this region are more thoroughly decomposed and the drainage ways more thoroughly established than in the region of more recent drift in other parts of the county.

In this county there is a marked variation in the depth of glacial drift over the underlying rock formations. From various well records the depth of the drift has been determined in a number of places. At Richmond the depth is about 230 feet; at Elkhorn, 213 feet; at Yerkes Observatory, 405 feet; and at Delavan, 439 feet. In LaGrange and Sugar Creek Towns the records of five wells, chiefly from the outwash plains, show that bedrock was reached at a depth of 230 to 235 feet. This variation in depth is accounted for by the presence of a preglacial valley extending across the county. In this valley the till in places is over 200 feet deeper than elsewhere. In Sharon Town the depth of the drift is variable also, although this is in the region of the older glaciation. A number of rock outcrops occur, while on the other hand the depth extends locally to 200 or 250 feet. Very little of this region has a shallow mantle of glacial material over the rock. Ninety per cent or more of the gravel found in the drift consists of limestone material. Mixed with this, however, are varying proportions of crystalline rock gravel. In the morainic areas the material carries a very high percentage of stone, gravel, and bowlders, and in deep cuts some rough stratification can be seen. The ground moraine areas or till plains are less stony and a large proportion of the stones present are angular or subangular, showing that they have not been transported for any great distance. The outwash plains and terraces consist of stratified beds of sand and gravel mantled with a thin layer of sandy or silty material.

Probably for a long time after the glacial period there was very little forest growth on any of the lands of the county. Marsh and prairie conditions became well established in time. Later tree growth took possession of the areas where conditions were least favorable for maintaining a heavy sod of grasses, as in the rougher morainic and sandy areas. As time went on the forest encroached more and more upon the prairie areas of the smoother till plains and along streams and slopes until a large percentage of the upland and terraces were

covered with a medium to heavy tree growth. In the main the timber growth held to the better drained areas, but some of the wet lands became forested, including the overflow lands along the streams and the swampy depressions where deep peat deposits have accumulated. As found by the early settlers, the forest areas with fair to good drainage were supporting a scattering to dense growth of hardwood consisting mainly of oak, maple, and hickory, and on less well drained areas oak and hickory, with some ash, elm, and soft maple. Some of the areas of peat had a dense growth of tamarack or a mixture of alder and willow with scattering tamarack. Prairie grasses thrived over the open lands, except the low-lying flats and depressions that were in a condition of true marsh.

The soils of the Walworth County have resulted from the changes brought about by weathering of the several classes of material laid down during and since glacial times. Naturally they are quite varied in their color and other characteristics. The soils developed under forest cover where fair to good natural drainage has been established are light in color, characterized by gray to brown surface soils and gray and brown mottled to yellow and reddish-brown subsoils. The weathered zone extends to a depth of 2 to 3 feet in the more recent glacial areas, and to 4 feet or more in the old glaciation in the southwestern corner of the county; and enough leaching has taken place to remove all free carbonates, the surface soils being in an acid condition. The soils that have developed under prairie conditions vary from black surface soils over mottled yellow and gray subsoils in the poorer drained area to dark-brown surface soils over yellowish-brown evenly oxidized subsoils in the best drained areas. As with the light-colored soils, all free carbonates have been leached from the weathered zone, which extends to depths ranging from 2 to 4 feet, and in most areas the surface soil shows at least a slight acid reaction. The marsh and swamp soils are characteristically black or very dark brown over gray to bluish-gray and yellowish brown mottled subsoils; or, in the case of the organic soils, they have a black mucky to brown peaty character to depths of 1 to 3 feet or more. The soils developed in the marshy areas generally are not in an acid condition, although as a rule they contain very little if any free carbonate, except in the substratum.

Taking into account the different processes by which the

soil-forming material was accumulated and the different physiographic positions occupied, the soils may be arranged in four main groups: (1) soils of the uplands derived from ice-laid deposits; (2) soils of the terraces and outwash areas derived from old water-laid sediments; (3) soils of the flood plains consisting of recent alluvium; and (4) soils from organic remains or peaty accumulations. In the first two groups the soils may be divided into light and dark soils. For the purpose of mapping, the soils are classified into series and types. Each soil series consists of soil types that have a comman origin and are similar in color, structure, topography, and drainage. The types in a series differ from each other in the texture of the soil.

The light-colored soils developed under fair to good conditions of drainage in the uplands are classed in the Miami series, except the very gravelly, kamey areas classed in the Rodman series and the light sandy areas in the Coloma series. The light-colored terrace soils include a corresponding range of conditions which give the Fox and Plainfield series. The Fox soils correspond in color to the Miami soils.

In the dark upland group the soils developed under good drainage conditions belong to the Carrington series, and under poor drainage, to the Clyde series. In the terrace or old sedimentary group the Waukesha and Clyde series represent the well-drained and poorly drained soils respectively. The Clyde series includes dark depressions in the upland as well as some poorly drained terrace soils. All of the recent alluvium is classed in the Genesee series, although the Wabash series is represented to a small extent. The organic soils are mapped as Peat.

The surface soils in the Miami series are grayish brown to brown, and the subsoil is reddish brown or yellowish brown in the upper part and reddish brown below. The subsoil is heavier than the soil, and rather compact and tough. At a depth of 2 to 2½ feet it passes into a lighter, more friable material, this being stony and gravelly till only slightly weathered and carrying a high percentage of limestone material. In this series the surface soils are neutral or only slightly acid. The surface is undulating to strongly rolling and rough, and drainage is well established.

In the deep phase of Miami series the surface soils are brownish gray to grayish brown, and the subsoil is yellowish brown

and usually shows some rusty iron streakings and specks. The subsoil is heavy and tough to a depth of 36 to 48 inches, grading below into a more friable material which is moderately to strongly calcareous. The surface soils are in an acid condition. The topography is undulating to gently rolling, and the drainage is fairly good, but slower and not so perfect as with the typical Miami. The level phase of the silt loam has rather imperfect drainage.

The Coloma series is characterized by grayish-brown surface soils and a yellowish-brown light sandy subsoil. The unweathered parent material below depths of 2½ to 3 feet usually is light and sandy and carries little or no limestone material. The surface is undulating to strongly rolling, and the natural drainage is good to excessive.

The Rodman series is developed on the very gravelly parts of the moraines with very irregular and broken topography and the rougher parts of the terraces, where a shallow layer of brown soil has formed over the loose gravel deposits. The drainage is excessive.

The Fox series has grayish-brown to brown surface soils and a yellowish-brown to slightly reddish brown subsoils, heavier than the soils in texture and somewhat compact and tough in structure, resting upon stratified beds of gravel and sand at depth of 20 to 48 inches. The substratum contains a high percentage of limestone material. The surface soil is in an acid condition. The topography is level to gently undulating, and the drainage is good.

The surface soils in the Carrington series are dark brown to black and the subsoil is yellowish brown to brown. The subsoil is somewhat heavier and more compact than the soil to a depth of 24 to 48 inches, giving way below to moderately friable calcareous till like that underlying the Miami series. All free carbonates have been removed from the soil section, and the surface layer gives an acid reaction. The topography is gently rolling, and the natural drainage is good.

The types of the Plainfield series have grayish-brown sandy surface soils and a yellowish-brown sandy subsoil and substratum. The surface soils are in an acid condition, and no free carbonates occur in the soil section. The surface is level to undulating. The drainage is good to excessive.

The types of the Waukesha series correspond in their profile characteristics to those of the Carrington series except that the substratum beginning at depth of 24 to 48 inches is more distinctly sandy and gravelly, consisting of stratified beds of calcareous sand and gravel. The topography is level, and is characteristic of the smoother terraces and outwash plains.

The surface soils in the Clyde series are black, and the subsoil is gray to bluish gray mottled with yellow and yellowish-brown. The subsoil is a little heavier than the soil in texture, but is generally plastic in the heavier types, becoming more friable in the unweathered material reached at depths of 30 to 40 inches. The substratum of the Clyde soils is calcareous glacial debris like that under the Miami and Carrington series. The surface soils are not acid. The Clyde soils occur in flat and depressed areas in the uplands where a marshy or semiswampy condition existed. The Clyde series also includes dark poorly drained terrace soils having some sandy layers in the subsoil but of practically the same agricultural value.

The Genesee series includes brown to nearly black soils with gray mottled subsoils. They occur in alluvial plains of streams and are subject to frequent overflows. Small areas of light-colored soils were included. Both Genesee and Wabash soils were included in this classification. The type is quite variable.

The organic soils mapped as Peat range from black and finely divided to brown and coarsely fibrous.

Approximate are of different soils

	Acres	Per cent
Miami silt loam	81,024	36.3
Miami silt loam deep phase	39,552	
Miami silt loam level phase	9,856	
Clyde silt loam	41,280	11.5
Waukesha silt loam	3,200	9.2
Waukesha silt loam, deep phase	29,696	
Peat	28,032	8.1
Peat Shallow Phase	1,216	
Miami loam	3,136	7.2
Miami loam, gravelly phase	22,464	

Carrington silt loam	24,256	6.8
Fox loam	2,624	6.9
Fox silt loam, deep phase	18,746	
Fox lom	2,624	2.5
Fox loam, gravelly phase	6,272	
Rodman gravelly loam	7,232	2.0
Clyde clay loam	6,528	1.8
Fox fine sandy loam	3,648	1.0
Miami fine sandy loam	3,456	1.0
Genesee silt loam	6,976	1.9
Carrington loam	950	.9
Carrington loam, gravelly phase	2,048	
Waukesha loam	1,792	.7
Waukesha loam, gravelly phase	896	
Clyde loam	2,176	.6
Coloma fine sand	1,792	.5
Miami stony loam	1,664	.5
Plainfield fine sand	1,408	.5
Total	358,400	

CHAPTER II.

GROUP OF HEAVY SOILS

MIAMI SILT LOAM

Extent and distribution: The Miami silt loam with its several phases covers 130,420 acres or 36.1 per cent of the area and it is the most extensive and important type of soil in Walworth County. It is widely distributed and is found in every town in the county. The portion of the type considered as the typical Miami silt loam is described first and this is followed by a description of the two phases which are shown on the soil map. The typical soil covers 81,024 acres, the deep phase covers 39,552 acres, and the level phase 9,856 acres. The largest areas of the typical soil are found in the towns of Lima, Geneva, Spring Prairie, and La Fayette. The Miami silt loam is associated with a wide range of other upland soils and its continuity is also frequently broken by areas of low lying poorly drained soils.

Description: The surface soil of the Miami silt loam is a grayish-brown mellow silt loam 6 to 8 inches deep. This is underlain by material of about the same texture and a slightly yellowish brown color which in places changes to a slightly reddish brown material and extends to a depth of 12 to 18 inches. Below this depth it gives way to the subsoil proper, which is a reddish-brown compact silty clay loam grading at a depth of 18 to 24 inches into a friable gravilly or gritty loam or clay loam. Locally the material below 30 inches is rather gravelly, but the gravel is almost always mixed with considerable clay so that the subsoil is retentive of moisture. The subsoil of this type differs from the subsoil of the Miami silt loam deep phase in containing considerably more sandy and gravelly material, in having a more crumbly structure, and in being more thoroughly oxidized. The supply of organic matter in the surface soil is rather low, which accounts for the light color.

The surface soil is slightly gravelly in places and locally

contains some fine sand. The depth of the surface soil also varies somewhat with the irregularities in topography, and on many slopes the surface has been sufficiently eroded so that the reddish-brown subsoil is exposed. These reddish-brown spots are characteristics of the Miami silt loam, and are common in many cultivated fields. Some crystalline rock bowlders occur on the surface and through the soil section, but as a rule they are not present in sufficient numbers to interfere with cultural operations. Where they were originally most numerous they have in most cases been removed from the fields.

Included with the typical soil and shown on the soil map by the same color is a phase which differs somewhat from the typical soil. It is a gray to grayish-brown silt loam 8 to 10 inches deep underlain by a yellow or mottled gray and yellow compact silt loam or silty clay loam which passes at a depth of 18 to 24 inches into a brown or reddish brown compact gritty clay loam. At about 30 inches or more the subsoil usually changes to gravelly sandy clay or gravelly sandy loam. This variation from the typical soil was found most extensively in the vicinity of Elkhorn in the towns of Lafayette Sugar, Creek, Delavan and Geneva. It is here associated with the Miami silt loam deep phase and level phase and occupies slight knolls and swells. The surface is undulating to very gently rolling. The drainage is better than on the level phase but not as good as on the typical soil. The material forming this variation has practically the same origin as the typical soil and the deep subsoil is calcareous. The surface soil in places shows some acidity.

Topography and drainage: The surface ranges from undulating to gently rolling, and in some places it is rolling and slightly hilly. Owing to the uneven surface and the open character of the subsoil, the natural drainage is good. Water moves through the soil section freely, but there is sufficient clay present to make the soil retentive of moisture. Some of the type is subject to erosion, as indicated by the exposure of the subsoil on knolls and slopes and the formation of small, shallow gulleys. Where the wash from the slopes has accumulated along the lower slopes, the soil is considerably deeper than the average.

Origin: This type has been derived from glaciated limestone material ground from the underlying limestone. With this has been mixed a small proportion of material from the region of crystalline rocks farther north as evidenced by the small content of granitic gravel and stones. Although the material is mainly from limestone, the surface soil has been leached to a considerable extent and in many places is now in an acid condition. The deep subsoil, however, still contains considerable lime carbonate.

Native vegetation: The original forest growth consisted of several varieties of oak, hickory, and maple. Most of the merchantable timber has been removed, but there are still a few wood lots that contain saw timber. If properly conserved, these wood lots would furnish fuel for the use of farmers for a long time.

Present agricultural development: The Miami silt loam is one of the most important soils of Walworth County, and nearly all of it is included in highly improved farms. It is a good general farming soil and all of the general crops grown in the region are produced on this type. Corn, oats, barley, wheat, and hay are the most important crops. Sugar beets are raised to a considerable extent, and canning peas are grown successfully. This soil is probably better adapted to alfalfa than any other of the extensive types in the county, and a large majority of the alfalfa fields are located upon this type. This is doubtless due to the open character of the subsoil and to the fact that there is generally considerable lime in the deep subsoil.

The crop rotation most commonly followed consists of small grains, hay, and corn. The small grains are seeded with alfalfa or clover and timothy. Hay is usually cut for 1 and sometimes 2 years, then the land is broken, planted to corn, which generally occupies the land for one year, although on some farms it is grown for 2 years. The available manure is usually applied to sod before plowing for corn. When alfalfa is grown it occupies the land for 3 to 5 years, or as long as the stand is satisfactory.

Miami Silt Loam, Deep Phase

Extent and distribution: The Miami silt loam, deep phase, is found in several portions of the county, though in most

places it does not occupy areas of more than 5 or 6 square miles in one body. Some of the more important areas are in the northeastern part of Walworth Town, in the central part of Geneva Town, and in LaFayette, Richmond, Lima, and Sugar Creek Towns. This phase in the older glacial area occupies about 70 per cent of Sharon Town and extends over into the western part of Walworth Town. This is by far the most extensive development of the phase. This phase covers a total area of 39,532 acres.

Description: The surface soil of the Miami silt loam, deep phase, in its typical development consists of a brownish-gray, smooth, friable silt loam extending to a depth of from 10 to 12 inches, and becoming somewhat lighter in color in the lower part. The soil is remarkably free from gravel and coarse material, and very few bowlders occur on this type. The subsoil is a slightly yellowish brown silt loam passing at about 14 or 16 inches into a compact yellowish-brown or light-brown, smooth, compact silty clay loam. This extends to a depth of 36 inches, where it grades into a more porous, gritty, calcareous till, which is somewhat gravelly in places.

The surface soil is uniform in texture but varies slightly in color owing to the large accumulation of organic matter on some of the nearly level or slightly depressed areas. There is also some variation in the depth of the soil section over gravelly till. This may range from about 20 inches to 4 feet, with an average of about 3 feet. The areas where the depth to gravelly calcareous material ranges from 20 to 30 inches are similar to the typical Miami silt loam, but are too limited in extent to map out.

The large areas of the phase in Sharon Township are in the old glaciation. Here the surface soil to a depth of 8 to 10 inches consists of a brownish-gray, smooth, friable silt loam, rather low in organic matter. When dry the surface material has an ashen appearance. The surface is entirely free from gravel, only an occasional bowlder is found and the soil section contains very little sand. The upper subsoil consists of a yellowish silt loam which becomes heavier and grades into a silty clay loam at a depth of 14 to 16 inches, and this in turn becomes a silty clay at about 2 feet. At a depth of 3 feet or more the subsoil shows a slight mottling or streaking with rusty iron stains. The sub-soil is heavy, and compact, and

rather tough, and is almost entirely free from sandy and gravelly material. The tough silty clay loam to silty clay subsoil extends to a depth of 4 to 6 feet where it passes abruptly into unassorted gravelly sandy material. This gravelly material contains much lime, but it is less calcareous than the substratum of the typical Miami silt loam. Tests indicate that the entire soil section form the surface down to the gravelly material has varying degrees of acidity. The contents of organic matter varies slightly, being greatest along the bottoms of slopes and in slight depressions.

Topography and drainage: The surface is very gently undulating to gently rolling, and most of the slopes are long and smooth. As a rule the natural surface drainage is good. In a few places, however, where the surface is nearly level, tile drain can be established to advantage, and on a number of the gentle slopes tile drainge would be beneficial because of the heavy character of the subsoil.

The slopes along some of the stream courses in the old glacial area are more abrupt than typical. This variation is of limited extent and minor importance. It varies considerably from the typical soil.

Gravelly material comes closer to the surface in places and gravel is frequently found on the surface. In places erosion has removed surface soil and cut gullies in some of the hillsides.

Origin: This soil has been derived from glaciated limestone material. The portion found in the southwestern part of the county represents an old stage of glaciation, while the remainder was formed from the late Wisconsin drift. Over much of both of these glacial deposits there is an extremely silty covering which may be in part of wind-blown origin. The gravelly till material beneath the soil section in the deep subsoil contains considerable lime but the upper part of the soil section is usually somewhat acid.

Native vegetation: The native timber growth on this soil consisted chiefly of oak, maple, hickory, with some elm and cherry. Most of the trees suitable for saw timber have been cut but there is sufficient left in farm wood lots to supply fuel for farm use for a long time.

Present agricultural development: Practically all of this type is included in farms, and nearly all of it is highly develop-

ed. It is an excellent soil, and a good seed bed can usually be prepared without difficulty. The yields average well with those on the prairie land. The chief crops grown are corn, small grain, hay, sugar beets, and peas for canning. The large areas in Sharon Town are devoted chiefly to general farming and dairying and the chief crops are corn, small grains, and clover.

Barnyard manure is the only fertilizer generally used, although recent tests indicate that the soil responds well to commercial fertilizers containing phosphorus, as the soil is somewhat deficient in this element. Small amounts of nitrogen combined with the phosphorus also give excellent results. The crop rotation most commonly followed consists of small grain seeded to clover and timothy. Hay is cut for 1 or 2 years, and sometimes the land is pastured for one season before it is plowed for corn. Corn may be raised for 1 or 2 years, when the land is again sown to small grain.

Miami Silt Loam, Level Phase

The level phase of the silt loam is most extensive in the vicinity of Elkhorn. It occurs chiefly in the towns of Lafayette, Sugar Creek, Delavan, and Geneva. None of the areas are large, but in this region they are rather numerous and make up from 20 to 25 per cent of the total area of certain sections. The area covered by this soil amounts to 9856 acres.

Description: The surface soil of this phase is a mellow gray silt loam, about 8 inches deep, the lower part of which may be somewhat mottled. Below this depth it grades through 3 or 4 inches of yellowish or mottled yellow and gray silty clay loam into a subsoil of mottled yellow, plastic silty clay. The subsoil becomes strongly mottled with increasing depth, showing drab, gray, red, and yellowish mottlings below 24 inches and soft concretions of dark-brown iron-bearing material. The lower subsoil becomes decidedly plastic and impervious. Mottled gravelly sandy clay or sandy loam is found locally in the lower part of the 3-foot section, but the presence of this material does not appear to improve internal drainage to any marked extent.

The deep subsoil is quite calcareous.

A variation from this phase was found and included with the level phase and is shown on the map by the same color. It is confined largely to the town of Sharon in the southwestern

part of the county. Here it occurs chiefly as a gradation from the deep phase of the Miami silt loam to the areas of Clyde silt loam. The surface is flat or very gently sloping and the natural drainage is deficient. It varies from the level phase by being somewhat darker in color, more strongly mottled in the subsoil and somewhat deeper to calcareous material. The variation is cold and wet in the spring and usually late in warming up. The material has about the same origin as the deep phase of the Miami silt loam.

Topography and Drainage: The surface is flat or very gently undulating and the soil occupies a position intermediate between the Miami silt loam and soils of the Clyde series. In many low spots small areas of Clyde silt loam are surrounded by this soil. Because of its position and its heavy subsoil, the type has deficient natural drainage and it is cold, wet, and backward in the spring.

Origin: The material forming this soil has been derived chiefly from late Wisconsin glaciated limestone till, the same as most of the Miami silt loam, deep phase. Leaching has not been carried to as great an extent, however, and the lower part of this soil is highly calcareous.

Present Agricultural Development: All of the level phase is included in farms, and part of it is devoted to the raising of general farm crops. Yields, however, are rather uncertain and usually low. Because of its backward condition and rather poor drainage, the type is devoted chiefly to hay and pasture. The native growth on this soil consists chiefly of hickory, oak, some ash, and soft maple. This soil generally does not constitute entire farms and usually is associated with some higher lying, better drained land; it is therefore not difficult to utilize it in its present condition, since it supplies good pasture for the greater part of the year.

Fox Silt Loam

Extent and Distribution: The Fox silt loam occurs in small areas, in 14 of the 16 towns in the county, mainly, however, in the northern half of the area. The largest single area is in sections 17 and 20 in the town of Troy. The typical soil of this type covers an area of 6,016 acres, while the deep phase covers 17,536 acres and a poorly drained variation covers 1,216

acres additional. In all, the Fox silt loam with all its variations covers 6.7% of the entire county.

Description: The surface soil of the Fox silt loam consists of about 10 inches of light-brown floury silt loam which becomes a grayish brown when thoroughly dry. This grades through several inches of yellowish-brown or buff, compact silt loam into yellowish-brown silty clay at a depth of from 12 to 14 inches. This material is uniform and is comparatively free from coarse particles. Stratified sand and gravel is generally encountered at depths ranging from 18 to 36 inches.

Topography and Drainage: The surface of this type is flat or very slightly undulating. Pot holes and terrace slopes form variations in the topography in a few places. On some slopes the surface soil has been removed by erosion, thereby exposing the heavier subsurface material, which accounts for the soils being heavier on these slopes than elsewhere. In places the gravelly subsoil is also exposed on these slopes. The underlying coarse material insures good drainage.

Origin: The type is derived mainly from limestone material ground up by glacial ice and modified to some extent by the action of water. It occurs on outwash plains or stream terraces deposited in their present position largely by the action of streams coming from beneath the glacier. The deep subsoil contains considerable limestone gravel but from the surface this lime has been mostly leached and the soil is now slightly acid in places.

Native Vegetation: The native forest growth on this land consisted chiefly of maple, oak, some hickory and various other hardwoods. Nearly all of this timber has been removed and this land placed under cultivation and is now in highly improved farms.

Present Agricultural Development: This soil can be classed with the types of the highest agricultural value in the county. The chief crops grown are corn, oats, barley, clover and timothy, with a gradually increasing acreage of alfalfa.

The gravelly material in the subsoil is calcareous, but the surface soil in places has become leached to a great extent and acidity has developed. This acidity is seldom strong, and in many places alfalfa can be grown without the use of lime. However, tests should be made on each field before alfalfa is grown, and lime applied where needed.

The methods of farming on this type are practically the same as on the Miami silt loam.

Fox silt loam, deep phase: Fox silt loam, deep phase, has an average depth of 12 inches and consists of a gray to brownish-gray floury silt loam. This grades through a zone of 3 to 6 inches of compact silt loam into a compact yellowish-brown silty clay, which continues without change to a depth of over 3 feet. Stratified sand and gravel are generally encountered at depths of 40 to 60 inches, but are seldom reached within the 3-foot soil section.

There are some minor variations in the soil, chiefly around potholes where the surface soil is somewhat more loamy than typical and not quite so deep. Around some of these places gravel occurs in small quantities on the surface.

The Fox silt loam, deep phase, is confined almost entirely to the north half of the county and occupies a total area of approximately 17,536 acres. The largest tracts occur in Richmond, La Grange, Troy, and East Troy Towns. The village of Troy Center is situated on an area of about 2 square miles of this soil.

The surface is for the most part level, but locally it is somewhat irregular from the presence of kettle basins and potholes. In some places these are sufficiently numerous to give the phase a slightly rolling topography. Because of the underlying sand and gravel, the drainage is usually fair to good, but where the heavy layer is deepest the drainage is slightly deficient, and in such places a slight mottling may occur in the lower subsoil.

This soil has been derived from glacial material, chiefly from ground-up limestone which was deposited in the form of outwash plains or stream terraces. The deep subsoil is not acid, but the surface soil in places has developed a slight degree of acidity.

The phase was originally in forest consisting chiefly of maple, hickory, and oak. Most of it has been cleared and placed under cultivation and is now in highly improved farms. It may be classed as one of the important agricultural soils of the county. It is devoted chiefly to general farming and dairying, and the principal crops are corn, small grains, clover, and alfalfa. The system of farming is practically the same as on the Miami soils, and the yields are very similar. Farms on this soil have a selling value of $150 to $200 an acre.

The surface soil of a variation in the deep phase consists to a depth of 6 to 8 inches of dull-gray, friable silt loam. The subsoil is a light-gray, whitish, or mottled yellow silt loam, passing at 12 to 18 inches into plastic, mottled, gray or yellow silty clay, which at a depth of about 3 feet grades into calcareous stratified material or into mottled gray or yellow calcareous silt loam.

This variation is confined almost entirely to the northern half of the county and is most extensive in the towns of Troy, Sugar Creek, and Richmond. Two of the largest areas are in sections 6, 7, and 8 of Richmond Town. None of the areas exceed one-fourth of a square mile in extent, and many of them cover only a few acres. The poorly drained variation is associated chiefly with the typical soils of the Fox series and it covers a total area of 1,216 acres.

Included with the variation are some areas of loam, in which the surface is a gray or light brown loam, about 8 or 10 inches deep, underlain by a subsoil of light-gray or slightly mottled yellow and gray sandy loam or loam, which changes at 18 to 24 inches to a compact impervious sandy or silty clay. Beds of stratified sand and gravel are reached at a depth of 36 inches or more. The loam occurs in the northern half of the county in patches of a few acres to forty acres. It is associated with the Fox series and may be considered as being a poorly drained variation in the Fox loam. In places it is associated with Clyde silt loam, but is lighter colored than the Clyde and occupies a slightly higher elevation on outwash plains. The surface is level or nearly level, and the natural drainage is deficient.

The surface of the variation is level and is slightly lower than the typical Fox soils with which it is associated. Because of this slightly lower position and the heavy nature of the subsoil, the drainage is somewhat deficient. The chief difference between this and the typical Fox silt loam is that it has poorer drainage, and consequently a strong mottling in the subsoil.

The original forest growth on the poorly drained area consisted chiefly of elm, soft maple, hickory, and some oak. Most of the merchantable timber has been removed, but there are a few scattering trees in places.

Most of the soil is under the plow and used for corn, hay,

and small grains. The part not cultivated is mainly in permanent pasture or meadow. The soil is rather cold and wet in the spring and becomes dry and hard in the early part of the summer. It is quick to show the effects of a dry spell, since the water does not move freely through the compact subsoil. Crop yields are somewhat lower than on the typical Fox soils. Better drainage is usually the most important need.

Carrington Silt Loam

Extent and distribution: The Carrington silt loam is one of the important and extensive types in Walworth County, covering over 24,000 acres. It occurs in rather large areas in several localities. A considerable prairie in the southern part of Spring Prairie Town, extends over into the eastern part of Lafayette Town. A second prairie region is in Delavan Town, and a third in Linn and Bloomfield Towns. Other smaller tracts of the type occur in various parts of the county.

Description: The surface soil of the Carrington silt loam consists of a dark-brown to a black silt loam which grades into a chocolate-brown silt loam and extends to a depth of 10 to 14 inches. It has a large supply of organic matter, is smooth and friable in structure, and contains very little material as coarse as a fine sand. The subsoil consists of a brown or yellowish-brown silty clay loam which becomes somewhat heavier with depth and in places lighter in color at about 2 feet. The lower subsoil is generally a clay or silty clay loam and grades at 30 to 36 inches into yellowish-brown gravelly sandy clay or gravelly clay loam. In many places there is a sharp line between the extremely silty material and that which contains coarser particles of sand and gravel. The areas of section 6 of Sharon Town and section 3 of Darien Town differ from the typical in having greater depth to the calcareous substratum, being about 4 feet. These areas are in the old glaciation.

There is some variation in the soil. On some of the slopes and knolls the color is lighter than typical, being more brown than black, the soil may be somewhat loamy and slightly gravelly, and the underlying gravelly clay material is nearer the surface than typical. This variation is due to the partial removal of the surface soil by erosion. Along the lower parts of slopes there are local accumulations of wash from the higher

land, and as a result the soil is somewhat deeper than usual and may contain more organic matter than typical. Such variations, however, are of small extent, and the slopes that are subject to destructive erosion are not numerous on this type.

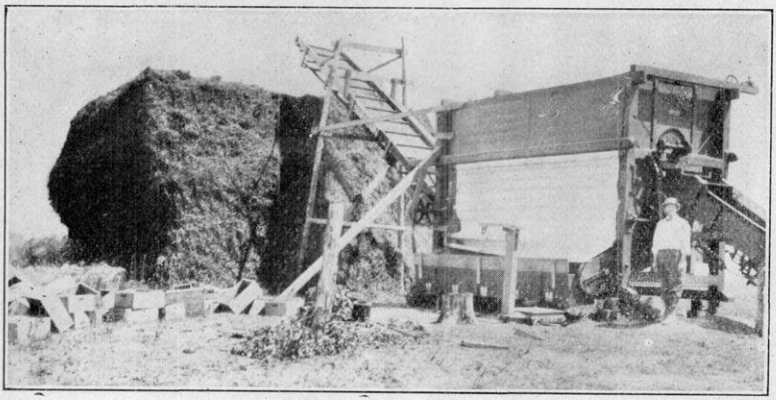
Topography and drainage: The surface ranges from level or nearly level to gently rolling. The natural surface drainage is adequate and the water moves through the soil in a satisfactory manner, but the drainage can hardly be considered rapid. In fact there are a few places with nearly level surface where tile drains would be beneficial.

Origin: The Carrington silt loam has been formed mainly from limestone material worked up by the most recent glaciation. The extremely silty covering of the type may be due to the presence of wind-blown material deposited over the unassorted glacial debris. The large content of organic matter in the soil is due to the growth and decay of a rank prairie vegetation. The gritty lower subsoil contains considerable limestone material in the form of small pebbles, but the surface material has been leached to such an extent that practically all of the lime carbonate has been removed and the soil is now acid. The degree of acidity is somewhat variable, but all portions of the type show some acidity. The gravelly portion of the deep subsoil is quite calcareous, containing a considerable amount of lime rock fragments.

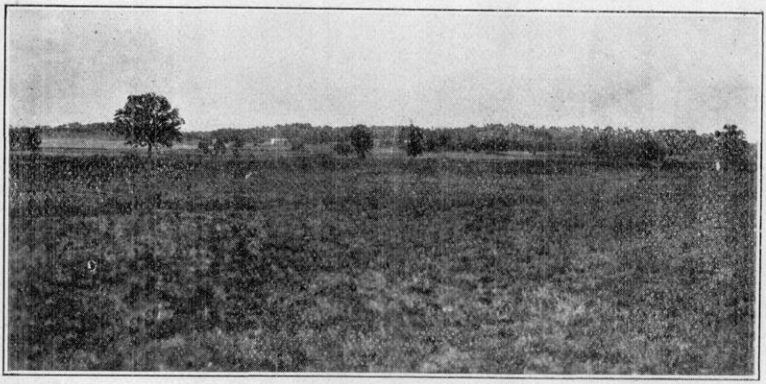
The portion of the type in the southwestern part of the county has been formed largely through the action of glacial ice of a much greater age than that which acted upon the remainder of the county. This portion of the type has therefore been subjected to a longer period of weathering and it is more thoroughly leached than is the material derived from the more recent glacial drift.

Native vegetation: This is a prairie soil and the native vegetation consisted largely of prairie grasses, with a fringe of timber along the water courses and bordering other types.

Present agricultural development: Carrington silt loam is one of the most highly prized agricultural soils in Walworth County. Probably 95 per cent of the type is in improved farms and is highly developed. It is devoted to dairying and general farming, corn being one of the most important crops. The most common rotation consists of corn for 2 years, followed by small



Peas are grown to some extent in Walworth county. This is a view of a viner. These are located in the pea growing sections and greatly reduce the hauling distance from the fields in which the peas are grown. The vines are stacked and later fed to stock.



View showing level surface typical of the Fox and Waukesha soils.

grain, usually for 2 years, when the land is seeded to clover and timothy. Hay is cut for 1 or 2 years before the land is again plowed for corn. Stable manure is usually applied to the corn ground. Because of the extremely silty nature of the soil, it works up readily into a mellow seed bed. The difficulty experienced in getting satisfactory stands of clover is attributed chiefly to the acid condition of the soil.

WAUKESHA SILT LOAM

Extent and distribution: The typical Waukesha silt loam is not extensive. The largest tract occurs in the town of Spring Prairie. Smaller patches are found in Troy, East Troy, and Walworth Towns. Most of these areas are small, and many of them consist of long narrow belts in slight depressions or on gentle slopes. It covers a total area of 3,200 acres. The deep phase, described later, is much more extensive.

Description: The surface soil of the Waukesha silt loam consists of dark-brown to black silt loam grading below 6 or 8 inches into chocolate-brown compact silt loam which extends to a depth of 8 to 12 inches. The subsoil is light-brown silty clay, grading into a gritty silty clay or compact sandy clay. At depths of 24 to 36 inches this passes abruptly into beds of sand and gravel. The soil for the most part is uniform, but in a few places the surface soil contains more fine and medium sand than typical. The depth to the sand and gravel is variable, but is seldom less than 18 inches. Where it is 3 feet or more the land has been classed with the deep phase of Waukesha silt loam.

Topography and drainage: The typical Waukesha silt loam occurs as outwash plains or stream terraces. The surface is level or very gently undulating. Because of gravel and sand in the lower subsoil, the natural drainage is good. In places the type occurs on the border of potholes or on terrace slopes. In such cases the soil is usually lighter in color than typical, and because of erosion there may be some gravel on the surface. In a few places the type occurs in long, narrow, shallow depressions through which water flows during wet seasons.

Origin: The material forming the type has been derived in part from glaciated limestone material which has been reworked by the action of water. The beds of gravel are largely of limestone material, and the lower part is not acid. The sur-

face of the soil, which is extremely silty, may be in part of windblown origin. Its dark color is due to the accumulation of organic matter. This surface has been thoroughly leached and is now in an acid condition.

Native vegetation: The type is practically all prairie land and the native vegetation was largely prairie grasses. There was frequently a fringe of timber along some of the water courses and bordering other types of soil but by far the greater portion of the type was treeless.

Present agricultural development: Waukesha silt loam is classed with the land of high agricultural value in Walworth County. The type is almost entirely under cultivation and included in highly improved farms. It is used for the production of corn, small grains, hay, and some special crops. Potatoes are grown to a considerable extent on the area in Spring Prairie Town, and some onions are also grown with success. Because of the underlying beds of gravel and sand, the type is somewhat better drained than the deep phase and can usually be worked a little earlier. When the need for lime is supplied, alfalfa gives satisfactory yields and is gradually being grown more extensively on this soil. The use of lime is the first and most important step in the improvement of this type. Phospate fertilizers give excellent results and can be used with profit on all crops.

Waukesha Silt Loam, deep phase: The surface soil of Waukesha silt loam, deep phase, consists of 10 to 14 inches of dark-brown to a black silt loam. The subsoil is a deep-brown or chocolate-brown silty clay loam, which becomes heavier and more compact with depth until at 24 inches it generally is a yellowish-brown silty clay. At about 30 inches some gritty material occurs in places in the subsoil and at depths of 40 to 60 inches beds of sand and gravel are reached. The phase as a whole is uniform, except for a slight variation in depth to the sand and gravel and a slight mottling here and there in the lower subsoil.

The deep phase of Waukesha silt loam has a total area of approximately 29,000 acres and with the typical soil it covers 9.3 of the county. It is an important soil in Walworth County. It occurs chiefly in three areas, one in Walworth Town, one in Darien and Richmond Towns, and one in LaGrange and Sugar Creek Towns. A number of smaller patches are scattered

throughout the western half of the county. Comparatively little of this phase occurs in the eastern half of the county.

The surface of the Waukesha silt loam, deep phase, is level or only slightly undulating. Because of the deep heavy soil material and the level surface, the natural drainage, while fair, is not quite as free as that of the typical soil. In some localities tile drains might be beneficial, especially where the soil is deepest over the underlying sand and gravel.

The material forming this type was deposited by water as terraces or outwash plains. The gravelly substratum was derived largely from the underlying limestone but the extremely silty surface covering may in part be wind-blown. The dark color is due to the accumulation of organic matter under a native vegetation consisting chiefly of prairie grasses. The deep subsoil is calcareous but the lime has been leached from the surface soil and practically all of the type is more or less acid and needs lime.

The Waukesha silt loam, deep phase, is one of the most highly prized soils of Walworth County, and includes some of the finest farms in the region. The leading crops are corn, small grains, and hay. Corn is one of the most important crops and does better on this soil than on most of the other soils in the county. The small grains yield well, but usually the quality of the grain is not so good as that raised on the light-colored upland soils. Sugar beets are also grown with good results. Alfalfa can be successfully raised if the soil is limed, and the acreage is gradually increasing. Corn yields from 40 to 70 bushels per acre; oats, 50 to 65 bushels; barley, 35 to 50 bushels; timothy and clover, 1½ to 2 tons of hay; and sugar beets, 13 to 18 tons per acre. Other special crops grown are cabbage, which yields 12 to 14 tons; potatoes, which yield from 125 to 200 bushels; and tobacco, with yields ranging from 1,000 to 1,600 pounds per acre. Tobacco is usually grown on the same field for years, and most of the manure is applied to the tobacco patch at the expense of the rest of the farm.

Chemical Composition and Improvement of Heavy Soils in Walworth County

These soils are very similar in the texture, and structure of the surface and the upper portion of the subsoil section. They differ chiefly in color. The Waukesha and Carrington silt

loams are dark colored prairie soils, and both are high in organic matter and nitrogen. Miami and Fox silt loams are light colored and are timbered soils low in organic matter. The types are so closely related that with few exceptions methods for the improvement of one will apply to the others.

The four elements of plant food with which the farmer is most concerned in his farming operations, and the ones which are the most apt to be deficient are nitrogen, phosphorus, potassium and lime or calcium. He should know the part which each plays in the development of the plant, and what are the best methods of maintaining an adequate supply in the soil.

The soil has been leaching for a large number of years, and has lost much of the lime which it may have contained. Varying degrees of acidity have developed over the entire region. The loss of lime from the soil is caused by two distinct factors, both of which are important. Crops require lime in their growth. A 5 ton crop of alfalfa requires 185 pounds of lime and 2 tons of red clover removes 61.6 pounds. A much larger amount is removed by leaching each year and these losses must be made up by the application of lime in order to maintain the fertility of this soil.

Tests show that the subsoil, especially of the deep phase of Miami silt loam is frequently deficient in lime to a depth of thirty-two inches or more. The deficiency frequently extends down to where fine gravel and coarse sand is found in the subsoil.

While it will be seen from tests that by far the greater part of this land shows some degrees of acidity it does not mean that all the land is in immediate need of lime. Where such crops as alfalfa, sugarbeets, tobacco, peas, cabbage and other garden crops are grown and where the acidity is medium from 2 to 3 tons per acre of ground limestone may be used with profit. Where a liberal supply of manure is available the need for lime will not be so great. The second application which may be needed after 4 or 5 years will be less than the first.

Where such crops as corn, clover and oats are grown with manure once during each rotation a smaller amount of lime will be needed. On parts of the farm where manure cannot be applied the lime can be used with profit on such soils and may be actually necessary for economic production. The

greater need will usually be on the higher places, rather than on the lower slopes.

It has been quite definitely established that the need for lime in these soils runs practically parallel with the need of phosphorus. The use of lime alone will not make enough phosphorus available, and the use of a phosphate fertilizer will not supply the lime requirements of the soil. Either lime alone or acid phosphate alone will give increased yields, but neither alone will give as great an increase nor as profitable an increase as when both are supplied. In the improvement of these lands, therefore, provision for the use of both lime and a phosphate fertilizer should be made.

Phosphorus exists in all soils in small amounts. Many of the best types in the state contain only 1,200 pounds to the acre eight inches deep, and this is in a form which becomes available to crops very slowly. Phosphorus is constantly being lost from the farm in crops, milk and in the bones of animals sold. It is well understood that when grain, hay, potatoes or other cash crops are sold, this element is removed from the farm. This element cannot be supplied from the air and in the long run the loss must be made up through additions of phosphorus fertilizer in some form.

Ten samples of Waukesha silt loam from Southeastern Wisconsin gave an average of 1,408 pounds of phosphorus per acre. In 16 samples of Miami silt loam the average amount of phosphorus present was 1,057 pounds per acre. The lowest amount found in any of the samples was 800 pounds per acre. The number of pounds of phosphorus in the soil however, cannot be taken to indicate the immediate need for phosphate fertilizer. The system of farming followed, crops grown, type of soil, and conditions relative to the need for lime are all important factors in determining the need for phosphorus. It should also be borne in mind that where soils are acid the amount of phosphorus which they do contain is not so readily available to plants as in soils which are not acid.

On good upland soil where dairying or general farming is practiced the use of 200-300 pounds of 16 per cent acid phosphate or 75-100 pounds of 44 per cent super-phosphate to the acre every four or five years will maintain the phosphorus supply. If much grain, potatoes or other crops are sold, more phosphate should be used.

On a farm at Elkhorn in Walworth County an application of one hundred pounds per acre of treble superphosphate (44 per cent) on corn gave a yield of 15,570 pounds of silage while on the untreated plot the yield was 13,335 pounds per acre. In a test on the Station Farm at Madison, on the Miami silt loam soil a phosphate fertilizer applied at the rate of two hundred pounds per acre on oats gave a yield of 93.8 bushels while the untreated yield was 70.4 bushels. This was on land where the fertility was quite high. In another case where 500 lbs. of 16 per cent acid phosphate per acre was applied to prairie land which received both manure and limestone the yield of alfalfa was nearly doubled. In some of these cases the increase is small but it should be kept in mind that the fertilizer left over in the soil will be of considerable value to the following crop, especially clover.

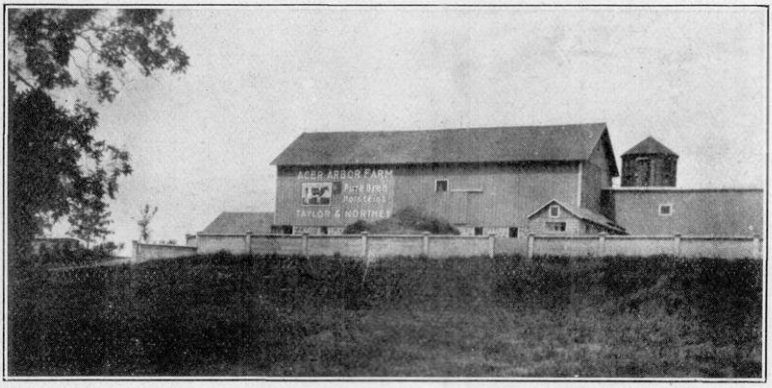
On soils relatively low in fertility somewhat more phosphate should be used at first. This is especially true of the dark prairie soils which have grown corn or small grain a long time without the use of manure or other fertilizer.

If considerable amounts of bran or cottonseed meal are fed, which are relatively high in phosphorus, the supply of this element may be maintained. It would usually be necessary to feed at least one-half ton of bran or cottonseed meal to each cow on a dairy farm per year to maintain the phosphorus supply of the soil. Since comparatively few farmers do that some phosphate fertilizer should be used.

Potassium exists in these soils in large amounts, but in relatively unavailable form. Chemical analyses show that they often contain from 30,000 to 40,000 pounds an acre eight inches, while these same soils will contain only one-eighteenth as much phosphorus. On most soils of fairly heavy texture, when live stock is maintained, and the manure carefully used so there is considerable actively decomposing organic matter in the soil, a sufficient amount of potassium will become available from year to year to supply the needs of general farm crops. There are some crops that need relatively large amounts of potassium such as potatoes, tobacco and cabbage and they will often be benefited by some addition of potash in the form of commercial fertilizer.

Nitrogen is chiefly responsible for the dark green, healthy color and rapid growth of corn or other crops on well manured

The difference in the growth of corn in this view is due to the fact that one side of the field received the drainage from a barn yard near and is thus fertilized with liquid manure, while the other side of the field received no fertilizer. Usually the drainage water from the barn yard is lost.



Barn yard with concrete retaining wall which is used to help conserve the barn yard manure.

land. It is important to have sufficient amounts in the soil, but when in excess it is detrimental for some crops. The quality of the grain may be injured by too much nitrogen. When the grain lodges the kernels do not fully mature.

Virgin soils contain large amounts of nitrogen but if they are cropped continuously to such crops as corn, oats and timothy without the addition of fertilizer material containing nitrogen the nitrogen supply is gradually used and the yields are reduced.

The supply of organic matter and nitrogen in the prairie soils is considerably higher than in the light colored timber soils. Eight soils tested from the Waukesha silt loam contained an average of 4,500 pounds of nitrogen in the surface eight inches per acre. Carrington silt loam will average about the same. This amount is considered a very good supply. A question of importance in connection with the nitrogen of this soil, however, is its availability to plants, and in the soils which have been under cultivation for a long number of years, this nitrogen is somewhat inert, and when in this condition, decaying vegetable matter, green crops, or manure plowed under will give a more readily available supply of nitrogen.

The clover, alfalfa, peas and beans have bacteria on their roots that take the free nitrogen from the air and store it in the plant roots. This is the cheapest method of obtaining nitrogen and one which the farmers should use to the fullest extent. On the ordinary dairy farm at least one-fourth of the land under cultivation should be seeded to clover or alfalfa. This should be fed to stock or plowed under as green manure to insure keeping up the supply of nitrogen and organic matter.

A rotation with a legume plowed under will secure nitrogen and reduce danger from diseases, and when supplemented with phosphorus and potassium fertilizers the legumes thus treated will take the place of manure, which can then be used for other crops on the farm.

Certain crops such as tobacco, potatoes and vegetables are grown by farmers who do not keep much livestock and who do not rotate these crops with legumes. This is not a good practice. See chapter on Agriculture for more information on farm practices and types of farming.

CHAPTER III.

GROUP OF LOAMS AND FINE SANDY LOAMS

MIAMI LOAM

Extent and distribution: The typical Miami loam is confined chiefly to the towns of East Troy, Troy, and Lyons, although some patches occur in other parts of the county. Only a few areas contain more than a quarter section, and the total area covers 31,136 acres. The gravelly phase of this type is much more extensive than the typical soil. The gravelly phase covers 22,464 acres which makes a total of 7.2% of the county covered by the Miami loam and its gravelly phase.

Description: The surface soil of the Miami loam consists of a brown or light grayish friable loam extending to a depth of 6 to 8 inches. This is underlain by material of about the same texture and somewhat lighter color. At 14 to 18 inches this material passes into reddish-brown sandy clay or gritty clay loam, which rests upon gravelly till at a depth of 24 inches or more.

The type is somewhat variable and the texture of the surface may range from a heavy sandy loam to a light silty loam. The subsoil is looser and more open than the subsoil of the silt loam and is also more variable, in places containing considerable sandy material. However, it contains enough clay to make it retentive of moisture.

Topography and drainage: The surface ranges from undulating to strongly rolling, with numerous knolls and ridges. Some of the slopes are rather steep, but the most of the type would be classed as gently rolling. Because of the surface features and the open structure of the subsoil the type is well drained. The steeper slopes are somewhat subject to erosion, but not more so than on the Miami silt loam.

Origin: This soil has been derived from glacial material ground largely from the underlying limestone by glacial ice. The subsoil contains much lime carbonate, chiefly in the form

of small pebbles and powdered rock, but the surface soil has been leached to a large extent and over a considerable part of the type an acid condition has developed. The degree of acidity ranges from slight to medium according to the Truog test. There are numerous places where tests show no acidity at all.

Present agricultural development: The type originally was in forest, chiefly of oak, hickory, and maple. By far the greater part is under cultivation and is used for a wide range of crops, including corn, oats, barley, rye, soy beans, clover, alfalfa and timothy. Clover and alfalfa have been more uniformly successful on this type than on most other soils of the county. This is due chiefly to the fact that the soil contains considerable lime carbonate and is also well drained. The system of farming followed, including crop rotation, cultivation, and fertilization, is practically the same as on the Miami silt loam.

Miami loam, gravelly phase: The gravelly phase of the Miami loam varies in texture. It is mainly a brown gravelly loam with a deep-brown or reddish-brown, tough, gritty clay loam subsoil, which carries considerable gravel and passes at depths of 18 to 24 inches into gravelly or somewhat sandy calcareous till. The texture of the surface soil ranges from a gravelly sandy loam to a gravelly silt loam, and in some places where the surface has been eroded the exposed surface is a gravelly clay loam. A few small areas that are practically gravel free are included with the type.

The Miami loam, gravelly phase, is found in every town in the county. The smallest area is in Sharon Town, and the most extensive occurrence in Richmond, Sugar Creek, and Lafayette Towns. The surface ranges from rolling to broken and hilly, and in places the slopes are rather abrupt. Over most of the type, however, modern farm machinery can be used. Because of the uneven surface features and the loose character of the subsoil, the natural drainage is good and sometimes excessive.

The material forming this soil was worked up chiefly from the underlying rock by glacial ice and formed into terminal and recessional moraines. The type contains a very large proportion of limestone material, and the subsoil is very high in carbonates. The surface soil is seldom acid and for this reason is well suited to the growing of clover and alfalfa.

The native timber consisted chiefly of oak and hickory. There

are still a number of wood lots remaining, but most of the merchantable timber has been cut.

The greater part of this type is in improved farms, but considerable areas are kept for permanent pasture because of the uneven surface and rather steep slopes. Where it is farmed the general farm crops of the region are grown. These include corn, small grain, and hay. Alfalfa is grown on this soil and does very well because of the large content of lime. The rotation and methods of cultivation followed are similar to those practiced on the Miami silt loam. Care should be taken to keep the steep slopes covered with growing crops as much as possible, and where there is danger of erosion the land should be kept in permanent pasture.

Miami Fine Sandy Loam

Extent and distribution: The Miami fine sandy loam is confined chiefly to the northern row of towns. It is of rather limited extent, occupying a total of about 5 square miles. It is closely associated with other soils of the Miami and Fox series, and usually occurs in small irregular tracts.

Description: The Miami fine sandy loam has a surface soil of brown or brownish-gray fine sandy loam extending to a depth of 8 to 10 inches. This is underlain by material of about the same texture, although somewhat lighter in color, which grades at 18 to 24 inches into reddish-brown loam, sandy clay, or clay loam. The lower subsoil is generally more or less gravelly below 30 inches. The type as a whole is somewhat variable but none of the variations were found to be of sufficient extent to warrant making a phase on the map.

Topography and drainage: The type occurs chiefly on knolls, drumlins, and slopes and the surface ranges from gently sloping to rolling and in some places hilly. Because of the surface features and gritty subsoil the natural drainage is good.

Origin: This soil has been derived from glaciated limestone material which still contains considerable lime. The surface soil has been leached to some extent and in places is in an acid condition.

Present agricultural develpoment: The original forest consisted chiefly of oak and maple. The crops grown most extensively at present are rye, oats, barley, clover, and alfalfa.

Soy beans and potatoes and some peas and melons are raised. Cucumbers are grown as a special crop in some localities.

This soil warms up early in the spring, is easy to cultivate responds well to fertilizers, and is considered a fair soil. It is better adapted to truck crops than to general farming, however, and where situated so that transportation is satisfactory, it should be devoted to this line of farming.

FOX LOAM

Extent and distribution: The Fox loam occurs in small areas rather widely distributed in East Troy, Troy, and LaGrange Towns. The typical soil covers 2,624 acres and the gravelly phase described under this same type name covers 6,272 acres. Taken all together the type, with the phase included, covers 2.5% of the county.

Description: The Fox loam consists of about 8 inches of grayish-brown loam, underlain by light-brown to yellowish-brown loam, which changes at about 18 inches to a compact yellowish-brown clay loam. Stratified sand and gravel generally occur at a depth of 24 to 30 inches. The surface soil is somewhat variable and ranges in texture from silt loam to fine sandy loam. Wherever these variations were extensive enough they were separated and mapped with the type to which they belong.

Topography and drainage: The surface is level or very gently undulating, except in a few places where it is gently rolling, owing chiefly to potholes and terrace slopes. Because of the underlying coarse material, the drainage is good.

Origin: The Fox loam is an alluvial soil and was practically all deposited by water action in the form of outwash plains or stream terraces. The parent material was largely limestone but because of the action of water much of the lime has been leached out and the surface soil is sometimes found to be acid. The deep subsoil however, is usually calcareous and contains lime.

Present agricultural development: Practically all of the Fox loam is cleared and under cultivation and included in improved loams. The uncleared land is in forest, chiefly of maple, oak and hickory. The chief crops grown are corn, oats, rye, clover, and timothy. Alfalfa also does well on this soil because the underlying material contains much limestone. The methods of cultivation, fertilization, crop rotation followed are practically

the same as on the Fox silt loam, and the methods for the improvement of that type will apply equally well to this soil.

Fox loam, gravelly phase: The Fox loam, gravelly phase, is rather variable in texture, but is consistently gravelly both on the surface and through the soil, with the exception of a few small areas north of East Troy where the surface is free from gravel. The surface soil generally is a brown gravelly sandy loam or gravelly silt loam, extending to a depth of about 8 inches, underlain by a more or less gravelly subsoil, heavier in texture than the surface soil and ranging from a compact loam to a silty clay loam. Beds or loose porous sand and gravel are reached at depths of 18 to 30 inches.

The Fox loam, gravelly phase, occurs chiefly on slopes bordering lakes and streams, on slopes bordering potholes and various other depressions. The surface is irregular but seldom steep enough to interfere with the use of modern farm machinery. Because of the sloping nature of the surface, erosion has removed part of the surface soil in many places, leaving the heavier subsoil exposed. The natural drainage of the surface and subsoil is good and in places excessive.

The material forming this type has been derived from glacial debris which was reworked and deposited by streams as outwash plains and terraces. The gravelly material consists largely of limestone, and consequently the subsoil is never acid and the surface soil is seldom acid.

The native growth consists chiefly of oak, with some hickory and a little maple. Probably half of the phase is used for crop productions while the remainder is in forest or permanent pasture. The crops grown are the same as those produced on other soils of the region. The yields, however, are somewhat lower than those obtained on the loam and silt loam types. Alfalfa is probably the most promising crop because of the abundance of lime in the soil. In addition, alfalfa forms a protecting cover that helps to prevent erosion.

FOX FINE SANDY LOAM

Extent and distribution: The Fox fine sandy loam in its typical development is confined to the northern half of the county and is located mainly in LaGrange, Troy, and East Troy Towns, the largest area being in sections 11, 12, 13, and 14 in the town of LaGrange. Areas of medium texture which

approach a sandy loam occur in sections 1, 19, 20, 21, 28, 31 and 32 of Troy Town and sections 6 and 21 of East Troy Town. The type covers a total area of 3,648 acres or about 1% of the entire county.

Description: The surface soil of the Fox fine sandy loam is a dull-brown fine sandy loam to sandy loam, 8 inches deep. The subsoil is a yellowish or light-brown fine to medium sandy loam which grades at 20 to 24 inches into compact sandy loam or sandy clay. This material may continue to depths of more than 36 inches or it may pass into stratified sand and gravel within the 3-foot section. The type varies in texture and in places consists of a loamy fine sand or medium sand underlain by an upper subsoil of about the same texture, which grades into the heavier subsoil before the beds of sand and gravel are reached.

A variation included with this type consists of a surface soil of brown or grayish-brown sandy loam, with an average depth of 12 inches, and a subsoil of mottled yellowish and grayish sand, which extends to depths of 5 to 7 feet, where it is underlain by dense, heavy, calcareous clay having a pinkish or drab color mottled with yellow and gray. This heavy clay is similar in texture and structure to the subsoil of the Superior series of soil as found in other sections of the state. The depth to the heavy clay is variable but is seldom less than 4 feet. This variation occurs chiefly as slight swells and low knolls associated with soils of the Clyde series in the towns of Whitewater and LaGrange. The surrounding land is for the most part poorly drained and low. This soil occurs as slightly better drained areas, and although lying somewhat higher than the adjoining land, its drainage is somewhat deficient.

Topography and drainage: The surface of the typical Fox fine sandy loam is generally level, but locally it is slightly undulating. Where the type is lightest in texture it has in places been influenced slightly by wind action. Potholes are rather numerous and tend to make the surface irregular where there are several close together. Because of the texture of the soil and its underlying coarse material, the natural drainage is good.

Origin: The material giving rise to this type is of alluvial origin. It was deposited in its present position largely by streams coming from beneath the great ice sheet and occurs as

outwash plains or stream terraces. Most of the material has come from the grinding up of the underlying limestone by glacial ice, but has to some extent been modified by the action of water.

Native vegetation: The type was originally forested land and the tree growth was chiefly maple, hickory and oak. Practically all of the timber has been removed and the soil placed under cultivation.

Present agricultural development: Practically all of it is improved and devoted to the production of all farm crops suited to the region. The soil is especially well adapted to truck crops. It is easy to cultivate, warms up early in the spring, and responds readily to fertilization.

Most of the sandy subsoil variation near Whitewater is under cultivation and devoted to general farming and truck crops. It is best suited to the growing of truck crops and is so situated that it could well be used for gardening.

CARRINTON LOAM

Extent and distribution: The Carrington loam is of limited extent in Walworth County. It is found chiefly in the northwestern part of the county associated with Carrington silt loam. The typical soil covers an area of only 950 acres while the gravelly phase covers an area of 2,048 acres.

Description: The surface soil of the Carrington loam has an average depth of 10 inches and consists of dark-brown loam which contains considerable organic matter. The upper subsoil is a chocolate-brown loam which becomes yellowish brown at about 16 to 18 inches and grades into a sandy clay loam at about 20 inches. This gritty subsoil extends to a depth of more than 3 feet. Small quantities of gravelstones and occasional bowlders are found in places on the surface. The subsoil may also contain considerable gravel and stones.

This type is somewhat variable and ranges in texture from fine sandy loam to silt loam. Where the silty variation occurs the soil is deeper than typical. These variations give the type a somewhat spotted appearance, which differentiates it from the typical silt loam.

Topography and drainage: The surface of the typical soil ranges from nearly level to gently rolling. Because of the sur-

face features and the open character of the deep subsoil the natural drainage is good.

Origin: The Carrington silt loam has been derived from limestone material which was deposited by the late Wisconsin ice sheet. The glacial material is made up almost entirely of limestone, but the surface has been leached to such an extent that it is now in an acid condition. This acidity, however, does not extend to as great a depth in the loam soil as in the silt loam.

Native vegetation: This is a prairie soil and the main growth was prairie grasses. There was a fringe of timber along streams and bordering other types and in places such as gravelly knolls there was also a scattering of timber, but the growth was not heavy. Practically all of the timber has been removed.

Present agricultural development: Practically all of the type is under cultivation and in improved farms. About the same crops are grown as on the silt loam, but it is not quite as desirable a soil as the silt loam. Methods of improvement recommended for the silt loam will apply also to the loam. The most important lines of improvement are the correction of acidity and supplying the element phosphorus.

Carrington loam, gravelly phase: The surface soil of the Carrington loam, gravelly phase, consists of about 8 inches of dark-brown or nearly black loam which in places is somewhat sandy and gravelly. This is underlain by a chocolate-brown gravelly loam which becomes yellowish with increased depth. The subsoil is variable. In places the material below 18 inches is a gravelly clay loam which may extend to a depth of 3 feet or more. In other places it is more sandy. Locally the lower subsoil grades into unassorted clay, gravel, and sand, and in a few places into beds of sand and gravel within the 3-foot section.

The Carrington loam, gravelly phase, is associated with the Carrington silt loam and occurs scattered through practically all of the prairie regions, mainly in tracts of a few acres to 40 acres, although there are some larger tracts. It is a soil of minor importance from an agricultural standpoint.

The phase usually occupies gravelly ridges or knolls, and many of these are conspicious as they form a contrast to the

gently undulating silt loam. The natural drainage is sufficient and in places excessive.

The material forming the Carrington loam, gravelly phase, is of glacial origin and occurs chiefly as kames and eskers. The gravelly material is almost entirely limestone, and the subsoil is well supplied with carbonates. The surface soil, however, is usually found to be slightly acid. The degree of acidity is less than on any of the other Carrington soils. For this reason alfalfa will grow on the gravelly phase of the Carrington loam, whereas, on the Carrington silt loam it is sometimes difficult to secure a good stand of alfalfa without lime.

The greater part of the phase is under cultivation and is devoted to the general farm crops of the region. The yields are lower than on the Carrington loam or silt loam, and the phase as a whole is not as highly prized.

WAUKESHA LOAM

This soil is of comparatively small extent and therefore of minor importance. The largest area is in sections 21 and 22 in East Troy Town. Small patches occur in Troy and La-Grange Towns. None of the areas are of more than one square mile in extent, and most of them are much smaller. The typical phase covers 1,792 acres.

The surface soil of the Waukesha loam consists of a dark-brown to black loam 8 inches deep. This grades into a chocolate-brown subsoil, which becomes heavier and more compact with depth, takes on a yellowish-brown color below 14 inches. At a depth of 2 feet there is usually considerable gritty material, and beds of sand and gravel are reached at depths ranging from 20 to 30 inches. The surface of the Waukesha loam is level. The underlying sand and gravel insure good natural drainage.

The soil has been derived largely from glaciated limestone material deposited in the form of outwash plains and terraces. Although the lower subsoil contains much limestone material, the surface soil is acid and in need of lime.

All of this type occurs within the prairie regions. Most of it is included in improved farms and is devoted to the production of the ordinary farm crops of the area. Being somewhat lighter in texture it is better suited to special crops than the

heavy silt loam of this series, but the trucking industry has not been developed.

The methods of cultivation, fertilization, and crop rotation followed are practically the same as on the silt loam.

Waukesha Loam, gravelly phase: The Waukesha loam, gravelly phase, has the same relation to the Waukesha soils as the Fox loam, gravelly phase, has to the light-colored terrace and outwash soils. The surface soil for the most part consists of a dark-brown to nearly black sandy or silty loam, extending to a depth of about 8 inches. This is underlain by a gravelly subsoil that is somewhat heavier in texture than the surface soil and in places becomes a silty clay loam. Beds of loose sand and gravel are reached at depths ranging from 18 to 30 inches.

The gravelly phase occurs chiefly in Richmond, Darien, and Sugar Creek Towns. It covers an area of 892 acres. In a number of places it occurs within areas of Waukesha silt loam, deep phase, as terrace escarpments or bordering pothole depressions. It also occurs along the slopes leading to streams. This soil has been formed from glacial outwash material derived from the limestone till which covers the region.

The surface is somewhat irregular or sloping but seldom steep enough to interfere with the use of modern farm machinery. Because of the loose character of the soil and the sloping surface, the natural drainage is good to excessive.

The greater part of the Waukesha loam, gravelly phase, is included in farms and is devoted to the general farm crops of the region. It is probably better suited to alfalfa than the Waukesha silt loam because the gravelly subsoil contains much lime within reach of the roots of the plants. Where the surface soil has a dark color it is for the most part slightly acid. Where the surface soil has been eroded so as to expose the heavy subsoil, there is considerable lime near the surface.

In the use of this soil, efforts should be made to prevent erosion, and this may be done by keeping the surface covered with a growing crop as much as possible.

There is a fine sandy loam variation which is confined to small scattering areas in the towns of Troy, East Troy and La-Grange. It covers a total of about 448 acres. The surface is level and the natural drainage good. The surface soil is a dark colored fine sandy loam. The subsoil is a chocolate brown fine sandy loam which becomes more yellowish with depth and

usually grades into a sandy or gritty clay loam at 14 to 16 inches. Beds of sand and gravel are reached at 2 to 3 feet. This variation was so limited in extent that it was not considered advisable to map it as a separate type and therefore it was included with the Waukesha loam, since its agricultural value is about the same.

CHEMICAL COMPOSITION AND IMPROVEMENT OF LOAMS AND FINE SANDY LOAM

In this group of soils there are eight separate types most of which are of minor importance individually but collectively the group is important since it covers a total area of 49,390 acres or about 14 per cent of Walworth County. These soils are somewhat lighter in texture than the silt loams but where general farming is carried on practically the same methods of improvement can be followed as outlined for the silt loam soils on pages 35–39.

While there is some variation in the texture, structure and color of the types of soil in this group there is a sufficient similarity so that general methods of improvements discussed here will apply to the entire group.

Tests and observations which have been made on these soils indicate that most of the types are in need of lime. The dark colored prairie soils show a greater need than the light colored soils. There are a few exceptions to this need and these are found where the underlying limestone or gravelly till comes to the surface. Frequently, however, the soil will be in an acid condition even when the lime stone or gravelly till is within one foot of the surface.

The supply of organic matter in the dark colored types such as the Waukesha and Carrington loams is somewhat greater than the light colored types but in older cultivated soils this organic matter is in an inactive form so that the introduction of decaying vegetable matter will greatly aid in the improvement of these types regardless of color.

The supply of phosphorus in these loams and fine sandy loams is lower than in the heavier types and these soils show a marked deficiency in this element. The actual number of pounds of phosphorus which these soils contain, however, is not a true index of the actual need of this element. Some of the soils which show a small total amount do not respond as well

to an application of the phosphorus fertilizer as do the types which have a large amount present so that the behavior of the crop is a more important indication of the need of phosphorus than the chemical analysis.

Regarding the supply of potassium in the soil the total amount is approximately 25,000 pounds per acre or fully 20 times as much as the supply of phosphorus. Where general farming is conducted and where there is maintained a good supply of vegetable matter in the soil this will doubtless be sufficient. Where special crops are raised which require a large amount of potassium this element may be supplied to advantage in the form of a commercial fertilizer.

The principal characteristics of these types is that they hold somewhat less water than heavier soils do and they warm up more quickly in the spring. This together with the readiness with which they can be worked adapts them to truck and special crops, better than the growing of staple crops. It is necessary to give them somewhat more attention to maintain fertility partly because of the fact that they are lower in fertility than the heavier soils but more because of the fact that these special crops require a higher degree of fertility to produce satisfactory yields. When these soils are used for the production of special crops their fertility can be maintained either through the use of a rotation in which a legume is grown as the means of securing the necessary nitrogen and organic matter while the other elements, chiefly phosphorus and potassium, are supplied in commercial fertilizers. When this latter system is followed one-third or one-fourth of the land should be sown to a legume such as clover or soy beans which have large powers of gathering nitrogen from the air, and a part of the phosphorus and potassium should be used for the growth of different green manuring crops. The fertility used in this way will become available for the succeeding crops through the decomposition of the legume when plowed under and the remainder of the fertilizer to be used should be applied on this ground at the time of fitting it for the succeeding crops.

CHAPTER IV.

GROUP OF MISCELLANEOUS SOILS

MIAMI STONY LOAM

Extent and distribution: The stony loam occurs chiefly in rather large bodies in the morainic region in the northwestern part of the county, particularly in LaGrange and Whitewater Towns. A few smaller tracts are in other morainic parts of the county. The type covers a total area of 1,664 acres or 5% of the whole county.

Description: The Miami stony loam does not have the uniform characteristics of a district soil type. It includes areas of stony soils with extremely rough and irregular morainic surface features similar to those of the Rodman gravelly loam. This stony loam, however, differs from the Rodman gravelly loam in having a heavier covering of soil material over the underlying gravel. The surface soil ranges in texture, from place to place, from a heavy sandy loam to a silt loam. It is not very gravelly but is generally extremely stony, except in very small local areas. The subsoil is chiefly reddish brown in color, ranges in texture from loam to gritty compact clay loam, and extends to depths of 20 to 30 inches or more before beds of loose gravel are encountered.

Topography and drainage: Its surface is extremely rough and broken so that cultivated corn crops could not well be grown. The natural drainage is good, but seldom excessive, because the soil above the gravel is sufficiently deep to retain moisture.

Origin: This soil is of glacial origin and has been formed largely from the grinding action of glacial ice on the underlying limestone rock. Some of the type occurs in the form of kames and eskers but over the beds of gravel there is usually a covering of soil from 1-3 feet deep. The type is well supplied with lime but the subsoil contains considerable more than the surface soil.

Native vegetation: The forest growth consists mainly of red oak, white oak, and hickory with some poplar and birch. The best timber has been removed but there is still some left that would make posts, ties, and stove wood.

Present agricultural development: The chief use of this type is for pasture and it supplies good grazing for the entire season where cleared of timber and brush. This is in direct contrast with the Rodman gravelly loam, where grazing is limited to spring and early summer.

In the improvement of this soil there is not much that can be said except that it is advisable to keep the land in pasture as much as possible, but if the steep slopes are cultivated the danger of erosion would be greatly increased.

Where the land is not too steep or stony to be cultivated it might be advisable to plow and sow to alfalfa. Being well drained and well supplied with lime this type should produce excellent alfalfa. The amount of feed secured from the alfalfa, either as pasture or hay, would be much greater than from the native pasture. Once started, alfalfa would doubtless stand on this land for a number of years.

RODMAN GRAVELLY LOAM

The Rodman gravelly loam includes areas that are rather variable in texture and have a broken and rough topography. The surface soil generally consists of a brown or dark-brown loam, silt loam, or fine sandy loam, containing a considerable amount of gravel and extending to depth of 4-6 inches. This is frequently underlain by from 4 to 8 inches of extremely gritty clay loam which is underlain at from 8-12 inches by beds of stratified gravel. In places the layer of sand and gravel is less than this, and in others somewhat deeper.

The type occurs chiefly in LaGrange, Whitewater, Lyons, Geneva, and Troy Towns, and in a number of small scattering areas in other sections. The areas are all irregular and are associated chiefly with soils of the Miami series. In some places stones appear upon the surface, but these are usually not numerous.

The surface of the Rodman gravelly loam is extremely rough and broken, being made up largely of kames, eskers, and potholes. In many places the land is too steep for cultivated crops. Because of the uneven surface and the extremely

gravelly nature of the subsoil, the natural drainage is excessive and the type suffers from drought every year.

The material forming this soil has been derived largely from the underlying limestone through the grinding action of glacial ice. Over 90 per cent of the gravelly material consists of limestone. Much of it has been deposited by water underneath the the ice. This soil is not acid but contains large quantities of lime carbonate.

The native vegetation consisted chiefly of scrubby oak and hickory, and a considerable part of the type is still covered by a scattering growth of scrubby oak. The type is used chiefly for grazing and supplies good pasture during the spring and early summer. As soon as hot weather sets in, however, the grass dries up and is of little value for the remainder of the season. This soil should be kept for grazing, and the timber now standing should be retained in order to prevent erosion.

COLOMA FINE SAND

The Coloma fine sand consists of a grayish-brown loamy fine sand or loose fine sand, underlain at 6 to 8 inches by yellowish fine sand. Locally at depths of 30 to 40 inches it contains enough clay to make the sand slightly sticky, and in places the lower subsoil also contains small quantities of fine gravel.

This type covers a total of 1792 acres or about .5% of the county.

The Coloma fine sand occurs chiefly in LaGrange Town. The topography varies from gently rolling to rolling, and owing to the loose subsoil and the rolling surface, the natural drainage is excessive.

This type has been formed from glacial material probably derived in part from local limestone and in part from sandstone material carried by the ice sheet. This soil has been leached considerably since its first deposition, and practically all of the carbonates that may have been present originally have been leached from the surface soil, and an acid condition has developed.

The native forest growth consists of a rather scattering growth of oak, hickory, some poplar, and hazel brush. A large part of the type is cleared and in farms, and is being used for the production of the ordinary farm crops. Its productivity,

however, is rather low, and the general appearance of farmsteads is inferior to those of heavier soils. The type is better suited to the production of special truck crops than to general farming, and where it is favorably located for shipping it should be devoted to the trucking industry. The type responds readily to fertilizers and is in need of mineral plant-food elements and also nitrogen and organic matter. With the use of mineral fertilizers, good stands of clover can be secured, and by turning these under the organic content can be increased. Where the supply of manure is small, mineral fertilizers should be used. They may also be used to good advantage to supplement the manure and thus make it cover a larger acreage.

PLAINFIELD FINE SAND

The surface soil of the Plainfield fine sand is a light-brown fine sand 6 inches deep. The subsoil is a yellowish fine sand, which becomes somewhat lighter in color and extends to a depth of over 3 feet. Locally the lower subsoil is coarser in texture and may grade into beds of stratified sand and gravel.

This type occupies a total area of 2 square miles in the northern tier of towns, and occurs chiefly in LaGrange Town. The surface of this soil is level to gently undulating, and the natural drainage is good to excessive.

Small areas occur in Whitewater and La Grange Towns that are not typical. They are low lying and have a heavy clay stratum a few inches thick at shallow depth which interferes with the underground drainage. The surface soil is a brown or grayish fine sand underlain by a yellow or grayish and sometimes grayish and brown mottled fine sand which extends to a depth of 4 to 8 feet.

A dark phase is of very small extent and is confined chiefly to the town of East Troy. It covers an area of only 128 acres and because of its small extent it is not mapped separately but is included with Plainfield fine sand. The soil consists of a dark-brown to a nearly black fine sand or loamy fine sand, 8 to 12 inches deep, underlain by light-brown or yellowish-brown fine sand which usually grades into stratified sand and gravel at depths of less than 3 feet.

The surface ranges from level to gently undulating, and the natural drainage is somewhat excessive. The soil is of alluvial origin and occurs on terraces or out-wash plains. It is

practically all under cultivation, being devoted to corn or to the general farm crops of the region. The yields are slightly better than those obtained on the typical Plainfield fine sand.

The greater part of this type is cleared of the native cover, consisting chiefly of scrubby oak, and is devoted to the ordinary farm crops of the region. Yields, however, are considerably lower than on the heavier type. Corn, rye, small grains, and hay are the chief crops, but the type is better suited to special crops, such as potatoes or garden truck, than to general farm crops. The soil works up easily, warms up early in the spring, and responds readily to fertilization. More organic matter should be added, and complete fertilizers will give good results on this land.

To improve this type legumes should be grown, and to succeed with these it may be necessary to use commercial fertilizers. For this purpose a mixed fertilizer will be best, and a 2-10-4 will be well suited to this sandy soil. About 200 or 300 pounds per acre should be used. When clover is well established, a second crop may be plowed under to supply the needed organic matter. Where acid, the soil should be limed before best results can be expected from the mixed fertilizers. The use of lime will help to insure the success of clover. By following a short rotation in which a legume is grown and a part of it plowed under, and by supplying the mineral plant food elements through commercial fertilizers, good crops may be secured. A rotation consisting of clover, corn or potatoes followed by a small grain is well suited to this soil.

CHAPTER V.

GROUP OF POORLY DRAINED SOILS

CLYDE SILT LOAM

Extent and distribution: This soil occupies a total area of 41,280 acres or 11.5% of the entire county. From the standpoint of area it is one of the important types of the county. It is found in practically every township but is most extensive in the towns of Linn, Bloomfield, Geneva, Walworth, and Lima. Very few areas are over one square mile in extent, most of them ranging from a few acres to a quarter section.

Description: The surface soil of the Clyde silt loam consists of 10 to 16 inches of black heavy silt loam. The subsoil grades through a few inches of dark-drab or bluish silty clay loam into plastic silty clay, which passes at 20 to 24 inches into stiff, impervious, mottled clay or yellow silty clay. Lenses of mottled clay and yellow fine sand a few inches thick are found here and there in the deep subsoil. There are a few variations in the surface material; locally the soil is slightly heavier than silt loam, and in some places loam areas have been included.

As developed in the old glacial area, chiefly in Sharon Town, the surface soil consists of 12 to 16 inches of dark-gray to black silt loam containing much organic matter. The upper subsoil consists of a grayish, yellowish, or sometimes bluish silt loam, which rapidly grades into a silty clay loam, and generally becomes a strongly mottled impervious silty clay below 20 inches. The heavy material extends to a depth of 4 feet or more and rests upon unassorted glacial material. In some places the soil is heavier than a silt loam and could probably be classed as a clay loam or silty loam.

Topography and drainage: The surface is level and gently sloping or saucer-shape. The type occurs chiefly in long narrow strips occupying depressions in the upland; in places it occurs along drainage ways. It is all low-lying, and has poor natural drainage. Owing to its low position it frequently receives seepage from the adjoining high land. While the drain-

age is naturally deficient, the part which is the most elevated can sometimes be cultivated safely, although tile drains would be beneficial to all the land.

Origin: The material forming this soil consists for the most part of till derived by glacial action from the underlying limestone. As the soil occupies low places, there has been an accumulation of vegetable matter, the decay of which accounts for the dark color and the high organic content. Since this soil has been derived from limestone material and has received the wash from the higher land, it is well supplied with carbonates and but little of it is acid.

Some of the type occurs as low terraces or outwash plains and has the same origin as the Waukesha but is lower and more poorly drained. The phase which is found on terraces has been leached more than the ice-laid phase and is frequently found to be in need of lime. This variation was too limited to be shown separately on the soil map.

Native vegetation: The original forest on this soil consisted of ash, elm, alder, and willow. Most of the merchantable timber has been removed, but there are still a few trees available for saw timber.

Present agricultural development: Probably half of the Clyde silt loam is under cultivation. The cultivated land is partly drained and lies between the upland and the lowest parts of depressions. Part of the type is too poorly drained to be cultivated. Where the drainage is sufficient corn, root crops, small grains, and hay are being grown, and where the drainage is not so good the land is used for pasture.

Drainage is of course the first and most important step in the improvement of this type. When completely drained it is one of the best types for corn in southern Wisconsin. It is also well adapted to sugar beets, cabbage, and hay. Small grains are inclined to lodge and the quality of the grain is not quite equal to that grown on the upland soils. Wherever there is a small accumulation of peat or muck over the surface, the use of mineral fertilizers containing phosphorus and potash might be advisable during the early stages of cultivation. As the peat becomes mixed with the mineral soil by cultivation, the need for mineral fertilizers will be reduced.

For additional information on the management and improvement of this soil see page 60.

CLYDE CLAY LOAM

Extent and distribution: This soil covers a total area of 6,528 acres or nearly two per cent of the whole county. It is most extensive in the town of Whitewater but smaller tracts occur in nearly every town in the county.

It is associated with soils of Miami and Carrington series and forms part of the lowlands of the county.

Description: The Clyde clay loam consists of a black silty clay loam passing at a depth of 10 to 14 inches into mottled drab and yellow silty clay, which grades at from 18 to 30 inches into a dense, heavy, impervious clay, mottled with gray and yellow, and in places with an indication of a peculiar pinkish color typical of the Superior soils mapped in other parts of the State. Both the soil and subsoil are calcareous. This type includes several variations. The texture varies from a silty clay loam to a clay loam and even to a heavy clay, but because of its limited extent these variations were all grouped under the head of clay loam. The subsoil also varies. In places the heavy material extends to a depth of over 3-4 feet while in other places of limited area there are thin layers or beds of fine sand in the deep subsoil between 3-4 feet below the surface.

Topography and drainage: The type has a flat surface and a rather low position, lower than the Waukesha soils with which it is sometimes associated. The natural drainage is slow, but is naturally good enough or can be improved so as to be sufficient for general farm crops. From the standpoint of drainage the type includes two classes of land, one which is sufficiently drained to allow cultivated crops to be grown, and the other which is in a rather marshy condition and too wet for cultivation at the present time. This marshy land can all be drained and will, when improved, be equally as good land as that which is now being farmed, the soil material being practically the same. Artificial drainage is needed over a large proportion of the Clyde clay loam.

Origin: The typical Clyde silt loam occupies poorly drained depressions in the glacial till regions and the soil material has come largely from the underlying limestone formation through the grinding action of glacial ice. The low poorly drained condition favored a rank growth, the decay of which has result-

ed in the high content of organic matter and the dark color. A phase of the Clyde clay loam occurs on low terraces or outwash plains and has the same origin as the Waukesha soils. The typical soil is seldom acid but the terrace or outwash phase has been leached and acted upon to a greater extent by water and much of the limestone material has been removed. An acid condition has developed over most of this phase of the type.

Native vegetation: Some of the areas in Walworth Town are probably part of the prairie in that section. Most of the other tracts supported some forest, mostly elm, soft maple, and ash.

Present agricultural development: Probably half of the clay loam is under cultivation, and where fairly well drained it produces good crops. Drainage, however, is the important feature in improving this soil, and until artificial drainage has been supplied, crops can not be grown successfully year after year. When thoroughly drained, this is a strong, productive soil, well adapted to corn, hay, and root crops.

CHEMICAL COMPOSITION AND IMPROVEMENT OF CLYDE CLAY LOAM AND CLYDE SILT LOAM

These two types occupy a total of about 13.7 percent of the county, and form a substantial part of the best agricultural land in the region. They are characterized by having relatively large amounts of organic matter, accumulated as a result of poor drainage. The supply of organic matter is quite variable since the soil grades into Muck and Peat on the one hand and into upland mineral soils on the other. Chemical analyses of such soils show that the nitrogen content varies from 4,000 to 10,000 pounds per acre 8 inches. The supply of phosphorus runs from 1,000 to 2,460 pounds per acre while potassium usually runs from 25,000 to 40,000 pounds per acre or more. Where the soil has a thin covering of Peat the phosphorus and potassium are present in the surface soil in considerable smaller amounts.

The portion of these soils found on Terraces usually show some need for lime and ground limestone on such places can be used to advantage. Over most of the region, however, these soils do not need lime. They are so situated that they receive the wash from higher lands, which contain lime material, and this lime bearing water has prevented the development of an acid condition in these lands. Where acidity is found it is

usually so slight that but little if any lime is needed, except as indicated above.

The most important step and the first step in the improvement of these soils is to supply adequate drainage. Tile drains and some open ditches have been installed and a portion of the land is now devoted to cultivated crops. Considerable areas, however, are still undrained, and are used chiefly for pasture and hay. The drainage of these lands frequently requires the development of drainage districts, but there are numerous tracts which are so situated that they can be reclaimed by individual efforts.

A condition which sometimes develops on this soil is shown when corn turns yellow on areas of small extent. In such cases the use of some form of potash or strawy horse manure is helpful. There is relatively a much larger supply of nitrogen than phosphorus and potassium. For this reason it is a good practice to use the manure on the upland soils which are deficient in nitrogen and apply mineral fertilizers to the low land when these are needed. In many cases which show a marked need of potassium during the first few years of cropping, usually where the soil is high in organic matter to a depth of a foot, this lack of potassium frequently disappears after a few years of cropping as a result of the settling of the surface so that deep plowing mixed up some of the soil high in potash.

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 earthly 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.

These soils are capable with thorough drainage and proper fertilization and cultivation of being made among the most productive lands in the state. Within hauling distance of Racine and Kenosha these same soils are being utilized to some extent for trucking, and this industry could be developed in

Walworth County where locations are favorable and markets within reach. All of these lands not now being farmed should be drained and put to work, for it is an economic loss to have them idle.

CLYDE LOAM

Extent and distribution: The Clyde loam covers a total area of 2,172 acres or less than 1% of the entire county. It is found most extensively in Whitewater and LaGrange townships though small patches are found in other parts of the area. The Clyde loam is closely associated with Peat and with other types of the Clyde series.

Description: The Clyde loam consists of 12 to 18 inches of a black loam, passing through brown loam into mottled yellow and brown sandy loam at 20 to 24 inches, below which it is a mottled yellow and gray loamy sand. The subsoil is somewhat gravelly in places, and is underlain at depths of 4 to 6 feet by dense impervious clay similar to the lower subsoil of the Poygan series. The surface soil is somewhat variable in the depth of the dark-colored material as well as in texture. The depth to the heavy material in the deep subsoil is also variable. In some instances this heavy material appears to be lacking. In some places the surface soil was found to be a fine sandy loam but such variations were too limited to map separately.

Topography and drainage: This soil occupies low, level, or somewhat depressed areas and the natural drainage is deficient. Part of the land is in a marshy condition during a portion of each year and all of it should be tile drained before maximum crops can be expected from year to year. There are some areas where the surface is sufficiently well drained so that fair crops are being grown without artificial drainage, but there is always some danger during periods of heavy rainfall of there being an excess of moisture.

The better drained areas are the same from the standpoint of texture, color, etc. as the more poorly drained portions of the type, but occupy a position a foot or so higher and frequently have more fall than the remainder of the type.

Origin: The Clyde loam was formed in two ways. Part of the soil represents depressed areas in the glacial till which was derived from the underlying limestone by the action of glacial ice. Part of the type was derived also from outwash or valley

fill hill material which came originally from the same parent rock but which was acted upon to a greater extent by water. The water deposited phase, having been leached most, may be in need of lime in places, while the till phase seldom needs lime.

Native vegetation: The native growth on this soil consisted of ash, elm, soft maple, with some alder, willow, etc.

Some of it was rather open and only sparsely covered with brush and trees. Most of the timber of value has been cut but there is still some suitable for fire wood and possibly a few trees suitable for saw timber, together with some brush.

Present agricultural development: The Clyde loam where cultivated is used for corn, hay, pasture, and to some extent for small grain, but the soil is cold and wet in the spring and crop yields are often unsatisfactory. In many instances the crops are spotted and uneven owing to poor drainage conditions. When well drained this land is well suited to general farm crops and is classed as good land, especially adapted to corn. It is also suitable to such crops as cabbage and onions where marketing conditions are favorable.

Chemical composition and improvement: This soil is somewhat variable in its physical properties. Its supply of nitrogen, phosphorus, and potash is somewhat smaller than in the silt loam, but it contains more organic matter than do the light colored upland soils and contains a fair amount of phosphorus and potash. In its improvement drainage is the first and most important step. When this has been supplied, this soil is well adapted to the growing of general farm crops, but it is also well suited to special truck crops. Where favorably located, it should be devoted to these special truck crops rather than to the growing of general farm crops. When well drained, it warms up readily, is easy to cultivate and therefore very desirable for the growing of crops which require intensive cultivation.

GENESEE SILT LOAM

The Genesee silt loam as mapped in Walworth county includes a variety of soil materials all of which occur as first bottom land chiefly along Honey Creek, Turtle Creek, Sugar Creek and White River and in small areas along other streams chiefly in the north half of the county. This type as a whole

may be divided into two divisions or phases. The more extensive or dark phase covers 6,208 acres and a lighter phase covers 768 acres which in all makes a total of 1.9% of the entire county that is covered by the Genesee silt loam. The light phase which is the portion of the type more nearly typical of this soil as mapped elsewhere in the State consists of a medium to dark brown smooth friable silt loam underlain by mottled, drab and yellow silt loam which in places approaches a clay loam in texture. This contains numerous lenses of fine sandy material. These sandy layers vary from 1 to several inches in thickness. In places the subsoil to a depth of 3 feet is practically free from sand while in other places the greater portion of the soil section may be sandy. This lighter portion of the type occurs chiefly in Richland township with other small pieces in Troy and East Troy townships.

The darker portion of the type which might be considered as a dark phase or variation consists of a brown to nearly a black, smooth silt loam which ranges in depth from 8 to 18 in. but in some places extends to a depth of 24 in. The supply of organic matter is variable and in places is sufficiently high to make the material approach a muck. The subsoil is a drab or mottled gray and yellow silty clay loam. Lenses of fine sandy loam and gravelly material, a few inches in thickness may occur throughout the subsoil. where the organic matter is highest, the soil is frequently dark enough so that if it had been of sufficient extent it could have been mapped as Wabash silt loam.

The surface of the Genesee silt loam is all low, level or depressed and the natural drainage is poor. Practically all of the type is subject to annual over flow.

The material forming this soil has been deposited by flowing water and is derived from the glaciated limestone material that forms the upland soils of the region. The leaching of the water through the upland soils and its draining on to the lower lands keeps this lowland from becoming acid. The subsoil frequently contains a considerable amount of lime carbonate.

The native vegetation consists chiefly of elm, ash, soft maple, willow and alder. Most of the merchantable timber has been removed but on the larger areas there are still some trees that are suitable for saw timber.

Nearly all of the type is unimproved as most of it is too wet

in its natural condition for cultivated crops. In a few places where it adjoins the higher land it is cultivated and in dry seasons produces good crops. However, the danger from excess moisture is so great as to discourage the cultivation of this type of land. Some of this soil is in grasses and supplies good grazing a part of the year. Drainage, of course, is the most important factor in the improvement of this soil. This would call for the deepening of the drainage ways in most cases. When some of the larger marshes are drained portions of this type will also be greatly benefited. When thoroughly drained and placed under cultivation it will become a productive soil especially adapted to corn and seldom injured by frost.

The large water-holding capacity of such soils together with their large quantity of nitrogen makes them suitable for crops, making strong growth of stock or leaf. Among the staple crops, hay and corn are best suited to such land. Special crops such as cabbage, hemp and sugar beets also do well, but these will require larger amounts of potassium and phosphorus fertilizers. The degree of drainage must also be considered in selecting the crop to be grown. Timothy and alsike clover for hay may be grown on land having insufficient drainage to be adapted to corn or other crops requiring tillage.

Drainage: In Walworth County there are over 80,000 acres of land which may be classed as poorly drained, and which must be provided with open ditches or tile drains before cultivated crops can be safely grown from year to year. This includees 41,280 acres of Clyde silt loam, 29,248 acres of peat, and 6,528 acres of Clyde clay loam and 2,176 acres of Clyde loam, and the Genesee silt loam. In addition to these soils, there are places on the level prairie and also in the light-colored terrace soils where the lands are somewhat deficient in drainage, and where tile drains can be used with profit. It is safe to say that there are approximately 100,000 acres of land in Walworth County which could be profitably improved by drainage.

The soils mentioned above are, for the most part, unimproved, or are used only for grazing or for the production of wild or tame hay. The Clyde silt loam and clay loam, when drained, make some of the best types for corn in southern Wisconsin, and to have it in its present undrained condition is an economic loss. The peat is less valuable, but its improvement by drain-

age will greatly add to the producing possibilities of the county. The Clyde loam is a good trucking soil when drained. Practically all of these lands can be successfully drained, and every farmer having poorly drained land should develop a plan by himself, or with his neighbors for the improvement of these idle acres.

Since over 20 per cent of the land in Walworth County is failing to do its duty because of poor drainage, and since well-drained land adjoining is worth from $100 to $200 per acre, it would seem that the improvement of such land would be a matter of vital concern to the county as a whole. If this land were all in corn and properly handled, it would yield at a conservative figure over three million bushels per year.

For a more detailed discussion of the problem of management of marsh soils and drainage, see Bulletins Nos. 284 and 309, Wisconsin Experiment Station.

PEAT

Extent and distribution: Peat occurs in all towns and is more widely distributed than any other type in the county. The largest tracts are in the towns of Troy, Richmond, Sugar Creek, Whitewater, and Bloomfield. These larger tracts cover from 2 to 4 or more square miles. There are many tracts that vary from a few acres to one-half square mile in extent. There are in the county 28,032 acres of Typical Peat and 1,216 acres of Peat shallow phase.

Description: Most of the type mapped as Peat consists of dark-brown or black fairly well decomposed organic matter passing at from 10 to 18 inches into lighter brown and less well decomposed material. In the larger areas the surface material in places is only slightly decomposed and lighter brown in color. In such places the original form of vegetation may be plainly seen and the bulk of the material is fibrous. In the small areas the sloping portions are sometimes of a springy nature and the black thoroughly decomposed Peat may extend to a depth of over 3 feet. In some places the peat is over 10 feet deep.

The subsoil under most of the Peat consists of heavy material ranging from gritty loam to silty clay loam. Where the neighboring upland is sandy, however, the material is frequently sandy below the Peat. In several places the Peat is

underlain by marl. The depth of the Peat is somewhat variable, but will average more than 3 feet. Where the depth to the mineral soil is less than 18 inches, a shallow phase of Peat has been mapped.

Topography and drainage: The Peat is all low lying. The surface is level or very gently sloping, and the natural drainage is extremely poor. Some of it is subject to overflow and over a great deal of it the water table remains close to the surface most of the time.

Origin: The material forming the Peat has been derived from the growth and accumulation of vegetable matter which is now in various stages of decomposition. In some cases this material is still raw so that the original fiber can still be seen. In other places it is thoroughly decomposed so that the original structure has entirely disappeared. In some instances, especially around the border of marshes, a varying amount of mineral matter has been mixed with Peat, so that the result is soil approaching Muck. Because of the limited extent of this variation, however, the Muck is not shown separately on the soil map.

Owing to the large content of lime material in the deep subsoil throughout the upland, and because the water leaching from the upland and accumulating in the marshes carries lime, the Peat soil is not acid. A number of acidity tests were made on the Peat but only in a very few instances was an acid reaction obtained. There appears to be no relation between the degree of decomposition and acidity.

Native vegetation: Some of the marshes are treeless in part and are covered with a growth of sphagnum moss and coarse marsh grasses. The original tree growth in places consisted of dense growth of tamarack, while in other places the growth was ash, alder, willow brush, and a scattering of tamarack. Some ash was also found where the peat is shallow. Some marshes are partly open and partly forested.

Present agricultural development: Most of the large marshes are now included within drainage districts and many outlet ditches have been or are being constructed. In most cases, however, only the outlet ditches have been constructed and lateral open ditches or tile drains have not yet been put in. When this land is thoroughly drained and properly fertilized, it will be adapted to a number of crops, including corn, sugar

beets, cabbage, onions, and hay. Some grains may also be grown, but there is considerable danger of lodging and the grain does not fill out as well as on the upland soils.

Drainage is the first step necessary in the improvement of this type, and until thorough drainage is supplied it is useless to attempt cultivation. At present the Peat marshes are used chiefly for the production of marsh hay and some pasture. Only in a very few cases are cultivated crops being grown. Little tiling has been done on the Peat lands, but the importance of this is being appreciated and more attention than ever before is being given to the reclamation of the marsh lands. Because of the high value of the upland soils, it is desirable that the Peat soil should be under cultivation as soon as possible so as to make every acre on each farm productive.

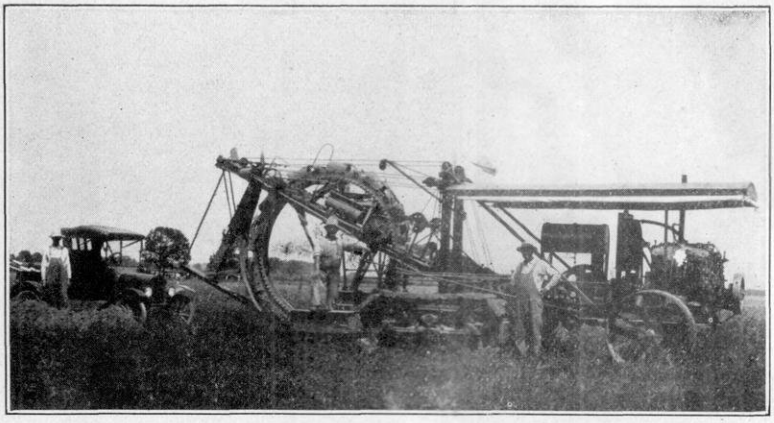
When the deep Peat is thoroughly drained, properly cultivated, and fertilized, it will have a crop producing power nearly if not quite equal to the upland, and will have a selling value of probably about two-thirds or three-fourths that of the adjoining upland. It will have a lower selling value because it is not adapted to as wide a range of crops as the upland soils and also because it requires special treatment with which many people are not familiar.

Peat, shallow phase: The shallow phase differs from the typical Peat chiefly in the depth to the heavier underlying mineral soil. The peaty material in the shallow phase has a depth of 18 inches or less. Where associated with sandy upland the underlying material is usually sandy, and elsewhere it is heavier. The soil section itself down to the mineral soil is practically the same as that of the deep Peat, consisting of decaying vegetable matter of a dark-brown or black color, with which there has been mixed a comparatively small proportion of mineral matter. The lower part of the peaty layer in places contains considerable mineral matter, especially where the subsoil is sandy, as in the areas mapped in the northern parts of LaGrange and Troy Towns.

The greater part of the shallow phase occurs in Troy and LaGrange Towns, but small areas also occur in most of the towns in the northern half of the county.

In regard to drainage, origin, and native vegetation this phase is practically the same as the typical peat. It has not been developed agriculturally to any extent, but a few small

Celery growing on Peat soils near Lake Geneva.



Large traction ditches of this kind are used in drainage work in Walworth county. The trench which this machine digs is very satisfactory for the laying of tile.

areas have been placed under cultivation. Before much of it can be utilized for cultivation, it must be thoroughly drained. Where the subsoil is heavy, this shallow Peat has a greater potential agricultural value than the deep Peat, because when the land is cleared and thoroughly drained the surface material will settle to such an extent that in many cases the heavy subsoil will be mixed with it in the cultural operations. When this land is thoroughly drained, properly cultivated, and fertilized, it will have a crop-producing power nearly equal to that of the upland soils.

AGRICULTURAL VALUE AND DEVELOPMENT OF PEAT

The amount of marsh land occurring in Walworth County so well located with reference to market and transportation facilities makes it important to consider its agricultural possibilities quite fully. At present only a very small proportion of the peat soil in this county is improved.

The question of the actual value of marsh land is one which depends on several factors. In the first place, the farmer whose land is largely upland and well drained can use a small amount of marsh land to very much better advantage than can the farmer whose land is essentially all marsh land. But probably the most important factor determining the value of marsh land will be the crops which can be grown on it. This depends on two factors, first the degree of drainage, and second the danger from frost. When only the main outlet and lateral ditches have been installed, in the great majority of cases hay crops are the only ones which can be safely grown, and the character of the hay will also depend a good deal on the character of the drainage. In the case of peat land underlain by sand the drainage by well-constructed and sufficiently deep ditches 40 to 80 rods apart will, in most cases, give adequate drainage for this purpose. When the peat soil is underlain by silt or clay, however, ditches not more than 20 rods apart will be necessary and these must lower the water in the ditch to a point 4 or 5 feet below the surface during part of the growing period. When tiled crops, such as corn, cabbage, or potatoes, or small grains are to be grown, the drainage systems in the form of either open lateral ditches or of tile not more than 10 and often not more than 5 rods apart on the average.

Another factor which must be considered in comparing marsh and upland soils is that of fertility as determined by chemical composition. Marsh lands are abundantly supplied with organic matter containing nitrogen, but are relatively low in potassium and sometimes phosphorus. The marsh lands of Walworth County are seldom in need of lime since the acidity which ordinarily develops in marsh land is kept neutralized by the lime carried down from surrounding uplands. A few of the marshes show some need of lime. Stable manure can be used for fertilizing marsh land, but it contains large amounts of nitrogen, which the marsh soil does not need and is relatively low in phosphorus and contains but a moderate amount of potassium. Moreover, weeds so commonly carried into the land with stable manure are especially hard to eradicate on this class of soil. Ordinarily, therefore, it is more satisfactory to use potash fertilizer on marsh soils than stable manure. At any rate this is true when the farm contains some upland soils as well as marsh land, since the stable manure can be used on the upland while the potash fertilizer is secured for use on marsh land.

Marsh lands are more subject to early fall and late spring frosts than are uplands, partly because of the fact that the cold air developing in contact with the soil as the latter loses its heat by radiation during the night, flows down and collects over the lower land, and partly because the loose, spongy nature of the peat soil prevents the heat of the sun from penetrating so that all except the mere surface is cool, and this loses its heat quickly at night, thereby increasing the tendency to frost. This loose character of the soil can be somewhat improved by the use of a heavy roller which firms the soil and so gives it better heat conductivity. This tendency to frost reduces somewhat the availability of marsh land for tender crops, but in Walworth County, potatoes and corn on marsh lands

The following tables show the results of fertilizer tests on the Peat Marsh at the University of Wisconsin. The Peat in the University Marsh is practically the same as that found in Walworth county and the results will apply to the peat lands of this county.

CORN YIELDS FOR FIVE YEARS ON UNIVERSITY PEAT MARSH EXPERIMENTAL LOTS

Plot No.	Fertilizer Treatment	A 1919	C 1920	B 1921	A 1922	C 1923	5 Yr. Ave.	Ave of Duplicate
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
1	12 Tons Manure	80.3	53.5	77.9	60.5	62.0	66.8	70.6
2	200 lbs. KCL	83.4	43.6	84.5	58.5	64.3	66.9	67.7
3	Check	34.6	18.6	32.7	29.7	25.7	28.3	22.8
4	200 lbs. KCL 400 lb.s 16% acid phosphate	71.4	55.6	81.7	56.8	64.6	66.0	68.1
5	62.5 KCL 62.5 16% acid phos in hill	69.7	57.9	86.0	52.2	55.4	64.2	62.0
6	200 lbs. MCL 1,000 lbs. Rock Phosphate every 6 years	72.4	48.0	80.6	33.7	58.3	58.6	58.9
7	125 lbs. 0-10-10 in hill	59.2	30.7	40.9	37.7	45.7	42.8	39.6
8	Check	38.2	9.1	25.2	15.1	20.0	21.5	
9	12 Tons Manure	86.7	65.8	107.3	49.7	62.6	74.4	
10	200 lbs. MCL	73.9	45.2	91.8	59.1	72.3	68.5	
11	200 lbs. KCL 400 lbs. 16% Acid phosphate	71.6	62.2	92.3	54.5	70.9	70.3	
12	62.5 lbs. KCL 62.5 lbs. 16% Acid phosphate in hill	59.7	52.7	91.8	51.4	42.9	59.7	
13	Check	30.7	6.5	22.6	14.8	18.6	18.6	
14	200 lbs. KCL. 1,000 lbs. Rock phosphate. Onee every 6 yrs.	67.7	27.1	86.3	54 0	60.6	59.1	
15	125 lbs. 0-10-10 in hill	34.8	20.4	36.6	39.4	52.3	36.7	

Note—KCL is Muriate of Potash.
0-10-10 is a mixted fertilizer containing 10% Potash and 10% Phosphate.
Yields given are on the basis of bushels per acre.

HAY YIELDS FOR FOUR YEARS ON UNIVERSITY MARSH—EXPERIMENTAL PLOTS

Plot No.	All fertilizers have been applied 2 years previous to the corn crop.	B 1920	A 1921	C 1922	B 1923	4 yr. Ave.	Ave of Dup. Plots
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
1	12 tons manure	6000	4500	1120	2960	3645	3625
2	200 lbs. KCL	5280	4400	1680	3140	3625	3645
3	Check	4400	2940	1200	1600	2535	2205
4	200 lbs. KCL, 400 lbs. 16% Acid phosphate	5560	4460	2000	3200	3805	4010
5	62.5 KCL, 62.5 Acid phosphate in hill	5300	3040	2240	2280	3215	3212
6	200 lbs. KCL, 1,000 lbs. rock phosphate once every 6 years.	5640	4000	1920	2780	3585	3342
7	125 lbs. 0-10-10 in hill	3740	2600	1600	2100	2510	2450
8	Check	3080	2040	1760	1300	2045	
9	12 tons manure	5400	4300	2080	2640	3605	
10	200 lbs. KCL	5520	4500	1120	3520	3665	
11	200 lbs. KCL, 400 lbs. acid phosphate 16%	5820	4360	2400	4280	4215	
12	62.5 lbs. KCL, 62 5 16 % Acid phosphate in hill	5140	3540	1440	2720	3210	
13	Check	4280	2960	960	1940	2035	
14	200 lbs KCL, 1,000 lbs rock phosphate once every 6 years	5440	4260	960	1780	3100	
15	125 lbs 0-10-10 in hill	3440	2580	1280	2260	2390	

Note—KCL is Muriate of Potash
0-10-10 is a mixed fertilizer containing 10% Potash and 10% Phosphate
Yields are given on the basis of pounds per acre
The rotation followed on this land is Corn, Oats and Hay, with fertilizers applied to the corn crop

CHAPTER VI.

GENERAL AGRICULTURE AND CLIMATE OF WALWORTH COUNTY

TYPES OF FARMING AND CROPS GROWN

At the present time general farming is practiced in all parts of Walworth county. In conjunction with general farming the dairy industry has been developed to a marked degree until Walworth County is one of the foremost in the production of dairy products.

Dairying is the most important industry in the county. In 1919 there were 38,714 dairy cows, which is 69 cows for each square mile in the county. The human population numbers only 41 to each square mile. For the county as a whole there are 1.6 cows for each person. The cows of Walworth County on the average are milked for 341 days in the year. During this time the production is 18.3 pounds of milk per day per cow. This means an annual production of 5,523 pounds per cow. The total milk production in 1919 amounted to 2,138,174 hundred weight, which had a value to the producers of $6,606,-958. This was the year of highest prices, and these prices were considerable above the average. Cattle of Holstein breeding are the most common in Walworth County, and there are a number of pure bred herds which have a national reputation. A very high standard is being maintained in the dairying industry, the herds are kept free from tuberculosis by frequent tests, and many of the cows are sufficiently high in production to make them eligible to the advanced registry. While there are more Holsteins than cattle of other breeds, there are also herds of Guernseys and Jerseys in the county. There are also herds of Brown Swiss which are giving good account of themselves.

LIVE STOCK STATISTICS

	April 15, 1910 (U S Census	Jan 1, 1919 (Assessors)	Jan 1, 1920 (Assessors)
No of Milk Cows	39,147	37,960	39,932
No of Other Cattle	21,500	25,120	23,738
Swine	56,528	29,232	37,118
Horses and Mules	13,328	12,925	12,247
Sheep	16,635	22,395	19,133

While dairying is the leading industry in the county, there are other extensive live stock products. In 1909, according to the census, the value of animals sold and slaughtered approximated $1,500,000. This included about 55,000 hogs, 24,000 sheep, and 23,000 calves. The extent of the live stock industry will be appreciated when an examination is made of the following table which gives the live stock population of the county over several years. There are more than two and one-half times as many cattle as there are people and about one and one-half times as many pigs as there are people.

While the dairy industry represents the greatest industry and while the county is known as a dairy county, the production of beef cattle is not overlooked, and there are a number of farms on which pure bred beef cattle are being raised, both for breeding purposes and for the block. The Shorthorn is probably raised more extensively than other beef cattle. but there are Herefords, Angus, and Shorthorns and Red Polled are sometimes classed as dual purpose breeds.

On every dairy farm hogs are also raised, and their value adds materially to the income on nearly every farm in the county. In 1919 there were over 56,000 hogs in the county, which on January 1, had a value of $733,300. Among the leading breeds are Duroc Jersey, Berkshire, Poland China, and Chester White.

Walworth County is not usually considered as a sheep country, yet on January 1, 1919, there were 22,395 sheep in the county. At that time they had an average value of $12.00 per head.

Poultry is raised on practically every farm, and many of the farms have some income from this source, although very few specialize in poultry husbandry.

Horses have been depended upon in the past for all of the

field work. During the last few years many farmers have purchased tractors and are doing much of the plowing and other heavy work of the farm with these machines. In most cases the tractors are proving to be satisfactory, especially on the larger farms and they are actually replacing some of the horse labor. The majority of the farm work, however, is still being done with horses, and in 1919 there were 12,247 horses and mules in the county. There are but few farmers that make a specialty of breeding horses, but quite a number raise from one to three or four colts and keep themselves supplied with working stock and frequently have a team to sell.

There is a very wide range of topography in Walworth County, and this has had some influence upon the development of agriculture and the types of farming which are followed in various sections. The topography ranges from level to extremely rough and broken. On the level prairies, agriculture is very highly developed, and practically all of the land is highly improved. On the most broken areas, such as are included in the morainic belts, some of the land is too steep to be used for cultivated crops and has value only for grazing purposes and forestry. Between these two extremes all graduations are found. It may be said, however, that there is only a comparatively small total area which is too steep to be used for cultivation, although some of the fields which are now being tilled are subject to more or less erosion because of the steep slopes.

In the following table there is given a list of the various crops which are grown in the county and the acreage devoted to each, covering a period of several years. It will be noted that these figures are taken from the United States Census reports and partly from the records of assessors.

STATISTICS OF FARM CROPS

			1879 Census	1909 Census	1917 Assessors	1918 Assessors	1919 Assessors
Acreage of all Cultivated Crops				168,444	177,147	181,367	----------
Clover and Timothy	Acres		32,844	44,760	45,390	35,564	36,002
	Yield		----------	----------	1.5 T.	1.4 T.	1.7 T.
Corn	Acres		63,456	58,036	62,200	57,621	60,648
	Yield	Grain	38.7 Bu	----------	----------	38 Bu.	48 Bu.
		Silage	----------	----------	----------	8 T.	8.2 T.
Oats	Acres		52,167	34,293	38,620	41,438	41,780
	Yield		42.6	----------	51	54	27
Barley	Acres		10,135	24,423	19,400	29,988	17,689
	Yield		31	----------	36	39	27
Spring Wheat	Acres		----------	574	2,600	8,044	14,948
	Yield		1,091	----------	23	29	15
Winter Wheat	Acres		----------	77	375	165	396
	Yield		----------	----------	24	35	24
Rye	Acres		1,466	938	1,500	1,395	2,318
	Yield		17	----------	20	24	18
Potatoes	Acres		2,203	3,054	2,900	2,388	1,839
	Yield		98	----------	99	84	61
Alfalfa	Acres		----------	1,538	3,100	1,507	2,933
	Yield		----------	----------	2.6 T.	2.4 T.	2.8 T.
Buckwheat	Acres		383	332	150	232	153
	Yield		10	----------	15	13	11
Peas (dry)	Acres		----------	----------	120	265	148
	Yield		----------	----------	----------	19	15
Beans (dry)	Acres		34	10	16	56	10
	Yield		12	----------	----------	17	11
Marsh Hay	Acres		11,038	7,927	4,500	4,832	5,571
	Yield		----------	----------	1.3 T.	1.4 T.	1.4 T.
Tobacco	Acres		30	15	15	10	6
	Yield		1,341 lbs.	----------	----------	1,200 lbs.	1,200 lbs.
Sugar Beets	Acres		----------	44	----------	226	194
Peas for Canning	Acres		----------	42	----------	371	417
Flax	Acres		17	----------	----------	15	55
Sorghum	Acres		59	----------	----------	----------	----------
	Yield		75 gal	per acre			

From this table it will be noted that the most important crops from the standpoint of acreage are corn, oats, hay, barley, and wheat. In addition to these there are a number of other crops which are quite important, but which have a smaller acreage.

Corn occupies a larger total acreage than any other crop. In 1919 there were 60,648 acres which produced an average yield of 47 bushels to the acre where the corn was harvested. Where the corn was cut for silage, it averaged 8.2 tons per acre. During this same year 51% of the corn was cut for silage. Corn is grown in all parts of the county and on all

soil types, but under present conditions the Carrington and Waukesha silt loams are the most favored for corn production. When thoroughly drained the Clyde silt loam is undoubtedly the best corn soil in the county. Its acreage, however, is limited, and at present only a small proportion of this type of land has been reclaimed by drainage.

Oats were grown on 41,780 acres in 1919 and produced an average yield of 27 bushels to the acre. The yield of this crop varies greatly from year to year. The average yield for 1918 was 54 bushels, and in 1917 it was 51 bushels. Oats are grown on practically all of the well drained soils and produce satisfactory yields except on the extremely sandy soils.

Timothy and clover are grown on about 36,000 acres and in 1919 yields about 1.7 tons per acre. During this year over 60% of the hay crop consisted of mixed timothy and clover. Clover alone made up about 13% and timothy alone made up about 30% of the total acreage.

While barley is grown to some extent it does not cover one-half the acreage devoted to oats. In 1919 there were 17,689 acres yielding a little better than 27 bushels per acre. In 1918 the acreage was over 29,000 and yielded 39 bushels to the acre. In 1917 it was about 19,000 with 36 bushels as the average yield. Barley is grown in all parts of the county and does fairly well on a wide range of soils.

Of the wheat which is being grown, very nearly all of it consists of spring wheat. In 1919 there were 14,948 acres of spring wheat and only 396 acres of winter wheat. The yield of spring wheat was only 15 bushels to the acre, while the winter wheat yielded 24 bushels to the acre. In 1917 spring wheat yielded about 23 bushels per acre and winter wheat, 24 bushels. Wheat is confined to the heavier soils of the county, and it does very well on the Miami silt loam. It is also grown quite extensively on the prairie types.

Rye is grown to a limited extent, and in 1919 there were 2,318 acres having yields of 18 bushels per acre. The yield the previous year was 24 bushels per acre. Rye is confined chiefly to the northern part of the county and is grown most extensively on types of a sandy nature.

Potatoes are grown chiefly for home use, and as a rule there are very few produced on a commercial scale. In 1919 there were 1,839 acres, which yielded only 61 bushels per acre. In

1918 the yield was 84 bushels per acre and in 1917 it was 99 bushels per acre. Potatoes make good growth on the light-colored sandy soils, although they are not confined to the sandy types by any means. One of the finest fields that was ever seen was grown on Waukesha silt loam. In this field there were 100 acres, and the average yield was 150 bushels per acre.

Alfalfa is coming to be a very important crop in Walworth County, although the present acreage is not large. In 1919 the reported acreage was 2,933 acres which produced an average yield of 2.8 tons. Alfalfa is grown in most parts of the county, but appears to do best on the Miami soils. These are very well drained and the structure of the subsoil is such as to permit the easy development of the large root system. The deep subsoil of these types also contains considerable lime carbonate which is favorable to the growing of alfalfa.

Peas are grown both for seed and for canning. In 1919 there were 148 acres that were allowed to mature, and the average was 15 bushels per acre. During the same year 417 acres were used for canning purposes. There are several canning factories in the county, and these usually have branch viners scattered throughout a considerable territory. The farmers bring the peas to the viner. They furnish the power for operating the viner, and the company hauls the shelled peas to the central canning plant from the viner. Where the farmers furnish the power and labor for running the viners, the viners are returned to the farmers for feed and silage. Where the canning company furnishes all of the labor and power they retain the vines for silage and sell them back to the farmers. The vines are usually put up in the form of silage and utilized during the late summer and early fall as feed. The varieties of peas grown for canning are the Alaska, which is a very early variety, Perfection, which is medium early, and Horsford, Rose Garden, and Peerless, which are late varieties. The yield of peas for canning usually averages from 1,500 to 1,800 pounds per acre, though 3,000 pounds per acre are not uncommon. The average income is from $50 to $60 per acre, though returns of $100 per acre are not uncommon.

Inoculation is practiced in growing peas to some extent, but the practice is not general. It is believed that the inoculation will pay on all new land and will insure a better stand and

bigger yield. Many also consider it advisable to inoculate old land, especially where peas have not been grown before. It is a poor policy to grow peas on the land more than two years in succession, but it is better to grow them for one year, and then other farm crops, haing peas as one member of the regular rotation. A rotation which was found to be practiced to some extent with peas consisted of hayland which was top dressed with manure in the fall or winter and in spring plowed for corn. If corn had occupied the field for one year, peas would be grown followed by buckwheat, although the practice of growing buckwheat is not very common. The next year the field was again devoted to peas followed by small grain, seeded to clover and timothy. The peas are sown at frequent intervals so that the crop will not mature all at the same time. By sowing at intervals and using different varieties the period of harvesting can be spread out over several weeks.

Peas are grown on quite a variety of soils, although the Miami silt loam doubtless gives best results. When grown on the dark-colored soils and those especially high in organic matter, there is danger of the vines becoming too large. The Carrington silt loam, however, is used quite extensively for the growing of peas in some parts of the county.

In connection with the canning industry sweet corn is also handled by some of the same factories which can peas. The Evergreen is an early variety of sweet corn, and the Shoepig is somewhat later. The average yield of snapped ears per acre runs from two to three tons. When the ears are snapped the stalks are usually used for silage. This sweet corn is grown chiefly on the Carrington silt loam, although it is not confined to this type.

Marsh hay is another crop that is harvested, but no thought need be given to its cultivation. In 1919, 5,571 acres were harvested, yielding an average of 1.4 tons per acre.

Cabbage is one of the special crops and 141 acres were devoted to it in 1919. Sugar beets were grown on 194 acres, flax on 55 acres, tobacco on 6 acres, and beans on 10 acres. Sorghum is grown to a very limited extent, and the acreage does not seem to be increasing.

The production of fruit is limited chiefly to apples and small bush fruits, including berries. There are few commercial orchards, but nearly every farmer has a few trees on which

apples are grown for home use. The bush fruits appear to do very well and are grown for home use in nearly all parts of the county. The trucking industry has not developed to any marked extent in this county, chiefly because of its distance from large centers of population. There is some trucking around the small towns, but this is only a comparatively small acreage. Near Lake Geneva celery is being grown on marsh land and shipped to outside points as well as being marketed at home.

A large proportion of the crops grown in the county are marketed in the form of dairy products, as pork and beef Some hay is sold, but by far the greater proportion is fed on the farms as is also the case with the barley, oats, and corn.

ADAPTATION OF CROPS TO SOILS

It is generally recognized by practically all farmers that some crops are better adapted to certain soils than other crops, and there has been a gradual development along this line so that the crops which are most extensively grown on the various types at present are those which are most suited to those soils. This fact, however,must be kept in mind that on any farm it is desirable and necessary to raise different crops in order that various feeds may be produced; that rotations may be practiced and the best methods of soil improvement followed. It is evident, therefore, that no one crop can be grown exclusively on soil which may seem to be best adapted to that crop. It is generally recognized that the prairie soils are well adapted to corn production. Yet it is not considered advisable to grow corn to the exclusion of other crops on this land. The Clyde silt loam when thoroughly drained is one of the best corn soils in the state. Yet even on this soil other crops should be grown in rotation with corn. Such crops as rye and potatoes are grown more extensively on the sandy types than on the heavy soils. It is a generally admitted fact that small grains will produce a higher quality on the light-colored heavy soils than on the prairie lands, and there is also less danger from lodging. It is also true that when sugar beets are grown they have a slightly higher sugar content when raised on the light-colored heavy soils than when grown on the prairie soils or Clyde silt loam. However, the tonnage is usually larger on such soils as the Clyde silt loam, so that the total sugar yield is frequently larger on the dark colored soil. Farmers in general recognize

that soils of Miami and Rodman series where not too rough are well suited to alfalfa because of the large amount of lime which they contain. There is still much to be learned, however, in regard to the adaptation of crops to the different soils, and it would be well for every farmer to make observations relative to the behavior of different crops and different varieties upon the various soils, and to be guided as far as practical by the results of these observations.

METHODS

The methods of farming which are being followed in Walworth County at present are such as tend to the higher development of agriculture through the conservation of soil fertility. Gradually people are coming to recognize the importance of conserving the fertility and of following such methods as will permanently increase the productivity of the soil. Many farmers are taking advantage of the service offered by the Wisconsin State Soils Laboratory which makes it possible for any farmer to have a careful examination made of the soils of his farm. The results of chemical analysis and physical examination of the farm provide the information as a basis of a report outlining methods for the improvement of soils. As a result of this line of work many farmers are beginning to use lime to correct the soil acidity and are using such fertilizers as are necessary to supply the elements which the soil most needs. More care is being used in the conservation of stable manure, and this is often being applied to the land as rapidly as it is produced.

In connection with the handling of the corn crop which is one of the most important crops, it may be said that usually over 50% of this crop is put into the silo, the remainder is usually husked, but a small part is harvested by stock and is frequently referred to as "hogging off" corn. Sometimes cattle are also turned into the field and allowed to harvest the crop in part. When this is done cattle are usually followed by hogs.

In connection with the raising of grains many farmers thresh directly from the field, while others stack the grain and thresh later in the season, and some store the grain in barns and do not thresh until late in the fall.

COMMERCIAL FERTILIZERS AND MANURES

Analyses of the soil of Walworth county show that much of the land is somewhat deficient in phosphorus as is true of many Wisconsin soils. The light colored upland types are low in nitrogen and organic matter, the black prairies are usually acid and in need of lime and the peat marshes are low in both potash and phosphorus but are usually not acid.

The correction of these defects is a very important problem which cannot be solved except after making a very thorough study of the soils and types of farming followed.

The chemical and physical analyses show that these soils vary greatly in their composition and they also vary greatly in their needs. Some require all three of the most essential elements of plant food to keep up their productivity as well as lime, while others require only one element. As compared with other soils of the state the land in this region may be considered of very good quality and no more in need of fertilization than the other highly developed agricultural regions of the state. To correct minor defects, however, and to keep up and increase the fertility certain lines of improvement should be followed.

In supplying fertilizer materials to the soil the most economical sources available should be drawn upon The most common source of fertilizer for the farms is stable manure. The supply of this is greater in a dairy region than in a grain raising region, but even here the supply is not sufficient to meet the needs of the land.

The readily available plant foods in the form of commercial fertilizers are now being used to some extent in this region. In 1919 there were 149 farms reporting the use of commercial fertilizer and for this the sum of $15,293 was expended. In 1919 there were 2,195 farms reporting expenditures for feed, with a total cost of $1,017,947. Much of this money could be saved by the judicious use of fertilizers and the growing of such crops as alfalfa which have a high feeding value equal to wheat bran.

The analysis of the soil will give some indication as to the need of certain fertilizers, but the growth and behavior of the crop itself will be a more certain guide as to the needs of the soil.

From soil analysis, crop studies, and field tests it has been clearly demonstrated that one element in which many of the soils is deficient is phosphorus. This can best be supplied in the form of acid phosphate, which is readily available, or it may be applied in the more slowly available forms of raw rock phosphate or bone meal. In the trucking region where crops are forced, and where large amounts of readily available plant food must be at hand the complete fertilizers are most commonly used, and applications run as high as 1,000 pounds per acre or more. Frequently liberal applications of mixed fertilizers are used to supplement stable manure, and it is usually such combinations which produce the largest and most economical yields. In the improvement of the peat marshes potash alone is required first, but after a number of years cultivation it is probably that phosphorus will be needed also. This is especially true of the marshes which do not need lime. Where lime is needed, usually potash and phosphorus are both required.

For general farm crops the usual application of acid phosphate is from 300 to 400 pounds of 16% material per acre when sown broadcast. If applied in the row or hill about half this amount is sufficient. Subsequent applications should be at the rate of about 200 pounds every three or four years thereafter.

The most satisfactory way to apply commercial fertilizers is with a fertilizer spreader, or with a fertilizer attachment to a grain drill, or corn planter. If sown broadcast it should be put on the plowed ground, evenly distributed and worked well into the soil. Care should be taken that it does not come into contact with the seed. Commercial fertilizers may also be applied by spreading them over the top of a load of manure in the manure spreader. An application should be made at least once during each rotation, and preferably on the small grain crop, or on the corn. Frequently both of these crops are given an application.

In supplying nitrogen to the soil, the most economical form is through the growth of legumes.

For more information on The Use of Commercial Fertilizers on Dairy Farms, see bulletin No. 341, Wisconsin Experiment Station.

LIMING

Walworth County is located within the glacial limestone region of Wisconsin, and a considerable proportion of the soil forming material has been derived from limestone debris. The deep subsoil of many of the types is well supplied with lime and the surface soils in many places is neutral or only very slightly acid. In fact, many tests have been made where the soil does not show any reaction whatever. The types which are most apt to show acid reaction and which seem to be in need of lime are soils of the Carrington and Waukesha series. The soils of the Miami series also show slight acidity in places. The peat soils are also slightly acid in places but there is less acidity in the low lands of this region than in the central and northern parts of the state.

The degree of acidity on any farm may be quite variable. It is quite important therefore that before an expenditure is made for lime that the soil should be tested and the crops observed to determine the actual need for lime.

It should be kept in mind that when a soil is acid according to a laboratory test, it does not necessarily mean that that soil will respond profitably to the use of lime. The story which the crop tells should also be considered. Failure of clover and alfalfa, or a growth of sorrel may be indications of acidity. When there appears to be a medium need for lime, from 2 to 3 tons of finely ground limestone should be applied per acre. The amount to be used will usually vary with the degree of acidity, the character of the soil and the crops to be grown. Such crops as alfalfa, sweet clover, peas, cabbage, onions, and lettuce have a high lime requirement. Clover, garden beans, barley, hemp, turnips, and radishes have a medium lime requirement, while vetch, white clover, oats, rye, blue grass, potatoes, sorghum, and others have a low requirement for lime.

Ground limestone appears to be the most economical form of lime which can be extensively utilized. Lime should be applied previous to planting the crop which is to be benefited. It should be applied to plowed land and thoroughly worked in by harrowing. Either fall, winter or spring applications may be made.

The best way to apply lime is with a regular spreader made

for this purpose, and there are a number on the market. A manure spreader may also be used by first putting in a thin layer of manure and spreading the limestone evenly on top of the manure. Where several farmers are so situated that they can work together, a lime spreader may be secured jointly for this purpose. The end-gate type of spreader has given good results in spreading dry or moist limestone.

After making a first application of two tons or three per acre, it is not likely that another application will be needed for four to six years, and the need should be determined by the story which the crops themselves tell.

It should be remembered that most acid soils are also deficient in available phosphorus,* but applying lime will not add to the total amount of phosphorus in the soil. The need of phosphorus may be so great that but little result will be secured from liming until phosphorus is also added. Frequently the application of phosphorus alone to an acid soil will result in larger increases than the use of lime alone, and for this reason it is important that both deficiencies should be corrected to secure the most economical production.

Several demonstration plots on which lime and phosphate fertilizers were tried out in Walworth county bring out the relation between the needs of lime and phosphorus. In several instances it was observed that where lime alone was applied to Carrington silt loam, for example, that there was no increase in yield, but where acid phosphate was also added a very liberal increase in yield was secured. The acid phosphate when used alone did not give so great an increase. It is apparent, therefore, that these materials must sometimes be used together, and the only way to determine this accurately is by actual field tests.

DRAINAGE

Walworth County has over 80,000 acres of land over which the natural drainage is deficient, according to the classification of the soil survey, and which must be provided with some form of drainage before cultivated crops can safely be grown from year to year. Of this poorly drained land possibly 50% consists of peat, while most of the remainder is low, poorly drained mineral soil which belongs chiefly to the Clyde series.

* For a discussion of the use of commercial fertilizers see page 82.

The largest proportion of the Peat marshes are confined to the north half of the county, while the areas of Clyde soil are pretty well distributed over the county.

The following table taken from the 1920 census gives statistics covering the extent to which the development of drainage enterprises have been carried in this county.

Drainage Statistics for Walworth County, Wisconsin

	Acres
All land in operating drainage enterprises	8,910
Improved land in drainage enterprises	4,048
Open ditches completed. Miles	23.3
Tile drains completed. Miles	7.5
Maximum size of tile, diameter in inches	14.0
Area drained by open ditches and tile drains. Acres	3,820
Area on which corn was chief crop grown on reclaimed land	4,048

It will be observed from this table that there are nearly 9,000 acres in drainage enterprises and that about 30 miles of drains, open and tile, have been constructed.

The types which offer the best opportunity for drainage from the standpoint of productivity are the soils of the Clyde series. When well drained these soils make the best corn land in the State, and they are also well suited to cabbage, sugar beets and hay. On the lighter soils of the series onions will do very well, though not grown in the area to any extent at present.

The drainage of the peat land offers opportunity of agricultural development, but the problems in the improvement of this type of land are more numerous and difficult than is the case with the Clyde soils. The peat requires the use of commercial fertilizers, as indicated elsewhere and special methods of cultivation are also called for, but with proper handling peat lands can be made to produce profitable crops, and their drainage will add materially to the productive acreage within the county.

If all of the poorly drained land of the county were improved so that the gross income would be only $10 per acre there would be added over half a million dollars to the farmers annual income. Such an important project is worthy of the most careful study by every public spirited citizen of the region. The best results can be secured only through cooperation of all parties concerned.

Where areas of low land include land owned by several

people the owners can readily form a drainage district and issue bonds for the improvement. This is the method which has been used and a number of drainage districts have already been formed in Walworth County. In this way the cost can be spread over several years, and can actually be paid for from the products of the improved acres. Assistance for the development of such projects can, and in fact must, be secured from the State authorities, who pass upon the feasibility of the project before the courts will permit the organization of a district. Where areas of marsh are small and confined to one farm from which there is an outlet the drainage can be installed without the cooperation of the neighbors. This has been done in a number of places, and small tiling systems are not uncommon in Walworth County. There are thousands of acres in small tracts which have not as yet been improved, but which would make good productive land when drained.*

EQUIPMENT

Most of the farms in Walworth County are very well kept. The farm buildings are usually quite substantial. The barns are large, usually built on stone foundations, and are kept painted and in good repair. The farm houses are neat and attractive in appearance. Many of the farms are equipped with silos, and in 1918 there were 793 in the County. In 1921 there were 2262 silos. Farm machinery of the most modern types is in common use throughout the county. There are many tractors in use, manure spreaders, hay loaders, side delivery rakes, two-row cultivators, lime and fertilizer distributors, and other modern implements. In 1921 the number of tractors in the County was 345 and they are gradually increasing in number. The live stock upon the farms is, as a rule, well bred, and there are many herds of pure bred live stock throughout the County.

A number of dairy farms are equipped with milking machines. Electric lighting plants are common and many farm houses have furnace heat, running water and are as modern in their equipment as the houses in the cities. Nearly every farm has a telephone, an automobile and rural free delivery service reaches all parts of the County.

* For additional information on drainage see Bulletins of the Wisconsin Experiment Station No. 284 and 309.

Walworth County as a whole is a region of high agricultural development and highly developed and prosperous farms are the rule rather than the exception.

LABOR, FARM TENURE AND LAND VALUES

The question of farm labor is one which has been rather difficult in the last few years. With the development of manufacturing in Racine, Kenosha, Beloit, Janesville and Milwaukee, there has been a gradual drawing away of labor from the farms. The highest point in farm wages was reached in 1920 when as much as $60 to $70 per month and, in some cases, even $100 was paid. In 1921 there was a marked decrease in the farm wages. The pre-war wage was usually from $35 to $50 per month for the best farm labor when secured by the year, and frequently included house and garden for the married help. Day labor, of course, commanded a larger wage, but was needed for only a part of the season. It may be said that the raising of pure bred live stock requires a higher grade of labor than where a system of purely grain farming is followed.

In 1920 the average size of farms in Walworth County was 118.8 acres per farm, and there were at that time 2803 farms in the county. In 1910 there were 64.4% of the farms that were operated by the owners. In 1920 there were 66.2% of the farms that were operated by the owners. This is a much smaller number than was operated by the owners in 1880, since at that time 86.4% of the farms were operated by the owners. In Walworth County, and especially in the region of Lake Geneva and Delavan Lake there are a large number of farms owned by non-residents, chiefly wealthy people from Chicago and elsewhere who have their summer homes in this region, and many of them own and operate under a manager considerable tracts of land. Many of these places are very highly developed. The farms which are operated by tenants are worked both on the share and on the cash basis. The share which the tenant receives is quite variable, depending on the amount of stock and equipment which he furnishes. The share usually ranges from a third to a half, sometimes less where the owner furnishes all the stock and equipment.

There is a wide range in the selling price of the land in Walworth County, due to the valuation of the land itself and also to location and improvements. Some of the best farms which

do not have a location making them valuable as summer homes have a selling value of as much as $200 or $300 per acre, though this is higher than the average for the farms in any community. The other extreme is found in the land within the extremely rough and hilly sections where land can be purchased from $25 to $50 per acre. Between these extremes all variations in land values may be found. The land near or adjoining the lakes frequently has a much higher selling price, due to its desirability for summer homes and being especially attractive to non-resident people who have farming ambitions and wish to combine them with recreation. The average assessed valuation of farm land in Walworth County in 1900 was $48.26 per acre. In 1910 this was $69.38, and in 1920 $116.14. The average value of farms in 1880 was $5,030 and in 1890 this was $7,000. In 1900 it had increased to $8,928. In 1910 the average value per farm was $13,265, and in 1920 it was $22,672. The following table gives information concerning the farm values and tendancy as found in the U. S. Census.

FARM AREAS

Value and Tenancy—Walworth County
(U. S. Census)

	1880	1890	1900	1910	1920
Population of County			29,259	29,614	29,327
Number of Farms	2,761	2,660	2,754	2,803	2,779
Average Size of Farms	121A	124A	123A	120A	118.8
Percentage of Land in Farms	93.4	92.5	95.1	94	92.1
Valuation per Acre			$48.26	$69.38	$116.14
Percentage of Farms operated by Owner	86.4	75.27	69.1	64.4	66.2
Value of all Property per Farm	$5,030	$7,000	$8,928	$13,265	$22,672

CROP ROTATIONS

It is of great importance in selecting crops to grow, that careful consideration be given to the question of climate. This is about the only factor which the farmer absolutely cannot control. A poor soil may be improved, better markets may be found, and better labor secured, but the farmer is powerless to change climatic conditions. He must, therefore, select such crops as are suited to his climate.

The soil is also a factor of great importance. As a general

rule, small grain crops do better on heavy than on light soils, and the same is true of grasses grown for hay. On the other hand, the same variety of corn requires shorter season for maturity on light than on heavy soil. Rather light soils and those of intermediate texture are better adapted to potato growing and root crops. Therefore, on lighter soils the greater acreage should be devoted to cultivated crops than on heavy types.

Shipping and marketing facilities must also be considered in planning a rotation. The farmer located on a sandy loam farm close to a railroad station or home market will often find it profitable to include potatoes in his rotation. If he is located six or seven miles from a station, the profits from growing potatoes will be much lessened. It will then pay him better to raise more corn for stock feeding, and to convert his crops into dairy products which are less bulky, and which for the same bulk have a greater value.

Some of the other things which we should keep in mind regarding a good rotation are that it helps to control weeds. It also aids in controlling plant diseases, and serves to check insect pests. Following a good rotation increases the humus supply in the soil, and insures maintaining a good amount of available nitrogen in the soil. It helps to distribute the labor efficiently throughout the year. It will also increase net returns from each acre, and improve the general appearance of the farm.

The rotation of crops which is most common probably consists of corn, followed by small grain, which is seeded to timothy and clover, after which hay is cut for one or two years. Corn may be grown on the same field for two years in succession, especially on the prairie soils, or the second year may be devoted to peas instead of corn, but usually on a much smaller acreage. Small grains may also be grown for two years in the rotation. The manure is most frequently applied to the corn ground and this is frequently plowed in the fall. The manure is sometimes spread on the plowed ground in the winter or on the land which is to be plowed in the spring. The question of rotations is receiving more careful attention now than in previous years, and most farmers follow some sort of a rotation, though not always the one most suited to their particular soils.

Potato raising when properly managed is a profitable industry in many parts of the state. Although good crops may be grown on heavy soils, the sandy loams are especially well adapted to potato production. For best results, this crop should be grown in rotation with other crops, and should always follow a legume of some kind. Potatoes should not follow corn or corn potatoes as both crops draw heavily on the fertility of the land. In the rotations which have been given, potatoes can be planted as one of the cultivated crops. It is better to apply manure to the cloer crop rather than just before planting to potatoes, for scab is more common when potatoes are planted on freshly manured land. The three-year rotation just described is excellent for sections where potatoes are grown extensively. As a rule cropping to potatoes oftener than once in three years is not recommended.

The growing of peas for canning is important in some sections, and this crop may be introduced into the rotation very readily. A four-year rotation may consist of small grain, clover, a cultivated crop, followed by peas This may be made a five-year rotation by adding timothy and cutting hay two years.

The growing of sugar beets is also an important industry, and beets may also be introduced into the rotation without difficulty. It is best not to have the beets follow or precede the corn, but the crop may follow barley or other small grain. Beets may simply take the place of corn in a three or four year rotation, Cabbage may be substituted for beets without difficulty.

Hemp is an important crop in Wisconsin and could be grown in Walworth county as it is now being grown in Racine and Kenosha counties. The most satisfactory place in the rotation for this crop is after corn. The corn should have been preceded by clover sod, well manured and plowed in the fall. Hemp may also follow potatoes, cabbage, or any other cultivated crop. Hemp should not follow timothy meadow, blue grass sod nor pasture in Wisconsin. Neither should hemp follow any small grain unless the soil is very well supplied with manure. Hemp will leave the soil in splendid physical condition for any spring sown small grain. It also leaves the land relatively free from weeds, and it is, therefore, a good crop to precede sugar

beets, or canning peas. The following rotations with hemp have been found applicable to Wisconsin:

Small spring grain crop (seeded down to clover)
Clover for hay and pasture (manured and fall plowed)
Corn, potatoes or similar crops
Hemp (then back to small grain and clover)

Another rotation covering three instead of four years is as follows:

Small grain crop (seeded to clover)
Clover (manured and fall plowed)
Hemp (then back to small grain and clover)

AGRICULTURAL HISTORY

The agricultural history of Walworth County dates back to 1836 when the first farm operations were started in Section 25, in Spring Prairie township During that year about 100 acres were plowed. Before the end of that year there were in the county about 100 head of cattle, 50 sheep, and a few hogs. The first farm operations were started on the prairie land where practically no clearing operations were necessary. Early historical references indicate that at another point where farm operations were started early was the prairie in Walworth township. Here the first plowing operations were on a rather extensive scale, and fields fully two miles in length were laid out.

The crops most extensively grown in the early history of the county are indicated by the following report covering the year 1839. During that year wheat was produced to the extent of 59,580 bushels; barley, 1,499 bushels; oats, 25,155 bushels; rye, 205; corn, 40,837; potatoes, 42,455; and hay, 3,624 tons.

The population in 1839 was 2,611. Because of the marked fertility of the soil in this region and the success with which the early settlers met, settlement became quite rapid as soon as information concerning the bountiful crops reached the surrounding territory, and by 1842 the population had reached 4,618 By 1880 the population had increased to 22,632. Between these two dates there was a rapid growth not only in the population, but in the amount of land under cultivation. Since 1880 the population has remained nearly the same as has also the number of farms in the county.

There has, however, been a considerable change in the

acreage of the different crops which have been and which are now being grown. In 1879 wheat was grown on 26,080 acres, and since that time the acreage has gradually been reduced. In 1889 it amounted to 13,302 acres, and in 1899 to 1091 acres. In 1909 it was 664 acres. On the other hand the acreage of corn, while relatively large in the early history of the county has always remained high, as has also the acreage of oats. The reduction in the acreage of wheat was partly due to the cinch-bug and partly to low prices. As the acreage of wheat was reduced a more diversified system of farming was followed.

The first railroad was built through Walworth County in 1851. This was a part of the line now known as the Chicago, Milwaukee and St. Paul, and was completed from Milwaukee to Prairie du Chien in 1856. The line which is now the Chicago and Northwestern connecting Racine and Beloit was completed in the county in 1856.

CLIMATE

Walworth County is practically all included within the Rock River Basin, which is one of eight climatic provinces in Wisconsin.* This section has the longest growing season of any in the State, averaging about 170 days, which is as long as that of central Illinois, longer than central Indiana or Ohio, and about equal to the Valley of Virginia and central Maryland. The annual temperature curves also show here a northward bend and though the winters (20 degrees) are cooler than along the lake, the springs (45 degrees) and summers (70 degrees) are warmer. Hence this section is the best corn area in the state. The temperature of the Rock River basin in summer is similar to that of northern Illinois, Indiana, Ohio and southern Pennsylvania, while in winter it resembles southern Vermont, northern Iowa, or southern Montana. During seven summer days, on the average, the thermometer may go as high as 90 degrees and during five winter mornings fall 10 degrees below zero or lower. The average rainfall ranges from 31 inches at Madison to 33.77 inches at Brodhead.

The mean annual temperature at Delavan is 45 degrees. The rainfall is 31.4 inches. The absolute maximum temperature is

* For full information on the Climate of Wisconsin and its relation to Agriculture see Bulletin of Wisconsin Experiment Station, No. 223.

103 degrees and the minimum is 29 degrees below zero. Extremes as marked as these are infrequent and of short duration.

The records at Delavan show that the average date of the last killing frost in the spring is May 17 and the average date of the first killing frost in the fall is October 6. This gives an average growing season at Delavan of about 142 days which is somewhat less than for the climatic province as a whole.

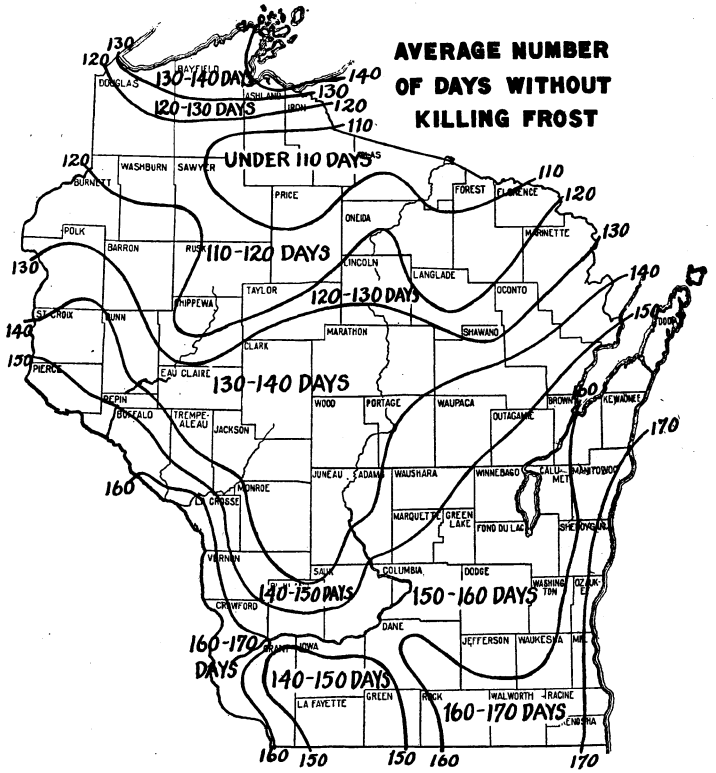


FIG. 3—SKETCH MAP OF WISCONSIN SHOWING THE AVERAGE NUMBER OF DAYS WITHOUT KILLING FROST

The average rainfall is normally well distributed throughout the year and especially during the growing season when most needed. The average for the three spring months is 8.56 inches, for the summer 10.80 inches and for the fall 8.07 inches. It is true, however, that during July and August there are occasional dry spells during which crops actually suffer from the lack of moisture. Dry spells may occur in the fall also, but as crops reach or approach maturity, a reduction in the

supply of soil moisture is not so serious a matter as when the plants are making the main part of their growth. While these dry spells frequently cause a reduction in the yields, they have never been so severe as to cause even an approach to a crop failure.

In the following table are shown the more important climatic data as compiled from the records of the weather Bureau station at Delavan.

NORMAL MONTHLY, SEASONAL AND ANNUAL TEMPERATURE AND PRECIPITATION AT DELAVAN, WALWORTH COUNTY

Elevation of Station 920 Feet Above Sea Level

Month	Temperature			Precipitation		
	Mean	Absolute Max.	Absol'te Min.	Mean	Snow-fall	Prevail, wind
December	23.9	62	—27	1.49		S. W.
January	18.4	59	—28	1.43		S. W.
February	20.1	58	—29	1.25		N. W.
Winter	20.8	62	—29	4.17		
March	32.2	82	—20	1.84		S
April	46.1	88	15	2.87		N. E.
May	57.1	93	22	3.68		S. W.
Spring	45.1	93	—20	8.56		
June	66.7	99	30	3.56		S. W.
July	71.9	103	40	4.04		S. W.
August	69.5	101	34	3.20		S. W.
Summer	69.3	103	30	10.80		
September	62.4	99	24	3.96		S. W.
October	49.3	89	2	2.23		S.
November	34.8	77	—15	1.88		S. W.
Fall	48.8	99	—15	8.07		
Year	46.0	1030	—29	31.40		S. W.

FROST DATA AT DELAVAN, WIS.

Average date of last killing frost in spring.....May 17
Average date of first killing frost in fall.....October 6
Latest date of killing frost in spring.....June 8
Earliest date of killing frost in fall.....September 10
Average length of growing season at Delavan free from killing frost, 142 days, according to above table.

SUMMARY

Walworth County is situated in the southeastern part of Wisconsin and has a land area of 560 square miles, or 358,400 acres. The area of the lakes within the county amounts to approximately 14 square miles. The southern boundary line of the county is the Illinois-Wisconsin State line, and the eastern boundary is 24 miles from Lake Michigan.

The most important topographic feature within the county is the terminal moraine of the Lake Michigan and Green Bay glaciers. Within this morainic belt the topography ranges from rolling to extremely rough and broken. Outside of this belt the surface of the county ranges from level to gently rolling.

The drainage of the western part of the county is chiefly through Turtle Creek into Rock River. The drainage of the eastern part of the county is chiefly through tributaries of the Fox River which flows south into the Illinois River.

The county was established in 1838, but the first settlements were made in 1836. The population in 1920 was 29,327 of which 69.8 per cent was rural. The entire county is well provided with railroads and public highways, and all sections are well settled.

The climatic conditions are favorable for the high development of agriculture The mean annual rainfall as reported at Delavan is 31.42 inches. There is a normal growing season between frosts of approximately 167 days.

The agriculture of Walworth County consists of general farming in conjunction with dairying. The principal crops are corn, oats, barley, clover, timothy, alfalfa, and wheat. There are other crops of lesser importance and also some special crops, including rye, buckwheat, tobacco, potatoes, sugar beets, peas, and cabbage. Hog raising has been developed quite extensively in connection with dairying, and some beef cattle and sheep are also raised. Stock feeding for market is also practiced in some parts of the county, although not extensively.

Land ranges in value from $25 to $300 an acre. The lowest value is in the extremely rough and broken lands in the morainic belt, and the highest priced farms are on the prairie lands, which are highly developed and very productive.

The soils of Walworth County are derived chiefly from glacial drift, some of which has been worked and redeposited by the action of water. Nine series, represented by 19 soil types, including Peat, were recognized in the soil survey. A number of phases have also been shown.

The Miami series includes light-colored upland forest soils in the glaciated limestone region. The types in Walworth County belonging to this series are the Miami silt loam with a

deep phase and a level phase, Miami loam with a gravelly phase, Miami fine sandy loam and Miami stony loam. This series includes much first class farm land.

The Coloma fine sand is a light colored, extremely sandy upland soil which has been leached to a considerable extent and is now in an acid condition. This is the only type mapped in the Coloma Series.

The Rodman Gravelly loam occupies rough and broken ranges of gravelly hills which are made up chiefly of kames and eskers. The total area is limited but the contrast between this and other soils is very marked. The agricultural value is low, the soil being droughty.

The Carrington series includes dark colored upland prairie soils in the glaciated limestone region. The surface is level to gently rolling and the natural drainage is good. The soils are highly productive, though usually acid. The types mapped in this series are Carrington Silt loam and Carrington Loam with a gravelly phase.

The Fox series consists of light colored outwash or terrace soils, in the glaciated limestone region. These soils have developed under a forest cover. These soils have sandy or gravelly subsoils at varying depths, and the natural drainage is usually good. The types mapped are the Fox silt loam with a deep phase, Fox loam, with a gravelly phase, and Fox fine sandy loam.

The Plainfield fine sand is a light colored soil, very low in lime carbonate and usually acid, which occurs in terraces or outwash plains.

The Waukesha series consists of dark colored prairie soils occupying terraces or outwash plains. The types mapped are the Waukesha [illegible]loam with a deep phase, and Waukesha loam with a gravelly phase.

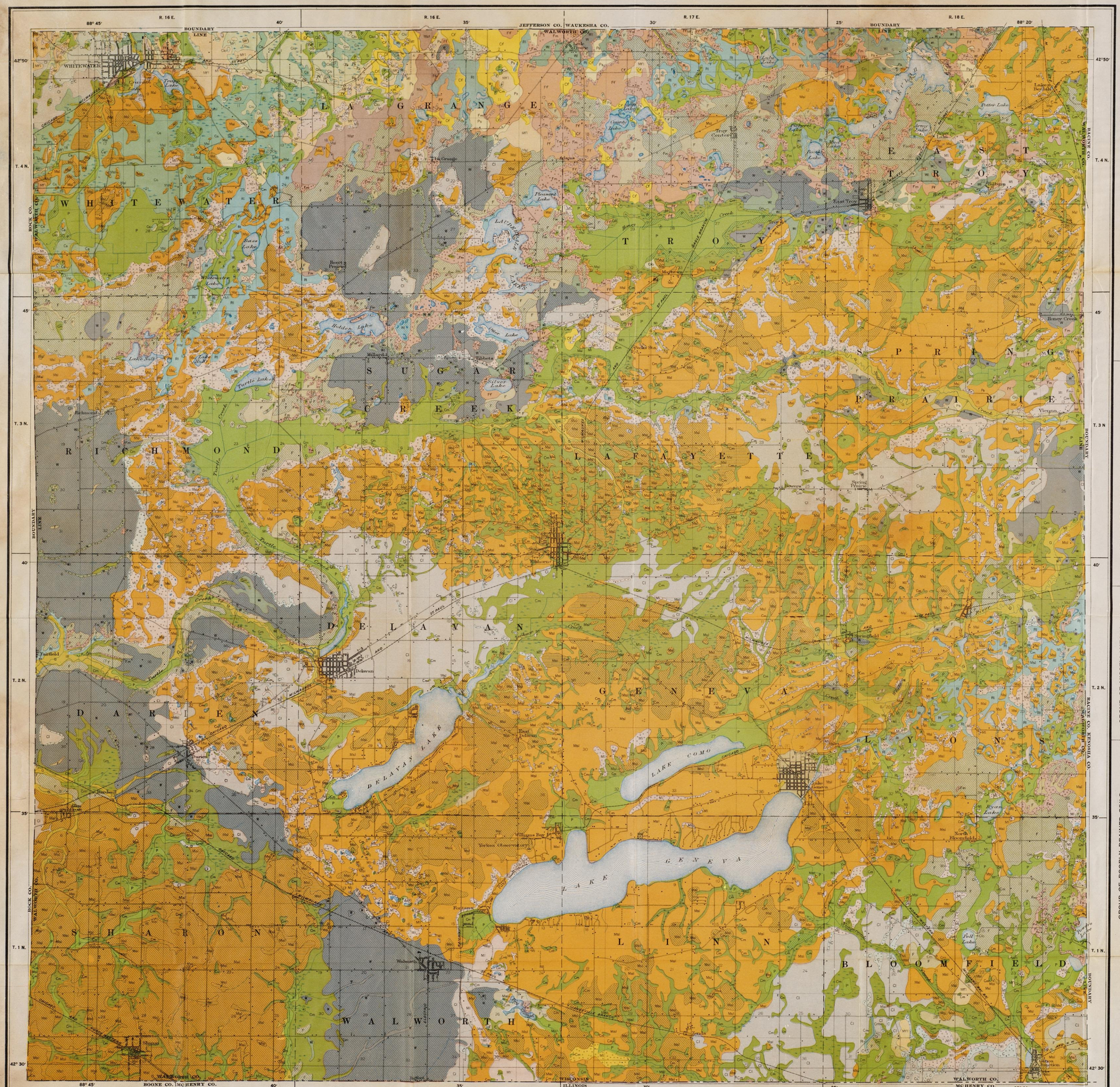
The Clyde series consists of dark colored low, poorly drained areas in the glaciated limestone region. Some of the material occurs as depressions in the glacial drift and some occurs as old lake beds or as poorly drained low terraces or outwash plains. When drained these soils make excellent land for corn, and some special crops. The types mapped are the Clyde clay loam, Clyde silt loam and Clyde loam.

The Genesee series includes the first bottom alluvial soils

somewhat variable in texture and subject to annual overflow. Only one type, the Genesee silt loam was mapped.

Peat consists of vegetable matter in varying stages of decomposition, which has mixed with it some mineral matter. Much of the peat contains as much as 80% of organic matter. It has been derived from decaying moss, grasses and other water loving plants. Along with the Peat a Shallow phase was mapped.

SOIL MAP OF WALWORTH COUNTY, WISCONSIN



KEY TO SOIL MAP

	NAME OF SOIL AND DESCRIPTION OF SOIL AND SUBSOIL	AREA IN ACRES	SURFACE FEATURES AND DRAINAGE	
GROUP OF HEAVY SOILS				
Msl	Miami Silt Loam *Light brown silt loam with yellowish or reddish brown subsoil grading into gritty clay loam at about 2 feet.*	81,024 Acres	*Surface undulating to rolling—somewhat bumpy in places. Drainage good.*	
Msd	Miami Silt Loam Deep Phase *Grayish brown silt loam with yellowish heavy silt loam subsoil. Silty clay loam below 2 feet. Three foot section free from coarse material.*	39,552 Acres	*Surface undulating to gently rolling. Mostly long gentle slopes. Drainage usually good. Slightly deficient along some lower slope.*	
Msl	Miami Silt Loam Level Phase *Gray silt loam, frequently mottled. Subsoil is gray or yellowish, mottled silty clay loam.*	9,856 Acres	*Surface flat to gently sloping. Drainage somewhat deficient. Soil rather cold and backward in spring.*	
F	Fox Silt Loam *Light brown, smooth silt loam with yellowish-brown silty clay loam subsoil. Gravel or sand at 18 to 30 inches.*	6,016 Acres	*Surface level or nearly so. Includes some pot-holes and terrace slopes. Drainage good.*	*For a more complete description of the soils in this group, for a statement of the crops grown and the methods of farming followed, and for a discussion of ways through which these soils may be improved, see Chapter II of the accompanying soil survey report on Walworth County.*
F	Fox Silt Loam Deep Phase *Grayish brown smooth silt loam, with compact silty clay loam subsoil to depth of 3 to 5 feet where sand or gravel is found.*	18,752 Acres	*Surface level. Drainage usually good; may be slightly deficient where heavy subsoil is deepest.*	
Cl	Carrington Silt Loam *Dark colored silt loam with yellowish-brown silty clay loam subsoil.*	24,256 Acres	*Surface nearly level to gently rolling. Natural drainage good.*	
W	Waukesha Silt Loam *Dark colored silt loam with heavy subsoil grading into gravel or sand at 24 to 30 inches.*	3,200 Acres	*Surface level. Natural drainage good.*	
W	Waukesha Silt Loam Deep Phase *Dark colored silt loam with heavy subsoil extending to a depth of 3 to 5 feet where sand or gravel is found.*	29,696 Acres	*Surface level. Natural drainage fair—somewhat deficient where subsoil is deepest.*	
GROUP OF LOAMS AND FINE SANDY LOAMS				
Ml	Miami Loam *Medium brown loam soil, gravelly in places, with gritty or gravelly clay loam subsoil.*	25,602 Acres	*Surface gently rolling to bumpy and hilly. Natural drainage good.*	
MFl	Miami Fine Sandy Loam *Medium brown fine sandy loam soil, with reddish brown sandy clay loam subsoil. Type somewhat variable.*	3,456 Acres	*Surface rolling. Drainage good.*	
Fm	Fox Loam *Light brown loam soil, gravelly in places, with heavy subsoil grading into sand or gravel at 24 to 30 inches.*	8,896 Acres	*Surface level. Drainage good.*	*For a more complete description of the soils in this group, for a statement of the crops grown and the methods of farming followed, and for a discussion of ways through which these soils may be improved, see Chapter III of the accompanying soil survey report on Walworth County.*
FF	Fox Fine Sandy Loam *Medium brown fine sandy loam soil with sandy clay loam subsoil, grading into sand and gravel.*	3,648 Acres	*Surface mostly level. Natural drainage good.*	
C	Carrington Loam *Dark colored loam with sandy clay loam subsoil. Some gravel stones in lower subsoil. Surface somewhat gravelly in places.*	2,968 Acres	*Surface nearly level to gently rolling. Natural drainage good.*	
Wl	Waukesha Loam *Dark colored loam, soil gravelly in places. Gritty clay loam subsoil grading into sand or gravel at 20 to 30 inches.*	2,688 Acres	*Surface level. Drainage good.*	
GROUP OF MISCELLANEOUS SOILS				
Rl	Rodman Gravelly Loam *Dark brown gravelly soil of variable texture, with gravelly clay loam subsoil grading into gravel beds at 8 to 12 inches.*	7,232 Acres	*Surface rough and broken. Drainage excessive.*	
Mst	Miami Stony Loam *Medium brown soil of variable texture and quite stony, with heavy subsoil grading into gravelly material in places.*	1,664 Acres	*Surface extremely rough and broken. Drainage good to excessive.*	*For a more complete description of the soils in this group, and a discussion of methods for their improvement see Chapter IV of the accompanying soil survey report on Walworth County.*
Cf	Coloma Fine Sand *Light brown, loose fine sand, with yellow fine sand subsoil slightly sticky at 30 to 40 inches.*	1,792 Acres	*Surface rolling. Natural drainage excessive.*	
Ps	Plainfield Fine Sand *Light brown fine sand with yellow fine sand subsoil. Coarser sand and gravel below 3 feet.*	1,408 Acres	*Surface level. Natural drainage good to excessive.*	
GROUP OF POORLY DRAINED SOILS				
Cs	Clyde Clay Loam *Black silty clay loam with heavy mottled clay subsoil. Thin layers of fine sand may be found in subsoil. Type variable.*	6,528 Acres	*Surface low, level or depressed, and natural drainage poor.*	*For a more complete description of the soils in this group and for a discussion of methods for their improvement see Chapter V of the accompanying soil survey report of Walworth County.*
Cm	Clyde Silt Loam *Black heavy silt loam, with drab or bluish mottled silty clay loam subsoil. Layers of fine sand are found in deep subsoil in places*	41,280 Acres		
Clo	Clyde Loam *Black loam with yellow to gray or mottled loam subsoil, becoming sandy in places. Heavy clay in places at about 4 feet.*	2,172 Acres		
G	Genesee Silt Loam *Dark brown silt loam, with yellow, drab or mottled heavy subsoil. Type quite variable.*	6,976 Acres	*First bottom land. Low, level, poorly drained and subject to overflow.*	
P	Peat *Light brown to nearly black partly decayed vegetable matter. Over 18 inches deep. Subsoil usually heavy though variable.*	28,032 Acres	*Surface low, level with poor drainage.*	
P	Peat, Shallow Phase *Light brown to nearly black partly decayed vegetable matter, less than 18 inches deep. Subsoil usually heavy, though variable.*	1,216 Acres		

CONVENTIONAL SIGNS

CULTURE *(Printed in black)*

- Secondary roads and trails
- Railroads, Steam and Electric
- School or Church, Cemeteries
- Stony and Gravelly areas
- Soil boundaries

DRAINAGE *(Printed in blue)*

- Streams
- Lakes Ponds, Intermittent lakes

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

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