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SOIL SURVEY IN COOPERATION WITH THE COLLEGE OF AGRICULTURE

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SOIL SURVEY

OF

DANE COUNTY

WISCONSIN

BY

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OF THE

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

AND

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OF THE

UNITED STATES DEPARTMENT OF AGRICULTURE

SURVEY CONDUCTED IN COOPERATION WITH THE UNITED STATES DEPARTMENT OF AGRICULTURE BUREAU OF SOILS

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INTRODUCTION.

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

The State of Wisconsin, working in 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. On this map boundaries between different soils are shown with black lines, while water courses, such as creeks, rivers and lakes, are in blue. The elevation of various localities is indicated with brown lines which are drawn through points of equal elevation. The difference in elevation between points on two adjacent lines is 20 feet. 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, work-ability, 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 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, through differing in other respects. A fine sand, for example, may be light colored and of alluvial origin, while another fine sand may be dark in color and of residual origin, while a third fine sand may have been blown into sand dunes by the wind, yet all of these soils would belong to the same class, because the greater proportion of the soil grains have the same size or texture. Thus we may have different kinds of clays, loams, sands, etc., and the class to which any soil will belong depends upon the size of the individual soil grains of which it is composed, and not upon its color, origin, topographic position, or agricultural value.

SOIL CLASSES

SOILS CONTAINING LESS THAN 20% SILT AND CLAY

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

SOILS CONTAINING BETWEEN 20–50% OF SILT AND CLAY

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

SOILS CONTAINING OVER 50% OF SILT AND CLAY

Loam.—Less than 20% clay, and over 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 examples, includes light colored, glacial material

where the soils have been derived largely from the underlying limestone. The Plainfield series includes light colored soils in regions where no limestone is present, where the parent rock was largely sandstone, and where the material occurs as outwash plains or stream terraces. 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 extent 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 DANE COUNTY, WISCONSIN

CHAPTER I.

GENERAL DESCRIPTION OF THE AREA.

Dane County is located in the southern part of Wisconsin, about midway between the Mississippi River and Lake Michigan. It has a total area of 1,202 square miles or 769,280 acres.

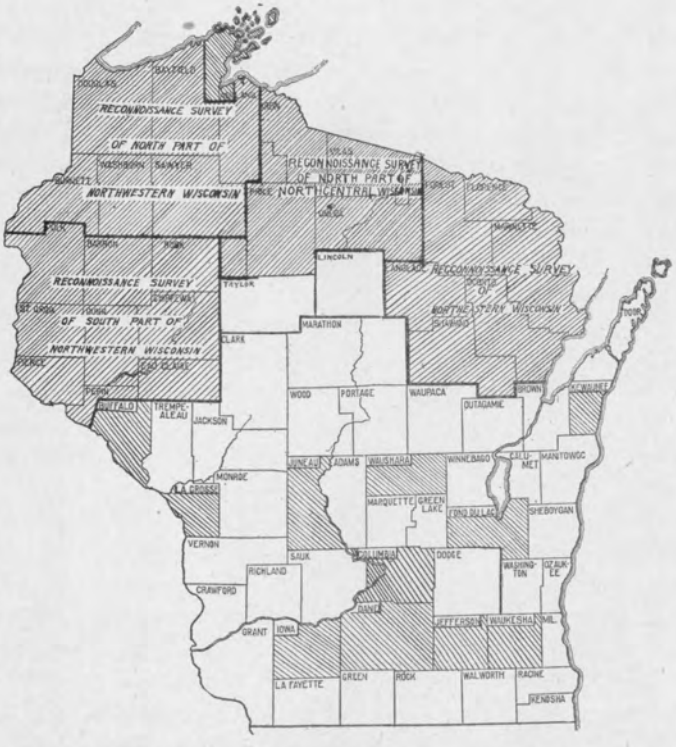

FIG. 1.—Sketch map showing area surveyed.

The topography is quite variable in different parts of the county. Southwest of a line running thru Cross Plains and Brooklyn it is that of a plain into which many valleys have

been cut by streams. This part of the county is rolling to rough and hilly, and is marked by undulating to rolling ridge lands, steep valley walls with numerous rock ledges outcropping, and rather narrow valley bottoms. Military Ridge, lying just south of Blue Mounds and Mount Horeb, has a rolling topography, and divides the drainage of this portion of the county, the streams to the south flowing into the Rock River, and those to the north into the Wisconsin.

In marked contrast to this western portion of the county is the central and eastern part, where the hills are more or less rounded and long steep slopes are almost lacking. In the north and southeastern parts of the county there are broad areas of undulating to gently rolling prairies. To the east there are numerous rounded hills or ridges with their long axis usually lying in a common direction—northeast and southwest. Narrow gravel ridges and small knolls occur through this portion of the county giving in places a rough, bumpy topography. Such areas are of limited extent, and while widely scattered are most numerous in the southeastern sections. Level tracts of land varying in size from a few acres to 5 square miles, with underlying gravel beds are of common occurrence. Between the hills and ridges are often level marsh areas which mark the sight of former lakes and ponds.

The natural drainage of Dane County is closely related to the topography, being perfectly developed in the western part where there are many drainage channels, and imperfectly developed in the central and eastern portions where the drainage waters have comparatively few channels for their outlet. Furthermore in the western part there are very few marshes, while in the eastern portion marshes are in great abundance.

The first white men to enter this general region were hunters and trappers, who reached the country by way of "The Portage" and the Wisconsin River. The first permanent settlers were lead miners. About 1830 homeseekers came in to take up land for farming purposes. The first settlers of this class were largely from Illinois, Ohio, and the New England states. Following these there was a great influx of Germans and Norwegians, and at present the population is made up largely of people of foreign extraction, including Germans, Norwegians, Irish, English, and a number of other nationalities. The county was set off from parts of Iowa and Milwaukee Counties

in 1836, but was not organized as a separate county until 1839. The population of Dane County is reported in the 1910 census as 77,435, and is quite evenly distributed.

Madison, the capitol of the State, is the county seat of Dane County. Its population is given as 25,531 in the 1910 census. Madison is a railroad and manufacturing center of considerable importance. The University of Wisconsin and the Agricultural Experiment Station are located here. Stoughton, with a population of 4,761, is the second city in size. It has extensive wagon-manufacturing interests, and is the center of a highly developed farming section. Other towns and villages of importance are Sun Prairie, Mount Horeb, Mazomanie, Middleton, Marshall, Waunakee, De Forest, Belleville, Cross Plains, Dane, Verona, Blue Mounds, Morrisonville, Windsor, Cottage Grove, Macfarland, London, Klevenville, Riley, Basco and Burke.

Dane County is exceptionally well provided with transportation facilities. Lines of three railroad systems serve the county, radiating in all directions from Madison. The main line of the Chicago & Northwestern Railway crosses the county from northwest to southeast. From Madison one branch of this line extends west along the "Military Ridge" and another branch extends east to Milwaukee. A line of the Chicago, Milwaukee & St. Paul Railway crosses the county from east to west and joins the main line at Watertown, Jefferson County. From Mazomanie a branch runs north to Sauk City and Prairie du Sac. Another line runs north from Madison to Portage and another southeast from Madison to Chicago. A branch of the Illinois Central Railroad extends from Freeport, Ill., to Madison.

The towns within the county provide a ready market for farm products and are shipping points from which large quantities of produce are sent to outside markets. Most of the live stock is shipped to Chicago or Milwaukee. The Lake cities constitute good markets for all products of the farm, dairy, and garden.

The wagon roads throughout the county are, as a whole, in good condition, and each year large sums are expended in road improvement. Through the assistance of the State, roads made of crushed rock are being constructed in various parts of the county. All parts of the county are supplied with the rural delivery of mail and telephones are in common use.

SOILS.

Dane County includes several distinct geological formations, and all of these have contributed to a greater or less degree to the material from which the various soil types have been derived. The oldest formation within the area is the Potsdam sandstone, which forms the surface rock in the valley of the Wisconsin River and in parts of the valleys of tributary streams in Dane, Berry, and Cross Plains Townships. It also forms the surface rock over a part of the Catfish or Yahara Valley, but in this instance the formation is represented only by the uppermost layers, the Mendota limestone and Madison sandstone.

Over the Madison sandstone is found the Lower Magnesian limestone, which forms the surface rock over the principal divide between the Wisconsin River and its tributaries on the west and the Yahara and Sugar Rivers on the east. Outcrops of this rock occur frequently along the valley walls of these streams and their tributaries. It is also the surface rock over most of the eastern half of the county.

Immediately over the Lower Magnesian limestone is the St. Peters sandstone, which outcrops frequently along the steep valley walls throughout the western and southwestern sections of the county, and also occurs in scattered areas in the eastern part.

The Trenton and Galena limestone constitute the surface rock in the elevated ridges between Blue Mounds and Mount Horeb, and south to the Green County line.

A large part of the county has been modified by the action of moving ice—the glacier—which formerly covered a large portion of Wisconsin along with nearly all of northeastern North America. In moving over the country the sheet of ice ground down hill tops, filled in the valleys and mixed much ground up rock with the original soil. As the ice melted vast quantities of sand, clay and gravel were dropped down, and streams formed by the melting ice carried immense quantities of sand and gravel and formed broad flood or outwash plains. Some of the material carried along by the ice was brought for long distances, and in this way boulders unlike the local rocks were brought in. The material deposited by the ice is often called till or drift. In Dane County the area which has been glaciated

may be roughly separated from that which was not glaciated—the Driftless area—by a line extending from the northwestern corner of the county through Cross Plains and Verona to a point 1½ miles east of Bellville. The glaciated region lies to the east of this line. Within a triangle, with the towns of Verona, Belleville and Brooklyn at the angles there is an area which has been covered by the pre-Wisconsin or earlier stage of glaciation. This area has more of the appearance of an unglaciated or driftless region rather than a glaciated one. The presence of scattered boulders and gravel which are not of the same kind of rock as that underlying this section is about the only sign that the glacial ice covered this portion of the county. The remainder of the glaciated portion of the county was covered by the late Wisconsin ice sheet, the last invasion of the ice. Many of the soils of the county have been derived from the glacial deposits.

The soils of Dane County have been grouped into 13 series and 31 types, including Rough stony land, Madeland, Peat, Muck, and Meadow.*

The Miami series is one of the most important, both in extent and agricultural value. It includes all the light-colored forested upland where the soils have been derived from unstratified glacial limestone till.

The Carrington series is also important in this county. The Miami and Carrington series include a large part of the best agricultural land in Dane County. The Carrington series comprises all the dark-colored prairie upland soils which are derived from the weathering of unassorted glacial limestone till.

The light-colored, waterlaid, forested soils of the glaciated limestone region are classed with the Fox series. The material has been very largely carried out by streams formed by the melting of the glacial ice and deposited in level stream terraces and outwash plains.

The Plainfield series includes glacial or terrace soils which do not contain lime—are not calcareous. Although in this county much of the material originally came from a limestone region, through its transportation by moving water most of the lime has been removed.

*The names of the various soil types used in this report are not in all cases the same as the names used in the original soil report published by the United States Bureau of Sails. The following table indicates the changes which have been made.

The Waukesha series includes dark-colored prairie or semi-prairie soils which have been derived from reworked glacial material and deposited in the form of glacial outwash plains and stream or lake terraces.

The Knox series includes the light-colored forested upland soils of the unglaciated portion of the county, where the soil has been largely formed thru the wearing down of limestone by the action of water, in dissolving out the more soluble portions of the rock, by the frost, and other processes forming residual soils. Portions of the soil of this series are extremely silty or loessial in nature and probably are of wind blown origin. This is the most extensive and important series in the unglaciated—the driftless—section of the county.

The Dodgeville series includes the dark-colored upland prairie soils of the unglaciated portion of the county, where the material probably is partly loessial and partly residual from limestone, which occurs at a depth of 2 to 10 feet. The soils of this series constitute good farm lands, except where the soil is shallow.

The Boone series embraces the light-colored residual soils of the unglaciated region, derived largely from the weathering and distintegrating of sandstone.

The dark-colored soils of the unglaciated region, where the soils are alluvial or stream deposits and occur as first-bottom land, are classed with the Wabash series. They are subject to overflow and require drainage.

Dark-colored poorly drained soils within the glacial region, and which are calcareous—contain lime—are included with the Clyde series. These soils occupy old glacial-lake beds, ponded valleys, or bottom land along the streams.

Similar dark colored poorly drained soils which are not calcareous are classed with the Dunning series.

The Genesee series includes light-colored alluvial soils which occur as first bottom lands and are subject to overflow.

Name used in the Bureau of Soils report.	Name used in the present report.
Miami gravelly fine sandy loam.	Miami gravelly sandy loam.
Carrington silt loam.	Carrington silt loam, shallow phase.
Carrington silt loam, deep phase.	Carrington silt loam.
Waukesha silt loam, low terrace phase.	Dunning silt loam.
Waukesha fine sandy loam, low terrace phase.	Dunning fine sandy loam.
Union silt loam.	Knox silt loam.
Union silt loam, steep phase.	Knox silt loam, steep phase.
Crawford silt loam.	Dodgeville silt loam, shallow phase.
La Crosse silt loam.	Wabash silt loam, terrace phase.

The Rodman soils consist of light-colored stratified glacial material, and occur as gravelly knolls and ridges. This series is not extensively developed in Dane County.

Rough stony land includes areas of steep, rocky slopes, where the land is too steep or too rocky to be of value for cultivated crops. These areas may be considered as nonagricultural.

Madeland includes small areas where the surface soil has been deposited by artificial means. It consists mainly of poorly drained areas which it has been desirable to fill in for building purposes.

Peat consists of vegetable matter in varying stages of decomposition, with which there may be incorporated a small amount of mineral matter. It occupies old lake beds, marshes, and poorly drained depressions.

Muck includes soils high in organic matter and intermediate between Peat and the soils of the Clyde series.

Meadow includes first-bottom land which is low, poorly drained, and subject to overflow. The texture is so variable that no separation into established types can be made.

The following table gives the name and the actual and relative extent of each of the soils mapped in Dane County.

Areas of Different Soils

Soil	Acres	Per cent
Miami silt loam	154,752	32.9
Deep phase	98,752	.....
Carrington silt loam	79,296	18.2
Shallow phase	60,736	.....
Knox silt loam	79,872	12.3
Steep phase	15,104	.....
Peat	52,288	6.8
Dodgeville silt loam	32,640	5.2
Shallow phase	7,424	.....
Clyde silt loam	37,184	4.8
Wabash silt loam	16,064	3.6
Colluvial phase	9,216	.....
Terrace phase	2,176	.....
Boone fine sandy loam	21,056	2.7
Fox silt loam	17,600	2.3
Waukesha silt loam	12,480	1 6
Miami fine sandy loam	12,480	1.6
Rough stony land	10,752	1.4
Miami gravelly sandy loam	10,368	1 3
Muck	8,448	1.1
Waukesha fine sandy loam	6,208	.8
Fox fine sandy loam	4,864	.6
Clyde fine sand loam	3,712	.5
Carrington fine sandy loam	3,584	.5
Plainfield fine sand	1,984	.2
Dunning fine sandy loam	1,728	.2
Rodman gravelly sandy loam	1,536	.2
Boone loam	1,408	.2
Meadow	1,344	.2
Fox loam	960	.1
Wabash loam	960	.1
Madeland	768	.1
Miami loam	512	.1
Clyde loam	320	.1
Dodgeville fine sandy loam	128	.1
Genesee fine sand	128	.1
Total	769,280	.....

CHAPTER II.

GROUP OF HEAVY, LIGHT COLORED UPLAND SOILS.

MIAMI SILT LOAM

Extent and distribution.—Miami silt loam, with its deep phase, is the most important type in the county. The typical soil is distributed throughout the eastern two-thirds of the county and is closely associated with its deep phase, with Miami fine sand loam, and with soils of the Carrington series. The most extensive areas occur in Medina, Middleton, Springfield, Dane, Berry, and Roxbury Townships. With its deep phase, this type covers almost one-third the county.

Description.—The surface soil of Miami silt loam has an average depth of 10 to 12 inches. It consists of a light-brown silt loam, which frequently has an ashen appearance when dry. There is often present in the soil a small amount of fine gravel, and in places a few stones occur on the surface. Where the content of silt is highest this soil is usually free from gravel and small stone and resembles those extremely silty soils called loess soils. In such places it is also deeper than where fine sand and gravel is mixed with the silt. Where the surface soil is the most silty or loess-like and of considerable depth a deep phase is indicated on the soil map.

The subsoil of the typical Miami silt loam consists of a brown or yellowish-brown silty clay loam which gradually becomes lighter in color, and in some cases lighter in texture, with depth. Where the soil is extremely silty it may continue quite uniform and almost stone free to a depth of two feet, where occurs an abrupt changes to mixed glacial material consisting of silty clay, sand and gravel. In much of this type however, there is some gravel and sand throughout the entire subsoil, which grades from a silty clay loam into a heavy fine sandy loam or even a fine sand at 30 to 36 inches. The lower subsoil usually contains a large quantity of fine gravel. By far the greater part of the gravel is limestone,

and the subsoil is generally calcareous. The surface soil has frequently been leached to a considerable extent, and in some places it is slightly acid. The subsoil, however is never in an acid condition.

This soil is subject to considerable variation, especially in the depth of the silty or loess-like covering and the amount of sand or fine gravel present. In the southern part of the county it contains more fine sand than in the northern section. On some of the higher elevations the silt loam covering is absent and the silty clay subsoil exposed over small tracts, while on the lower slopes, in the same locality the surface soil may be considerably deeper than the average. In the southern part of the county a reddish-yellow clay loam subsoil is encountered at about 2 feet in a few places, but such areas are of small extent. A few gravel knolls too small to indicate on the map have been included with this type. There is some variation in the color of the soil, especially where it borders Carrington or Clyde silt loam. In such localities the surface soil has a dark-brown color and the content of organic matter is higher than usual.

Topography and drainage.—The surface features of the typical Miami silt loam range from gently rolling to rolling, with occasional areas where the surface is only undulating. In the eastern part of the county, especially in Medina Township, there are a number of rounded hills and ridges upon which the type occurs. There are but few slopes too steep to be cultivated, and modern farm machinery can be used on practically all the type. In the southern part of the county, especially in Rutland Township, the slopes of some of the hills have but a shallow covering of soil, and rock outcrops are numerous.

On account of the surface features of this type the natural drainage is good. It is excessive in a few places where there is more gravel than usual in the soil or occurring in beds beneath the type. The steeper slopes are subject to erosion. But little of the type, however, has been seriously damaged by erosion.

Origin.—Miami silt is derived from the weathering of the glacial till and the loess-like material which is encountered throughout most of its area. The loess-like covering is much thinner over the typical soil than over the deep phase, and the glacial till thus enters into the main type to a greater extent than is the case with the deep phase. The underlying rock is

chiefly limestone, and it gives rise to the limestone gravel in the soil section. A large part of the soil material has doubtless been derived from the underlying limestone. In the southern part of the county there are a number of small areas where the St. Peters sandstone occurs, and it is quite probable that the presence of this rock accounts for the more sandy nature of the Miami silt loam in the southern part of the area. The calcareous nature of the subsoil is due to the influence of the limestone.

Native vegetation.—The original forest growth on Miami silt loam consisted chiefly of white, black, and red oak and maple, with some hickory, basswood, and elm. Over a part of the type the timber growth was scattered, and the term "oak openings" is frequently used to describe this condition. The typical soil was more heavily forested than the deep phase.

Present agricultural development.—It is estimated that approximately 80 per cent of the typical Miami silt loam is under cultivation, while the remainder is chiefly devoted to permanent pasture. The chief type of agriculture followed consists of general farming and dairying. Farming operations are confined chiefly to growing corn, small grains, and hay. Corn averages about 35 busehls, oats about 35 bushels, barley 25 bushels, wheat 10 to 30 bushels, and timothy and clover hay mixed 1 ton to 1½ tons per acre. In the southeastern part of the county tobacco is grown as a special crop, chiefly in the vicinity of Stoughton, Oregon, and Utica. Yields range from 1,100 to 1,700 pounds per acre. Where this crop is grown it is given much more care and is fertilized much more heavily than other crops. Dairying is carried on more extensively in the vicinity of Verona than elsewhere on this type.

The value of land on the Miami silt loam ranges from about $75 to $150 per acre.

MIAMI SILT LOAM, DEEP PHASE.

Extent and distribution.—Miami silt loam, deep phase, is an important soil in Dane County. Its most extensive development is in the northeastern section, in Sun Prairie and York Townships.

Description.—The surface soil of Miami silt loam, deep phase, to an average depth of 12 to 14 inches consists of a light-brown

silt loam, with a low content of organic matter, but high in silt. The color of the soil varies somewhat with the moisture content, the surface presenting a grey or ashen appearance when dry. With a few exceptions, the surface is practically free from gravel and stones, and but few areas contain as large quantities of fine sand as occur in the typical soil.

The subsoil consists of a yellowish-brown silt loam, which gradually becomes heavier with depth. At about 24 inches it is usually a silty clay loam which extends to a depth of 3 to 6 feet, where is encountered a mixture of sand, silt, clay and gravel. This sandy gravelly portion of the lower subsoil is undoubtedly the true glacial till, while the extremely silty material above it resembles loess. The upper subsoil sometimes contains thin layers of fine and very fine sand, while the lower subsoil may be slightly mottled with brownish red, yellow or drab. There is usually an abrupt change from the silty or loess-like portion of the subsoil to the true glacial till, the stones, boulders, or gravel being almost or entirely lacking in the upper part, but rather numerous below. The gravel consists chiefly of limestone.

While the deep phase as a whole is very uniform, a few local variations occur. Where this soil borders the Carrington or Clyde soils the color at the surface is darker than the average. Where it borders the typical Miami silt loam or Miami fine sandy loam the subsoil is frequently somewhat sandy below a depth of 24 inches. In a few places knolls or small hills occur within the type over which the silty covering is shallow and where the subsoil consists chiefly of a mixture of sand, clay and gravel. Such areas, where of sufficient extent, are included with the typical soil.

Miami silt loam, deep phase, resembles Knox silt loam quite closely in color and texture, and has a similar extremely silty or loess-like nature. It is underlain, however, by sand and gravel—the glacial till—, while the Knox silt loam is underlain by decomposing limestone. The phase also resembles the Carrington silt loam in texture and origin, but it is light colored and was originally timbered, while the Carrington is dark-colored and is a prairie soil.

Topography and drainage.—The surface of this phase is generally less rolling than that of the main type. The topography varies from gently undulating to gently rolling, the slopes being long and gentle. There are some small areas where the surface

is nearly level, and in which, even where the surface has a gentle slope, tile drains are sometimes needed. Over most of the phase, however, the natural surface drainage is good. The soil is somewhat more compact than in the main type, and the downward movement of water is not so rapid as in the lighter textured soils. The soil retains moisture very well, and crops suffer less during long dry periods than on most of the other soils of the county. The phase is not subject to destructive erosion.

Origin.—The deep phase of Miami silt loam owes its origin to the weathering of the loess-like covering over the glacial till. The loess-like material occurs as a mantle over all of this phase. It may have been blown on the glacial ice sheet which covered this region, gradually settling as the ice melted as a covering over the glacial debris. The underlying subsoil consists of typical glacial till. It contains large quantities of limestone gravel and is highly calcareous, while the surface silty material contains but little calcium carbonate, and is frequently in an acid condition. The phase is made up more largely of silty loessial material than the typical soil. The underlying rock, from which much of the glacial till is derived, is limestone.

Native vegetation.—The original forest growth on the phase was not as dense as on the typical soil and much of this land was referred to as "oak openings." Timber consisted of white, red, and black oak, hickory, maple, basswood, and some elm. Practically all of the merchantable timber has been removed, and about all that is now left is in small tracts of 1 to 10 acres of second-growth trees, suitable chiefly for fuel.

Present agricultural development.—There is only a very small part of the deep phase not cultivated. It constitutes good agricultural land, and many highly improved farms are located upon it. General farming is the chief type of agriculture followed. Dairying is carried on to some extent, and special crops are grown in some sections. For quality of products this phase is unexcelled in the county and only the Carrington silt loam, the Clyde soils, and the Waukesha soils produce heavier yields of certain crops. Corn yields about 40 bushels per acre on the average, oats about the same. Barley averages 30 bushels, and wheat produces 10 to 30 bushels per acre. For a number of years wheat was not grown, the farmers claiming that it could no longer be produced profitably. During the last few years,

TYPICAL VIEW ON MIAMI SILT LOAM

This is the most extensive and important type of soil in Dane County. It occupies an acre of over one quarter million acres or 32.9 per cent of the entire county.

VIEW OF KNOX SILT LOAM, SHOWING TYPICAL SURFACE FEATURES.

This is the most extensive type of soil in southwestern Wisconsin. In Dane county there are 94,976 acres.

however, some very successful crops have been grown. Clover and timothy, mixed, yield 1½ to 2½ tons per acre.

A number of the farmers are engaged in growing peas. Peas for canning yield about 2,000 pounds per acre, and dry peas about 20 bushels per acre, although larger yields are frequently reported. Where the green peas are used for canning, the vines make good ensilage, and may be utilized profitably for feeding cattle. The leading varieties of peas are the Alaska, a very early pea, and the Horsford and Advance, which mature somewhat later. Sugar beets are grown in Sun Prairie and Bristol Townships, with yields of 10 to 17 tons per acre. The sugar content is higher than that of beets grown on the dark-colored soils. Between Sun Prairie and Waunakee, and to a smaller extent in the vicinity of Marshall, tobacco is grown as a special crop. Considerable tobacco is also grown on this phase in the vicinity of Albion, though this soil is more limited in extent in the southern and southeastern sections of the county than in the northern and northeastern. Yields of tobacco range from 1,000 to 1,800 pounds per acre.

In general the same methods of farming are followed on the deep phase as on the typical soil. While the texture is somewhat heavier than that of the typical soil, it is as easily cultivated, as there are no steep slopes. The drainage is not as thorough, however, and in the nearly level areas it is a little later than the main type. The rotations followed, methods of fertilization, etc., are the same as for the typical soil, and the same methods of improvement are needed. The dairy industry offers good opportunities on this phase, and in general it is suited to a more intensive system of farming. Tiling is advantageous where the land is nearly level, and backward in the spring. Where tobacco is grown the remainder of the farm is frequently neglected. The tendency at present seems to be to reduce the tobacco acreage, and to give increased attention to the dairy industry. Alfalfa is coming to be an important crop.

The value of land of this character ranges from $100 to $150 an acre. In regions where tobacco is grown extensively the price for small tracts of land is still higher.

CHEMICAL COMPOSITION AND MANAGEMENT OF MIAMI SILT LOAM AND MIAMI SILT LOAM, DEEP PHASE.

As stated in the paragraph on origin, this soil was formed largely by the grinding up of underlying rocks by the ice during the glacial period and mixing this ground limestone with soil and clay of residual soils brought from farther north. In consequence it is not generally acid, but the leaching action of water dissolving out this lime corbonate from the surface soil has removed it and permitted the development of acidity over a part of the area. This is true especially of the hilltops and it is probable that the surface soil from a quarter to a third of the area of this type is acid and should be limed to suit it thoroughly for the growth of alfalfa. The degree of acidity so far developed does not yet appear to interfere with the growth of clover in many cases.

The chemical analysis of this soil shows it to contain on the average between 1100 and 1200 pounds of phosphorus in the surface eight inches, approximately 3000 pounds of nitrogen, and between 30,000 and 40,000 pounds of potassium. This amount of phosphorus is relatively high and it is comparatively easy to retain the phosphorus supply necessary to feed staple crops on this soil. When most of the crops grown on the farm are fed, the manure carefully preserved and returned to the land, and especially if some feed is purchased which contains phosphorus, comparatively little fertilizers need be purchased to maintain the supply of this element, but unless some bran or other feeds containing phosphorus are purchased, some phosphorus fertilizers will in time be needed, even on the dairy or stock farm, and when special crops, such as sugar beets, tobacco, etc., or grain for sale are raised, this element must be supplied, and the heavier the yield the more important does this matter become.

The nitrogen and organic matter in this soil on an average are naturally relatively low and all lines of farming should include the growing of clover, alfalfa or other legumes either for feed or for green manure in order to maintain and increase it. This is a much better method of securing nitrogen as a rule than the use of commercial fertilizers containing that element, though in special cases commercial nitrogen fertilizers can be used to advantage. The use of clover or other legumes in rotation, even with special truck crops, not only adds nitrogen but also adds

organic matter which improves the tilth and assists in keeping ground free from weeds. On an average not less than a quarter of the land should be in legume crops annually.

The amount of potash in this class of soil, as in fact in practically all clay loam or silt loam soils, is very large, but the amount supplied to the growing plants depends on the rate at which it is changed from the inert form to soluble and available form. The presence of a good supply of actively decomposing vegetable matter, such as stable manure or a green manuring crop, is the most important condition affecting this change. When this condition exists there will in practically all cases be a sufficient supply of available potassium for nearly all crops, but such special crops as tobacco, cabbage, and in some cases even potatoes, will be assisted by an additional application of potash salts.

The natural drainage of nearly all of this type is good. There are, however, some tracts where the levelness of the surface or the drainage of higher land to it, will require the use of tile to get thorough drainage.

The surface of this soil for the most part is undulating but is seldom so rough as to cause serious erosion. Nevertheless there are a great many fields of this type of soil in the county on which erosion produces a great deal of damage. Farmers owning lands of this kind should give these fields closest attention to prevent this injury. Methods of lessening erosion are discussed more fully on page 28 in the description of the Knox silt loam, which is much more subject to erosion than Miami soils as a rule.

The intermediate character of this soil together with the good supply of lime adapts it to a wide range of crops. It is especially adapted to grass both for hay and pasture, to clover and alfalfa, and to the small grains, but corn also grows very well when the proper attention in regard to organic matter and phosphorus is observed, and when well fertilized sugar beets and other special and truck crops succeed very well.

MIAMI LOAM.

Miami loam occurs in small areas in various parts of the county in association with Miami silt loam and fine sandy loam. The largest area lies 2 miles southwest of Madison. The surface soil to an average depth of about 10 inches consists of a light-brown loam containing a large quantity of fine sand and silt.

This is underlain by a yellowish brown, heavy sandy loam or sandy clay loam which becomes somewhat heavier with depth. At about 2 feet glacial material consisting of sand, clay, gravel, and bowlders, is encountered. Most of the gravel is limestone. In places this soil is lighter than typical, approaching a fine sandy loam. It appears to be a gradation between the silt loam and the fine sandy loam of the Miami series.

The topography is usually gently rolling, and the natural drainage is good. On some of the steeper slopes there is some danger of erosion, but little damage has resulted from this source.

Miami loam is derived from the weathering of glacial material, most of which was formed from the underlying limestone. The surface has been leached to a considerable extent, however, so that it is frequently found to be in an acid condition, while the subsoil is usually well supplied with lime.

Chemical analyses show that this soil resembles the Miami silt loam very closely in chemical composition, except in the phosphorus content which is usually slightly lower. Much of the type is farmed in conjunction with Miami silt loam, and the crops grown, yields obtained and methods for management are much the same as for that soil.*

FOX SILT LOAM.

Extent and distribution.—Fox silt loam is of moderately large extent and occurs in various parts of the glaciated portions of the county. It is developed along the north shore of Lake Mendota, near Springfield Corners, and in the northwestern and south-central parts of the county. This soil also occurs in small areas southeast of Stoughton.

Description.—The surface soil of Fox silt loam, extending to an average depth of 10 inches, consists of a brown loam which contains large quantities of silt and very fine sand. The content of organic matter is somewhat higher than is usual for this soil, the color frequently being almost as dark as that of the Waukesha soils. The subsoil consists of yellowish-brown loam to silt loam, with a small percentage of fine and very fine sand. With increasing depth the content of sand usually becomes greater. All of this soil is underlain by stratified sand and gravel. In a few places the gravel lies within 2 feet of the

*See page 18 for discussion of the management of Miami silt loam.

surface. Even though there is considerable limestone in the gravel, the surface soil, as indicated by tests with litmus paper, is strongly acid in many instances.

Topography and drainage.—The surface of Fox silt loam is level to very gently undulating and the natural drainage is fair, except where the gravel and sand layer lies at considerable depth in which case the drainage is frequently poor. Such areas are so situated, however, that they could be readily tile-drained.

Origin.—Fox silt loam occurs as outwash plains or old valley fill, and was all deposited by water, chiefly by streams issuing from the glacial ice sheet. The parent material is glacial debris which was mainly ground from the underlying limestone of the region. While the soil has been considerably leached since its first deposition, it usually contains some carbonate of lime, which tends to prevent the development of an acid condition. The original forest growth consisted chiefly of elm, ash, hickory, and oak.

Present agricultural development.—The greater part of this soil is under cultivation, and general farming is the chief type of agriculture. Where the drainage conditions are best, yields average about the same as on Miami silt loam, with which this soil is often associated. Corn, oats, barley, clover, and timothy are the general farm crops grown, and as this soil occurs in small tracts, it usually only forms parts of fields where Miami silt loam is the predominating type.

The value of farms on this soil ranges from $60 to $150 an acre, depending upon the condition of the land, improvements, location, etc.

Chemical Composition and Management.—This soil is one naturally having a high degree of fertility. The chemical analysis shows it to have on the average between 2500 and 3000 pounds of nitrogen, 1000 or 1200 pounds of phosphorus, and about 35,000 pounds of potassium per acre to a depth of eight inches. The organic matter and nitrogen are somewhat low and methods of increasing this element should be kept distinctly in mind by farmers working on this soil. When most of the crops grown are fed and the manure returned the nitrogen and organic matter may ordinarily be kept up, provided at least a quarter of the farm is in clover, alfalfa or other legumes regularly, and no considerable amounts of grain are sown. Level land of this kind, free from stone and having good fertility is of course ex-

ceptionally well adapted to special crops, such as tobacco, sugar beets, peas for canning purposes, etc. When such crops are grown fertility must be maintained at a high state to make their production profitable. Lime should be used for correcting acidity, and legumes should be grown either for feed or as green manure for maintaining the nitrogen supply. Some form of phosphate fertilizer should be used for maintaining or increasing the supply of this element. Some small fields of this soil need better drainage for which tile is by all means the best method. The soil on the whole has good under-drainage as the result of the fine gravel and sand found in the subsoil.

FOX LOAM.

Fox loam is an inextensive soil in this county, the largest area, comprising slightly more than a square mile, occurs in the south-central part of the county, immediately northwest of Brooklyn. There is a smaller area southeast of Sauk City, in the northwestern corner of the county.

The surface soil of Fox loam, extending to an average depth of 10 inches, consists of a brown loam which contains large quantities of silt and very fine sand. The organic matter content is somewhat higher than usual for this type, and the color frequently approaches that of the Waukesha soils. The subsoils consist of yellowish-brown loam to silt loam, with a small percentage of fine and very fine sand. The content of sand usually increases with depth, and in all cases this soil is underlain by stratified beds of sand and gravel. In few places the gravel lies within 2 feet of the surface. Even though there is considerable limestone in the gravel, the surface soil, as indicated by the litmus-paper test is strongly acid in many instances.

The surface of this soil is level or gently undulating, and the natural drainage is good. It occurs as a terrace formation and is of alluvial origin. It is well above the present flood plain.

This soil is now highly improved. In the area near Brooklyn corn yields 35 to 45 bushels, oats 30 to 45 bushels, barley 30 to 40 bushels, and hay 1½ to 2 tons per acre. Other portions of the type are of nearly equal value for crop production. The rotation usually followed consists of corn, followed by small grain for two years, and then timothy and clover. The soil is easy to cultivate and a mellow seed bed can be obtained without difficulty.

Land with Fox loam soil near Brooklyn is valued at $125 to $135 an acre. Elsewhere it has a somewhat lower value.

In chemical composition this soil resembles Fox silt loam, although it is slightly lower in phosphorus. The same methods for the improvement of that soil are applicable for Fox loam.*

KNOX SILT LOAM.

Extent and distribution.—Knox silt loam is confined chiefly to the western and southwestern portion of Dane County. Throughout that region this soil, with its steep phase, is the predominating type. The typical soil occupies the tops of ridges and gentle slopes, while the steep phase is found along the steep hillsides and narrow ridge tops. Associated with this soil are numerous areas of Rough stony land, where the surface is very steep and where rock outcrops are common on the valley walls.

Description.—The surface soil of Knox silt loam has an average depth of 12 inches and consists of a light-brown or greyish brown silt loam, with a very smooth feel and containing only comparatively small quantities of organic matter. This soil in its extremely silty nature resembles loess. The subsoil consists of a yellowish-brown heavy silt loam, which gradually becomes heavier in texture with depth, until at 18 inches there is a silty clay loam.

Below this depth the subsoil continues a silty clay loam or clay loam to more than 3 feet. Both surface soil and subsoil of the Knox silt loam are free from coarse sand, gravel, or stones, and the texture as a whole is very uniform. Tests with litmus paper indicate that there is in places a slight acid condition.

The variations which occur in the Knox silt loam are in depth of the soil and in topagraphy, rather than in texture. The greatest variation is in topography and a steep phase of this type has been mapped separately. Another variation which is not indicated on the map is in depth to the underlying rock or to the decomposed rock—the residual material—derived from the underlying rock. Usually the silty or loess-like covering has a thickness of 6 to 10 feet, but there are places where the underlying residual material is within 3 feet, and occasionally over small areas within 1 foot of the surface. The underlying rock

*See page 21 for chemical composition and management of Fox loam.

is usually limestone, which on decomposing has formed a yellowish-red or red clay loam or clay. Immediately over the rock the clay may have a variegated color, red, brown, yellow and drab being common. Where the rock is near the surface limestone fragments and some chert occur in the subsoil and in places on the surface. Where sandstone is the underlying rock, as is sometimes the case, the deep subsoil is sandy, and sand is more or less mixed with the silt. In such cases, as bedrock is approached the fine sand becomes more abundant. Such areas are comparatively inextensive. In this portion of the county the limestone in places is rather sandy, also in the sandstone there are occasionally thin clay or shale layers, from which in either case a sandy or gritty clay loam or clay could be formed by the decomposition or weathering of the rock.

Included with this soil are some areas of light-colored silt loam south of Verona where there is some indication that the country has been glaciated—occasional rounded boulders which are not of sandstone or limestone, but where the silty loess-like soil covers the whole country, and, with the exception of a few scattered bowlders, the soil resembles the typical Knox silt loam.

A variation in color of the Knox silt loam occurs where the type borders Dodgeville silt loam, which is dark brown or black in color. In such places the surface soil has a darker color than the average, and the subsoil also is sometimes darker than usual, while the lower portion of the subsoil is the same as in the case of the typical soil.

The texture and color of Knox silt loam are very similar to those of the deep phase of Miami silt loam. There is also a similarity in texture to that of Dodgeville silt loam and Carrington silt loam, but both of these are dark in color and are prairie soils while Knox silt loam is light in color and is forested.

Topography and drainage.—The topography of the typical soil varies from undulating to gently rolling, but the surface is not so steep as to prevent the efficient use of farm machinery. Where the slope is too steep for cultivation with modern farm machinery, it is mapped with the steep phase. The more nearly level areas are confined to the broad ridge tops. Where the ridges are narrow the surface is more broken, and the slopes grade into the steep phase. The natural surface drainage is good. Only on the nearly level ridge tops, which are of comparatively small extent, would tile drains be found profitable.

The subsoil is heavy and compact, and the movement of water through the soil is not as free as where there is some sand and gravel mixed with the subsoil, as is usually the case in the Miami soils. Where the bedrock is near the surface the soil may be somewhat droughty. This soil erodes readily, and when slopes are left bare ditches and ravines are formed rapidly.

Origin.—Knox silt loam is probably derived from the weathering of the silty or loessial mantle which seems to cover this section of the county, and from the decomposition of limestone which underlies the present soil at depth of three feet or more. Those areas south of Verona which have been lightly glaciated are of the Pre-Wisconsin drift sheet. Only scattered evidences of glaciation, such as crystalline bowlders, and some rounded gravel are to be found in this region. The silty loessial covering apparently extends over the old drift with the resulting soil very similar in origin to the typical Knox silt loam.

Native vegetation.—The original forest growth consisted of white, bur, and black oaks, with some maple, poplar, hickory, birch, and basswood. All of the type was originally forested, but the timber remaining is largely confined to the steep phase, with a few woodlots on the main type.

Present agricultural development.—By far the greater part of the typical soil is under cultivation, although some of the steeper slopes are kept in permanent pastures or woodlots. The type of agriculture followed most extensively consists of general farming in conjunction with dairying. That this is proving very profitable is shown by the number of silos and new barns which are being constructed and the many large comfortable farm houses which are common on this soil.

Of the crops grown corn produces about 40 bushels, oats 35 bushels, wheat 15 bushels; and timothy and clover mixed about 1¼ tons of hay per acre. Alfalfa is being tried on a small scale by many farmers and is proving to be a very valuable crop. Some tobacco is grown, but the acreage, which is small at present is becoming less each year. On many farms there is a limited amount of land desirable for corn because of the danger of serious washing on even rather gently rolling slopes when in an intertilled crop. This coupled with the large amount of permanent pasture on all these farms has been one factor in determining the type of agriculture of this portion of the county. Dairying has become the most important industry on this soil.

The result of small acreage of corn has been to keep the hog raising industry as a minor part of the farm business. On this account it has not been as profitable to use the milk for butter where there would be a considerable amount of skimmed milk, so desirable for feeding hogs, as to use it for cheese. The result has been that a very extensive cheese making industry has been developed in the section of the county where this soil predominates.

Although no systematic rotation of crops has generally been adapted for this soil, an increased number of farmers are giving this matter careful attention. Where practically all of the farm is ridge land the rotation commonly followed consists of corn one year, followed by a small grain crop for one or two years. The small grain is usually oats or barley, although some wheat is still grown. With the last grain crop clover and timothy are seeded, and hay is usually cut for two years before the land is again plowed for corn. Because of the amount of steep land in permanent pastures associated with this soil, the cultivated portion of the farm is usually not pastured. By far the majority of the farmers of this region live in the valleys and both ridge and valley lands are included in the farms. In such cases much of the corn is grown in the valleys, on the lower slopes below rough stony land or the steep phase of the Knox silt loam and on the higher portions of the valley lands. The rotation common for the Knox silt loam ridge land in such cases, especially where the land has a slope that would make it apt to wash badly when in an intertilled crop, consists of grain two years, then seeded to timothy and clover for hay. Timothy or clover sometimes is cut for seed. After being seeded down for two or three years the land is put in grain again. Very often these ridge lands do not receive much manure because of the difficulty of the haul from the valley, with the result that some fields show decreasing yields.

The value of farms on this soil varies widely depending on location, improvements and on the topography of the land, the more broken areas being as low as $30 to $50 per acre, while the gently rolling portions are held at $80 to $100 or over per acre.

Knox silt loam, steep phase.—Knox silt loam, steep phase, is confined to the southwestern part of the county, and is closely associated with the typical Knox silt loam. It forms a part of

nearly all the farms containing the latter and has considerable influence in determining the type of agriculture followed.

The soil usually resembles that of the main type, but is subject to more variation and forms a thinner covering over the underlying rock. The surface soil is usually a light-brown silt loam to a depth of about 10 inches. This is un lerlain by a yellowish-brown silty clay loam which usually extends to a depth of 3 feet or more. In many places erosion has removed the surface covering and heavy silty clay loam forms the surface soil. In other places, especially where the soil is shallow, rock fragments are mixed with the soil. Over sandstone there is frequently considerable fine sand incorporated with the soil, and the deep subsoil may consist of a fine sand or fine sandy loam. Where limestone is the underlying rock the subsoil is frequently a red or reddish-brown, heavy clay loam containing cherty fragments. Rock outcrops occur in a few places on this phase.

This soil has a rolling to hilly surface, and comprises steep slopes and sharp, narrow ridges over which the grade is sufficient to prevent or greatly interfere with the use of modern farm machinery, and where the danger from erosion is so great that intertilled crops can seldom be grown with safety.

The steep phase has the same derivation as the typical soil, but usually the underlying rock is nearer the surface. The original forest growth consisted of several varieties of oak, maple, hickory, birch, and basswood.

Only a small part of the steep phase is under cultivation. Most of it is still forested, and where the timber has been partially or completely removed the land is generally in permanent pasture. The timbered areas are best kept forested.

As a whole the soil of the steep phase is somewhat less productive than the main type, but if the surface were less broken it would be considered a fair agricultural soil. Associated with the steep phase are areas of Rough stony land, and these, together with the steep slopes, tend to reduce the value of tracts of typical Knox silt loam with which they are associated. This phase may be profitably used on all dairy farms as grazing land.

Chemical Composition and Management.—The analysis of this type of soil shows it to contain on the average from 900 to 1000

*See Bulletin No. 272 of the Wisconsin Experiment Station on "Keep Hillsides from Washing" for suggestions for controlling erosion.

pounds of phosphorus, about 2700 pounds of nitrogen, and 35,000 pounds of potassium per acre to the depth of eight inches. Acidity is quite general in the surface soil of the hilltops and upper slopes of the hills, but the acidity which would naturally develop on the lower slopes is often neutralized by lime brought down by the seepage of water over the limestone underlying the surface soil of these hills. The growth of clover and alfalfa which is extremely important as a means of increasing the nitrogen and organic matter of this soil therefore requires the use of lime in some form quite generally.

As indicated by the chemical analysis the total content of phosphorus in this soil is not high and the proper use of phosphorus fertilizers supplementing the natural supply along with the growth of clover or other legume for increasing the organic matter will be found to be the best means of increasing the fertility of this type of soil.

Erosion.—The roughness of the land occupied by this type of soil leads to a large amount of erosion or side hill wash. This erosion develops gulleys which interfere seriously or even prevent the working of the fields and removes a great deal of fertility by taking off the finest part of the soil including the organic matter. It is of the utmost importance therefore that owners of land of this type prevent erosion just as far as possible. The best means of lessening erosion consist in keeping the side hills in grass for hay or pasture as much as possible, and at any rate, of raising but one crop of corn or other tilled crop in each period of rotation. If a rotation for the side hills consisting of corn one year, which is sown to rye at the last cultivation, and then seeded to clover with timothy one or two years following the grain, and then used as pasture for two or three years before being again broken, the erosion is greatly reduced. Corn can be grown in this way one year on the sod with much less erosion than would result the following year if it were again planted to this crop.

The fields on side hills should be laid out as long narrow fields along the slope and so arranged that the dead furrows of the lands, which should be very narrow, can be opened into side ditches which are kept grassed.

Many farms in this section include some land in the valley which suffers but little from erosion, as well as a good deal on the side hills. In such cases two systems of crop rotation

should be followed. One as suggested on the steeper land, and another on the low land in which the land is laid out in two fields to be cropped alternately to corn and alfalfa for three or four years. A large part of the manure on the farm may be applied to the corn for all excepting the last year it is grown in rotation. This should be supplemented with some form of phosphorus, probably raw rock phosphate being best for that use, thoroughly incorporating it with the manure. If in addition to this the land is kept free from acidity maximum crops of corn and alfalfa may be grown on the more level land. Then by keeping the side hills free from acidity by use of lime or ground limestone and moderate applications of soluble phosphate fertilizer and growing of clover or other legume in the rotation, the fertility of the side hills can be maintained with relatively little manure. But light dressings of well rotted manure will be found very helpful in improving pasture on this land. It must be remembered that continual pasturing of land alone does not maintain the fertility but leads toward its depletion, and it is only by giving the pasture some attention as above suggested that the great profits which may come from first class pasturage can be expected.

BOONE LOAM.

Boone loam is confined to the southwestern section of the county and it is closely associated with Knox silt loam and Boone fine sandy loam. Its extent is small, and the individual areas are comparatively unimportant.

The surface soil of Boone loam has an average depth of about 10 inches, and consists of a light-brown or grayish silt loam, which contains only a comparatively small amount of organic matter It is underlain by a lighter colored loam or fine sandy loam, which gradually becomes heavier with depth and grades into a sandy clay at about 2 feet. This heavy subsoil extends to a depth of 3 feet or more where the rock occurs at considerable depth, or it may grade into a fine sandy loam or fine sand where the rock is within 3 feet of the surface, as is sometimes the case. Immediately over the rock the subsoil frequently has a mottled reddish color. The type as a whole is quite variable, but averages a loam in texture. An acid condition in the surface soil is quite general.

The surface of the type is rolling, and there is some danger

of erosion on the steepest slopes. The natural drainage is good, and excessive where the rock is near the surface.

This soil is of residual origin. It is derived largely from the underlying rock formations, which are limestone and sandstone. It is probable that a small part has been derived from the loessil material entering into the composition of Knox silt loam. The sandstone has contributed largely to its formation.

The natural timber growth consisted of several varities of oak, hickory, basswood, birch, and some poplar. The merchantable timber has been removed, but a large part of the type is still uncleared.

About one-third of this type is under cultivation, and it is largely devoted to general farming, like the Knox silt loam, with which it is associated. The steep land is used only for pasturage. Corn yields average about 30 bushels, oats 32 bushels, barley 30 bushels, and hay about 1 ton per acre. The methods of cultivation, crop rotation, and fertilization followed are practically the same as on the Knox silt loam,* and this soil responds to the same treatment.

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*See page 27 for Chemical composition and management of Knox silt loam.

CHAPTER III.

GROUP OF HEAVY, DARK COLORED UPLAND SOILS.

CARRINGTON SILT LOAM.

Extent and distribution.—Carrington silt loam with its shallow phase is one of the most important and highly prized soils in the State. In Dane county the largest area occurs in the northern part of the county, in Bristol, Windsor, Vienna, Dane, Burke, and Springfield Townships. Extensive tracts lay north, northeast, and northwest of Madison. This type is also encountered in the southeastern part of the county in Dunkirk, Albion, and Christiana Townships. A few smaller areas are found in various parts of the central and eastern portion of the county. Carrington silt loam is closely associated with its shallow phase, and grades into it so gradually that a boundary between the type and the phase is often difficult to establish and is always more or less arbitrary.

Description.—The soil of Carrington silt loam to an average depth of about 12 or 14 inches, consists of a dark-brown to almost black silt loam, having a smooth feel and containing large quantities of organic matter. Litmus tests indicate that the surface soil is in an acid condition. The subsoil consists of a dingy-brown silt loam in the upper part, becoming lighter in color and heavier in texture with depth, until at 22 to 26 inches there is a yellowish-brown, compact silty clay loam, in which the silt content is very high. This heavy subsoil usually extends to a depth greater than three feet, and ranges from 2 to 8 feet in thickness. The entire soil section is practically free from gravel stones, and bowlders, and is remarkably uniform in structure and texture. Immediately below this silty or loess-like mantle the typical glacial till, consisting of clay, silt, sand, and gravel, is encountered. The line of demarcation between

the yellow or yellowish-brown silty clay loam and the glacial till is well defined, the upper part being free from bowlders and gravel and leached free of calcium carbonate, while the till is filled with stones and bowlders and is well supplied with calcium carbonate.

A number of variations occur in Carrington silt loam, but only the shallow phase, described later, is of sufficient extent and importance to be indicated on the soil map. Where this type borders Miami silt loam the color is somewhat lighter and there is less organic matter present. Where it borders Miami fine sandy loam or Carrington fine sandy loam there is usually more fine sand in the surface soil and the subsoil than is typical. Bordering Clyde silt loam a gradation appears in the weathering of the subsoil, passing from the dark or drab subsoil of the Clyde to the dingy brown or yellow of the Carrington. The water table becomes lower, and the soil oxidation is more marked with improved drainage conditions. Over some of the higher elevations of this soil the silty loess-like covering is rather shallow, but the depth to underlying rock ranges from 10 to 50 feet through the type.

Carrington silt loam resembles Miami silt loam and Knox silt loam in texture, but is much darker in color, while it is about the same color as the Dodgeville silt loam.

Topography and drainage.—The surface of this type varies from level to undulating and in some places gently rolling. The slopes are long and gentle, and there is seldom any damage from erosion. In most places the surface has a sufficient slope to provide good natural drainage, but in the level areas the drainage is somewhat deficient and tiling is needed.

Origin.—Carrington silt loam is derived from the weathering of the loess-like covering over-lying the glacial till. The extreme silty material has a depth of 2 to 8 feet, and between this and the underlying typical glacial till there is a sharp line of demarcation. The gravel, stones, and bowlders in the drift are largely of limestone, and, while the soil is in an acid condition, the deep subsoil composed of till is not acid and contains a large amount of carbonate of lime.

Native vegetation.—Carrington silt loam is a typical prairie soil, and the native growth consisted almost entirely of prairie grasses, with some oak, maple, and hickory near the boundaries of other types and along streams.

VIEW OF CARRINGTON SILT LOAM, SHOWING SURFACE FEATURES. BUILDINGS, ETC., TYPICAL OF THE BLACK PRAIRIE LANDS OF SOUTHEASTERN WISCONSIN.

This is one of the best types of soil in the state. In Dane County there are 140,032 acres of this class of land.

VIEW SHOWING COMBINATION DAIRY AND TOBACCO FARM.

These two lines of farming are extensively developed in Dane County. Tobacco growing, however, is gradually giving way to the more extensive development of the dairy industry

Present agricultural development.—Practically all of this soil is under cultivation. There is only a very small acreage of waste land, the percentage being probably smaller than for any other type in the county. The principal type of agriculture followed on this soil is general farming. In some localities dairying is practiced extensively, and the tendency seems to be toward the more extensive development of this industry. Tobacco is a very important special crop on this soil.

This soil is well adapted to corn, producing an average of 45 bushels per acre. Where the best methods of farming are followed much larger yields are obtained, the production of 60 to 70 bushels being not uncommon. Oats yield 40 to 45 bushels, with considerable higher yields under good management. Some barley is grown, with yields of 35 to 40 bushels. The acreage of wheat is very small. The quality of the small grains is not quite so good as is produced on the light-colored silt loam, such as Miami silt loam. Hay, consisting of timothy and clover, yields 1½ to 2½ tons per acre. Alfalfa is grown to a limited extent. As this soil is usually acid some difficulty is often experienced in getting a good stand, but where properly prepared alfalfa does very well, and the acreage is gradually increasing, especially where dairying is carried on.

Tobacco is the most important special crop grown on this soil and it receives a great deal of attention, especially in the southeastern and northcentral parts of the county. Yields range from 1,200 to 1,600 pounds per acre. Sugar beets yield 12 to 18 tons per acre and are grown quite extensively, especially in the northern part of the county. The sugar content is not quite so high as from beets grown on Miami silt loam, but the yield is greater.

The rotation of crops is given less attention on this soil than on some of the other soils of the county. One reason for this is that tobacco receives so much attention that frequently other crops are somewhat neglected. Tobacco is usually grown on the same field for a number of years, and seldom in rotation. Where alternated with general farm crops the rotation generally followed consists of corn followed by small grains seeded to timothy and clover, and then tobacco two to four years, followed by corn.

Because of the tendency to concentrate interest on the tobacco to the neglect of the remainder of the farm, the general methods

of farming practiced in the tobacco-growing sections are not of so high a standard as in many regions of inferior soils where tobacco is not grown. The yields of the general farm crops are, therefore, hardly a fair indication of what this soil is capable of producing under the best methods of farming.

Carrington silt loam is not a difficult soil to cultivate, and a mellow seed bed can be readily worked up. There is a general need, however, for more thorough cultivation. Stable manure is the only fertilizer used with the general farm crops, and with tobacco it is used to a greater extent than any other form of fertilizer. Twenty to forty loads per acre are often applied to the tobacco field. The supply is not ample, however, and a large part of most farms receives too little stable manure. The practice of plowing under green-manuring crops is not common as it should be.

On account of the level topography, drainage is not always as good as might be desired. Over the extensive level or undulating tracts tile drains are needed. A system of tile drainage would permit the soil to warm up earlier in the spring, so that crops may be planted sooner. Well-drained land works up more readily into a mellow seed bed and permits a more rapid, vigorous growth.

The surface soil of the Carrington silt loam is in an acid condition, and responds to the application of ground limestone at the rate of 1,500 to 2,000 pounds per acre. With such treatment and the inoculation of the soil alfalfa can be grown successfully. This is a very valuable crop particularly where dairying is practiced.

Farms on typical Carrington silt loam range in value from $110 to $175 an acre, depending on location and improvements. In the tobacco-growing sections land in small tracts frequently sells for as much as $200 to $300 per acre.

Carrington silt loam, shallow phase.—Carington silt loam, shallow phase, is found most extensively in the southeastern sections, in Cottage Grove, Deerfield, Pleasant Spring, Christiana, Dunkirk, and Albion Townships. Other scattered areas of smaller extent are found in the northern part of the county in Sun Prairie, Burke, Westport, Vienna, Springfield, and Dane Townships.

The surface soil of the shallow phase is similar to that of the typical soil, consisting of a dark brown to black silt loam of

about 12 inches depth. There is frequently present in the surface soil some fine sand and a small quantity of fine gravel. The chief point of variation is in the subsoil. In the shallow phase the covering of extremely silty material over the glacial till is of considerable less depth than in the typical soil. The subsoil consists of a brown or yellowish brown silt loam or silty clay loam containing in places a small quantity of fine sand. Below 20 to 24 inches there is usually a yellow sandy clay which grades into the typical glacial till consisting of a mixture of sand, silt, clay and gravel. The depth to bed rock is usually less than in the case of the typical soil, but this is seldom an important factor, since the covering of soil over rock is sufficient except in a few instances.

The surface of the phase averages a little more rolling than the typical soil, varying from undulating to rolling. It is of the same origin as the typical soil, however, a larger portion is undoubtedly derived from the weathering of glacial till.

Probably over 80 percent of this phase of the Carrington silt loam is under cultivation, and the remainder is chiefly devoted to permanent pasture. The same crops are grown as on the typical soil, but the shallow phase is slightly less desirable for agriculture, and the yields average a little lower. The same conditions as to crop rotations, methods of cultivation and fertilization prevail as on the typical soil, and the suggestions for management of the main type apply to this phase.

Chemical composition and management.—A chemical analysis of this tpye of soil shows it to contain on an average about 1600 pounds of phosphorous, between 4800 and 6000 pounds of nitrogen, and aproximately 40,000 pounds of potassium per acre to the depth of eight inches. It is relatively high in organic matter as the dark or nearly black color indicates. This relactively large supply of organic matter is the result of its prairie origin. This supply of organic matter together with the fine texture and large amount of lime in the subsoil gives this type a very high degree of fertility, and wherever the original fertility of the land has been protected by proper management it is still an exceedingly productive soil. In some cases, however, this land has been used largely for the growing of grain and other crops which for the most part have been sowed for so many years that the original fertility has been greatly depleted, although the soil under this condition still retains its dark color,

the organic matter which is left is of a very resistent character and does not decompose readily to furnish the nitrogen or other elements needed by growing crops. The soil under these conditions has also become quite generally acid, probably to a considerable extent on account of the decomposition of the vegetable matter. When this soil is found to be at all low in fertility it must be improved by the addition of phosphorus and active organic matter, preferably through the growth of clover or alfalfa returned to the soil either in stable manure or plowed under as a green manure.

The relatively large amount of organic matter in this soil, its comparatively level surface and high degree of fertility adapt it especially to corn and other crops which require large amounts of plant food. This soil can be retained in an exceptionally high state of fertility more readily than most types of soil.

As a rule this soil has good surface and under drainage but some level areas would be benefited by tile, which would give perfect under drainage.

WAUKESHA SILT LOAM.

The main occurrences of Waukesha silt loam are in the valley of Black Earth Creek, north of Oregon and east and west of Verona. Other patches are encountered along Koshkonong Creek, about Lake Kegonsa, and in Rutland Township.

The soil of Waukesha silt loam to an average depth of 10 inches consists of a dark-brown to black friable silt loam which contains a high percentage of organic matter. The content of silt is high and the soil has a very smooth feel. The upper subsoil consists of a dark-brown silt loam which contains an appreciable amount of fine sand. At about 16 inches the color is brown. Below this depth the material is a yellowish-brown silt loam to a depth of 4 to 6 feet, where stratified beds of sand and gravel are encountered. The lower part of the subsoil is frequently drab or yellowish in color and contains some fine sand.

The surface of the type is level to very gently undulating, and there is sometimes a very gentle slope toward the stream or body of water along which it is developed. The natural drainage is usually fair, but there are a number of places where it is somewhat deficient.

The most marked variation in this soil occurs between Oak Hall and Oregon, where the underlying beds of sand and gravel are within 2 feet of the surface in a few small areas. The surface soil in such places contains more fine sand than typical, but not enough for the material to be classed as a fine sandy loam.

The main part of this type, in the valley of Black Earth Creek, occurs as an outwash plain. Most of the course of this stream is outside the glaciated region, but the material forming the soil was carried beyond the glacial border by waters rushing from beneath the ice sheet. In other parts of the county this soil occupies outwash plains, lake and stream terraces. The parent material is from the glaciated limestone region, and most of the gravel in the deep subsoil consists of limestone. The surface of the entire type, however, is in an acid condition. After its first deposition the moist conditions which prevailed favored a rank growth of vegetation, and the growth and decay of this accounts for the dark color and high organic-matter content of the soil. Part of this soil was prairie land, and prairie grasses constituted the chief growth. There was some timber, consisting chiefly of oak, some elm, ash, and soft maple, where the drainage was deficient.

Nearly all of Waukesha silt loam is under cultivation and in a high state of productiveness. The greater part of the type is devoted to general farming. Corn yields 40 to 70 bushels, oats 40 to 65 bushels, barley 35 to 45 bushels, and timothy and clover mixed 1½ to 2 tons of hay per acre. In the southeastern section considerable tobacco is grown on this soil and yields of 1,200 to 1,800 pounds per acre are obtained.

The value of land of this type usually ranges from $100 to $200 an acre. Where tobacco is grown, small tracts are held at about $300 per acre.

Chemical composition and management.—This soil is one naturally having high fertility. The chemical analysis shows that it averages between 4,000 and 6,000 pounds of nitrogen, 1,200 to 1,400 pounds of phosphorous, and approximately 30,000 pounds of potassium per acre to the depth of eight inches. The presence of the rather large amount of organic matter has lead to the leaching of a large part of the lime from surface soil which has brought about the development of acidity. This condition has its most marked effect on the growth of al-

falfa, clover, peas, and other legumes. For these crops liming will be found very helpful on most of this type, but liming will also be beneficial because of its influence on availability of phosphorus. This element is usually less available in acid than non-acid soils. Land which has been cropped a number of years without the use of stable manure or other fertilizers will be found rather low in available phosporous and the use of some form of fertilizer containing that element will add materially to the fertility.

This soil is well adapted to general farming and is particularly adapted to special crops, such as sugar beets and tobacco. When these crops are grown the use of lime and commercial fertilizers will be highly desirable, since considerable amounts of fertility are removed by these crops.

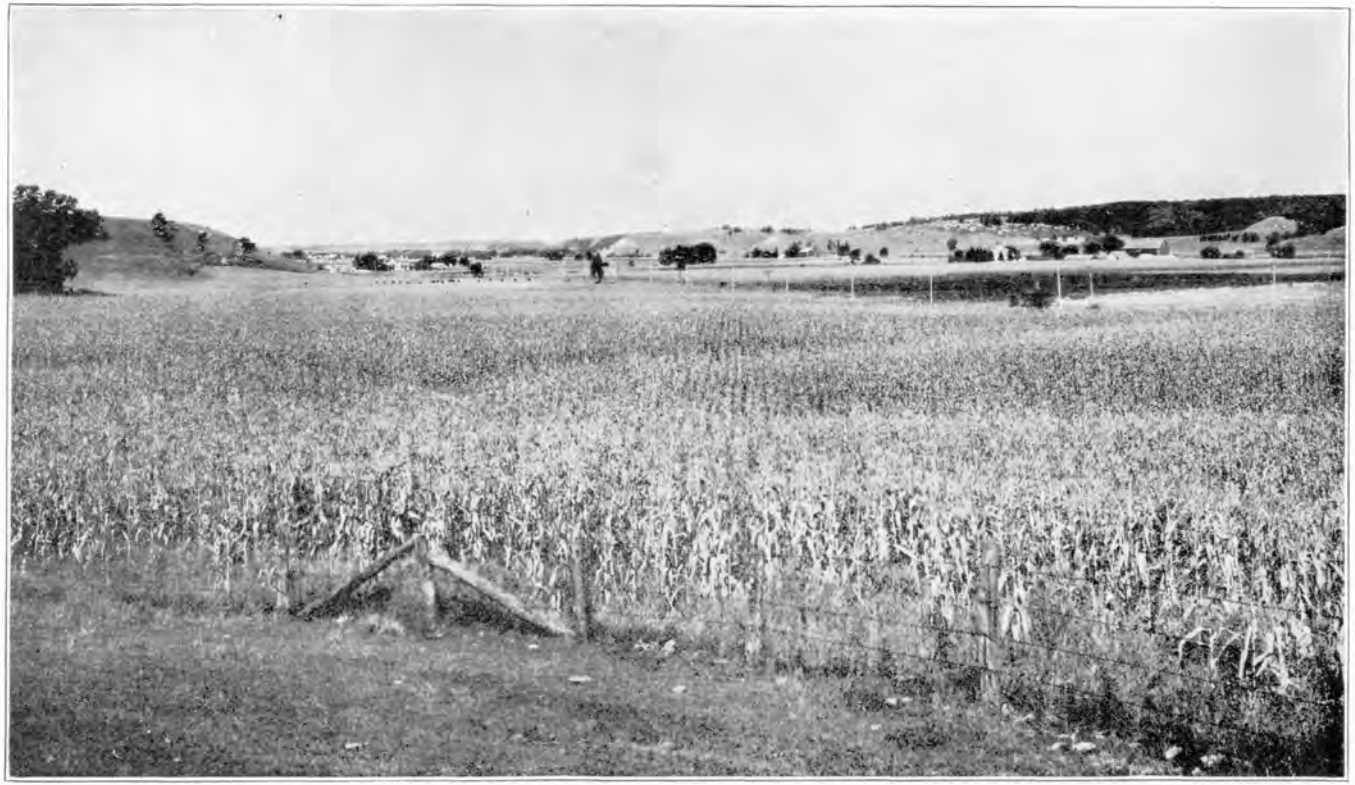
Some fields of this type of soil do not have adequate underdrainage and tiling would be a great improvement on land of this kind.

DODGEVILLE SILT LOAM.

Extent and distribution.—Dodgeville silt loam is confined to the prairie regions in the southwestern part of the county. It has a total area of 51 square miles, and is one of the important soils of the region.

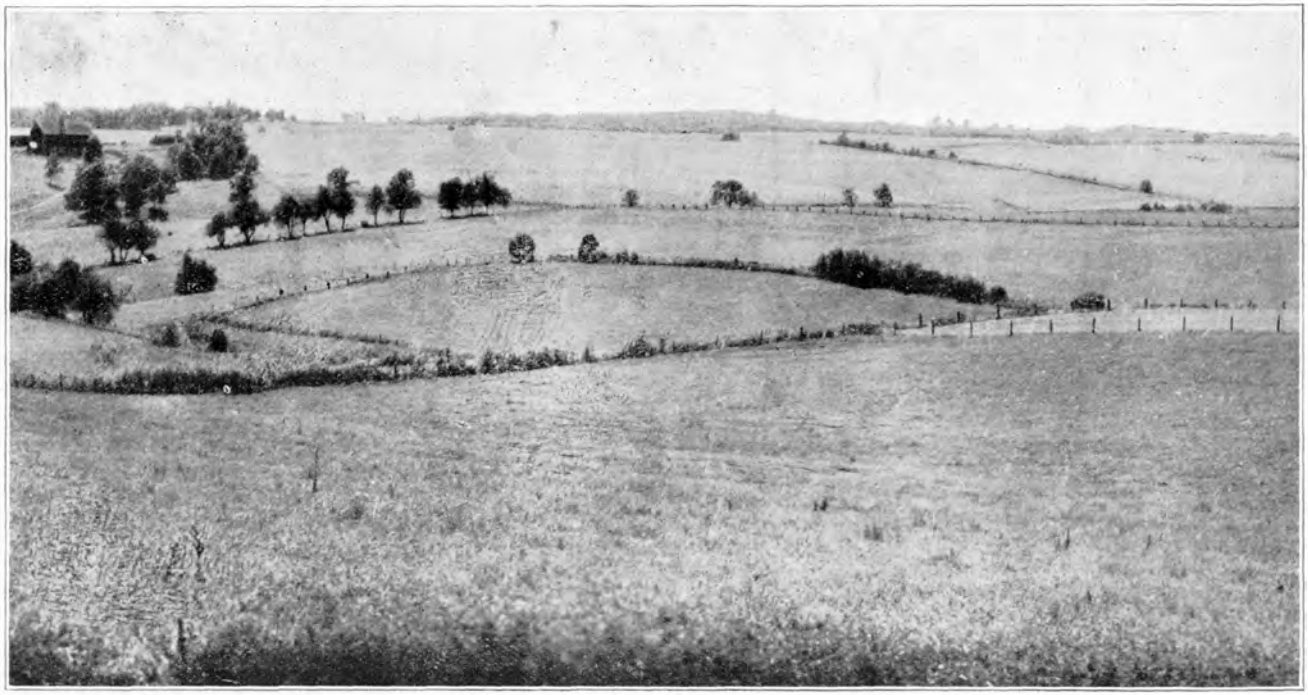
Description.—The surface soil of Dodgeville silt loam has an average depth of 12 inches. It consists of a dark brown or black silt loam with a relatively high percentage of organic matter. The soil is free from all coarse particles such as coarse sand, gravel, or stones, and the texture is remarkably uniform. The subsoil consists of a yellowish-brown heavy silt loam which grades into a silty clay loam at about 20 inches. Below this depth the color is a more pronounced yellow. Limestone rock occurs underlying this soil at an average depth of about 4 feet. Outcrops on hillsides are quite common. Where the depth is less than 4 feet, the subsoil frequently has a reddish or yellow-brown color, due to the presence of material derived from the weathering of the limestone. With this part of the subsoil there may be a few rock fragments which have resisted weathering. Litmus-paper tests indicate that the soil is in an acid condition.

Topography and drainage.—The surface varies from gently undulating to rolling, though the greater part of the type comprises gently rolling prairie land. The natural drainage is



VIEW SHOWING WAUKESHA SILT LOAM, WITH KNOX SILT LOAM OCCUPYING THE HIGHER LAND IN THE BACKGROUND.

This is a dark colored terrace soil, and is one of the best types of land in the county for the growing of corn.



VIEW SHOWING SURFACE FEATURES OF DODGEVILLE SILT LOAM.

This is typical of the prairie lands of southwestern Wisconsin. It is an excellent general farming soil. There are about 40,000 acres of this kind of land in Dane County.

usually well established, but on some of the more gentle slopes it is probable that tile drains might be installed to advantage. On the steeper slopes there is some damage from erosion, but this can be held in check by exercising care in cultivation and in the selection of crops.

Origin.—Dodgeville silt loam is derived mainly from the weathering of the underlying limestone. Possibly the surface material is of loessial origin. On some of the hillsides the surface material has been removed by erosion and the reddish, residual material usually found just above the limestone is exposed. This material is also frequently seen in road cuts. The small part of this type mapped in the south central section of the county where the pre-Wisconsin glacial drift is found may differ slightly in origin from the remainder of the type. The old glacial drift appears to be very thin, and the soil is practically the same as in the driftless area. A few crystalline bowlders occur in this region, and their presence is usually the only indication of glacial action.

Native vegetation.—Dodgeville silt loam is a prairie soil, and the native growth consisted chiefly of prairie grasses. There were a few trees on some of the steeper slopes and along the border of other types of soil.

*Present agricultural development.**—Probably 95 per cent of this type is under cultivation, the remainder being in permanent pasture. The type of agriculture most extensively followed consists of general farming and dairying. Corn yields 40 bushels, oats 35 bushels, barley 30 bushels, wheat 15 bushels, and clover and timothy mixed about 1½ to 2 tons of hay per acre. Yields of 1,000 to 1,700 pounds of tobacco per acre are reported, but this crop is not grown as extensively as in former years. The rotation most commonly followed consists of corn, which may be grown two or three years, followed by a small-grain crop possibly for two or three years, after which the land is seeded to timothy and clover and cut for hay for at least two years. Frequently the fields are pastured for a year or more before again being plowed for corn. The tendency is to reduce the length of the rotation by growing corn for only one year, grain for about two years, and hay for only two years. Better results are obtained by such a system.

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*For chemical composition and management see page 42.

Dodgeville silt loam is a rather heavy soil, but when cultivated under the most favorable moisture conditions little difficulty is experienced in getting a mellow seed bed. On some of the steeper slopes the heavy subsoil is exposed, and this is more difficult to handle. Barnyard manure is the only fertilizer used, and it is most frequently applied to sod which is to be plowed for corn.

Farms on the Dodgeville silt loam have a value of $75 to $150 or more an acre, depending upon location and improvements.

DODGEVILLE SILT LOAM, SHALLOW PHASE.

Extent and distribution.—This soil is confined to the southwestern part of the county. It has a total area of about 11 square miles. The greater part of the phase being located in a large continuous tract east and southeast of Perry.

Description.—The surface soil of the Dodgeville silt loam, shallow phase, is about 10 inches deep. It consists of a dark-brown or almost black silt loam which contains a high percentage of organic matter. Large quantities of fine sand are present in the surface soil, and small fragments of chert are common.

The upper part of the subsoil is a heavy silt loam, considerably lighter in color than the surface soil. At about 16 inches this grades into a reddish-brown clay loam containing numerous chert fragments. With increasing depth this grades into a heavy clay loam or clay, and the chert fragments become more numerous. The usual depth to bedrock varies from 2 to 3 feet, though outcrops along the slopes are quite common. Within a few inches of the underlying rock, which is limestone, the color is variegated, being characteristic of the decomposed rock. Small pockets of sand in the subsoil are common, and in a few small patches the surface material is a fine sandy loam. Such areas usually occur on the slopes, but are too small to be indicated on the soil map. Where large enough to be mapped the fine sandy loam is recognized.

A lighter phase of this type, covering about a square mile, occurs about 2 miles west of Verona. The soil consists of a dark-brown or black loam or heavy fine sandy loam, and the subsoil is a yellowish-brown loam or clay loam, with numerous small patches where the subsoil is a fine sandy loam. While the depth to rock may be 3 feet or more it probably averages about 2 feet, and the phase is more droughty than the typical soil. Both soil

and subsoil are variable, and the value of the lighter phase, as farming land is lower than that of the main type.

Topography and drainage.—The topography of Dodgeville silt loam, shallow phase, varies from gently undulating to rolling. The undulating areas occur as ridge tops, while the rolling surface is found where streams have worked back into the type, carving valleys and leaving ridges, along the slopes of which outcrops frequently occur. The natural drainage is well established, and where the soil is most shallow it is somewhat excessive. On the steeper slopes there is some danger of orosion.

Origin.—This soil is derived from the weathering of the underlying limestone. The dark color is doubtless due to the decay of a rank growth of grasses under moist conditions.

Native vegetation.—Dodgeville silt loam, shallow phase, is a prairie soil, and the original vegetation consisted chiefly of prairie grasses, with only a scattered growth of timber along some of the slopes and bordering forested types.

Present agricultural development.—Probably about 65 per cent of this soil is under cultivation, the remainder being used chiefly as permanent pasture. The leading type of agriculture followed consists of dairying in connection with general farming.

Corn yields about 35 bushels, oats 32 bushels, barley about 30 bushels, and hay 1 to 1½ tons per acre. A small acreage of wheat is grown and fair yields are obtained. Yields on the soil of the lighter phase west of Verona are lower than these. Alfalfa is not grown to any extent, but a few farmers are making an effort to get this legume started. The most common rotation followed consists of corn, followed by small grain, with which clover and timothy are seeded. As a rule the various crops are not rotated at close enough intervals. Corn frequently is grown on the same field for two or three years. This phase is somewhat more difficult to cultivate than the typical Dodgeville silt loam, chiefly because the surface soil is shallower and the underlying heavy subsoil is frequently turned up by the plow, especially along the slopes and on narrow ridges.

Farms on the shallow phase have an average value slightly lower than farms on the typical soil, which it closely resembles. The land sells for $60 to $100 an acre, and possibly more where the location and improvements are best. The value of the light phase is also lower than that of the typical soil and ranges from $40 to $70 an acre.

CHEMICAL COMPOSITION AND MANAGEMENT OF DODGEVILLE SILT LOAM AND DODGEVILLE SILT LOAM, SHALLOW PHASE.

As indicated by the dark color of this soil it is relatively high in organic matter and nitrogen. It averages 5000 pounds of nitrogen per acre to the depth of eight inches. This is nearly twice as great as the average of the Knox silt loam, which occurs in the same region. The phosphorous is also relatively high amounting to between 1300 and 1400 pounds per acre on the average. This supply of organic matter increases the water holding capacity which is good except where the soil is too shallow over the underlying rock. It also ensures the ready maintenance of good tilth. While this supply of nitrogen and phosphorus is relatively large it must not be assumed that it can be drawn on for successive crops without reducing the fertility. The system of farming must ensure that the supply of phosphorus and nitrogen already existing is maintained or even increased in order to maintain or increase the yields of crops. So far as phosphorus is concerned this can be done by the purchase of relatively small amounts of phosphorus fertilizers regularly. Phosphorus in this form is much cheaper than in the form of feed, though if considerable bran is used on account of its food value it will make the purchase of phosphate fertilizers less necessary.

The nitrogen supply can be maintained through the growth of clover, alfalfa or other legumes. On a farm on which most of the crops grown are fed to stock and the manure carefully preserved and returned to the land the nitrogen supply can be maintained when a quarter of the farm is in clover, or in clover and alfalfa together, counting two acres of alfalfa equivalent to three of clover.

A large part of this type of soil is acid and will be greatly benefited by the use of some form of lime. Since limestone underlies practically all this section of country it can be gotten out and ground by individuals or groups of farmers using small limestone grinders to very good advantage.* Ground limestone usually can be purchased from local dealers.

This land varies in topography so that while part of it has only a gentle slope a part has quite decided slopes and is subject

*See Bulletin 230, Soil Acidity and Liming by Wisconsin Experiment Station.

to erosion. Under these conditions it will frequently be found best to use two systems of rotation of crops. On the more level portion corn and alfalfa may be grown alternately, each being on the field for three or four years, while on the more sloping land but one crop of corn should be grown in the rotation to be followed by a crop of grain used as a nurse crop for clover, timothy and other grasses so that after hay has been cut for one or two years the field can be used as pasture for three or four years before it is again broken. The methods of preventing erosion are more fully discussed under the description of the Knox silt loam. See p. 28; also in a Bulletin by the Experiment Station.†

The adaptability of this land to pasture and the raising of hay as well as corn makes it very suitable for any line of live stock farming, but the raising of small grain is also practicable provided that proper means for the maintenance of fertility are made use of.

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†Bulletin 272, Keep Our Hillsides from Washing.

CHAPTER IV.

GROUP OF FINE SANDY LOAMS AND FINE SANDS.

Included in this group are a number of soils of relatively minor importance, the total extent of which makes up only one-twelfth of the area of the county. For the most part they are fine sandy loams and fine sands, and in addition certain soils which are of minor importance as agricultural lands. Since these soils are adapted to special crops they really have a greater importance than their extent would indicate. Although somewhat similar in texture, there is considerable variation in origin of the soils of this group. Miami fine sandy loam and gravelly sandy loam, Carrington fine sandy loam, and Rodman gravelly sandy loam, are glacial soils and occur in gently rolling, and sometimes rough, areas. Boone fine sandy loam and Dodgeville fine sandy loam are residual soils derived from the weathering of sandstone and limestone, and have a rolling to broken topography. Fox fine sandy loam, Waukesha fine sandy loam, Plainfield fine sand, and Genesee fine sand are of alluvial origin, having been deposited as stream terraces or outwash plains, and have a level topography. Only the Genessee fine sand is subject to overflow by flood waters, the other soils lying well above the flood plain of the present streams.

MIAMI FINE SANDY LOAM.

This type occurs most extensively in Dunkirk and Rutland Townships. It is rather variable but for the most part the surface soil is a light brown or grayish, rather silty fine sandy loam to a depth of 10 inches, underlain by yellowish-brown fine sandy loam which gradually changes into a sandy clay at 16 to 24 inches. Below 2 or 3 feet, the subsoil varies from a fine sand to a gritty clay loam. Limestone gravel is common in both soil

and subsoil, but there is seldom sufficient to decrease the value of the soil. In places the surface soil is rather lighter than the average, being a fine sand. The topography varies from gently rolling to rolling, in places it is hummocky or bumpy. Natural drainage is well developed, in the sandy areas it is sometimes excessive and the soil is somewhat droughty. Erosion is seldom injurious.

MIAMI GRAVELLY SANDY LOAM.

This type is widely distributed over the central and eastern part of the county where it is closely associated with the Miami fine sandy loam and Miami silt loam. The surface soil is a medium to dark yellowish-brown fine to medium sandy loam of 6 to 19 inches depth. There is considerable gravel on the surface and mixed with the soil, and in places bowlders are common. The subsoil is a gritty clay loam with considerable gravel. Below 12 to 18 inches there is a gravelly sand containing varying quantities of silt and clay. This soil occurs on the tops of rounded hills or in areas of rolling or somewhat broken land. Natural drainage is very good, in some places excessive, and on the steep slopes there is some danger from erosion. Because of its sandy gravelly nature and topography, very little of the type is under cultivation, most of it being in permanent pasture. A large part is still timbered.

RODMAN GRAVELLY SANDY LOAM.

This soil is very largely associated with the Miami silt loam. The surface soil consists of a light-brown fine sandy loam containing considerable gravel. At a depth of 6 to 12 inches this grades into stratified sand and gravel which extends to a depth greater than three feet. The surface soil is rather variable, in some places being a loam, but it is always shallow and underlain by sand and gravel. This soil occupies rolling to hilly areas or it may occur as long narrow ridges. Because of its sandy nature it is extremely droughty. This soil is used only for pasture and it supplies fairly good grazing for the spring and early summer, but the grass dries up with the first dry period and affords little grazing during the rest of the season. It is not suited to cultivated crops.

CARRINGTON FINE SANDY LOAM.

This soil occurs in small scattered areas throughout Carrington silt loam. The surface soil is a dark brown fine sandy loam of about 10 inches depth. The subsoil is variable, but generally consists of a yellowish-brown fine sandy loam, grading into a sandy clay loam. Varying amounts of gravel are common in both surface and subsoil. In some areas the bed rock is near the surface and outcrops frequently. Where the soil is thin chert and limestone fragments are common in the subsoil. This soil occurs on the tops of narrow ridges, rounded hills and knolls and has a sloping topography. Natural drainage is somewhat excessive, and it is likely to be droughty, especially where shallow.

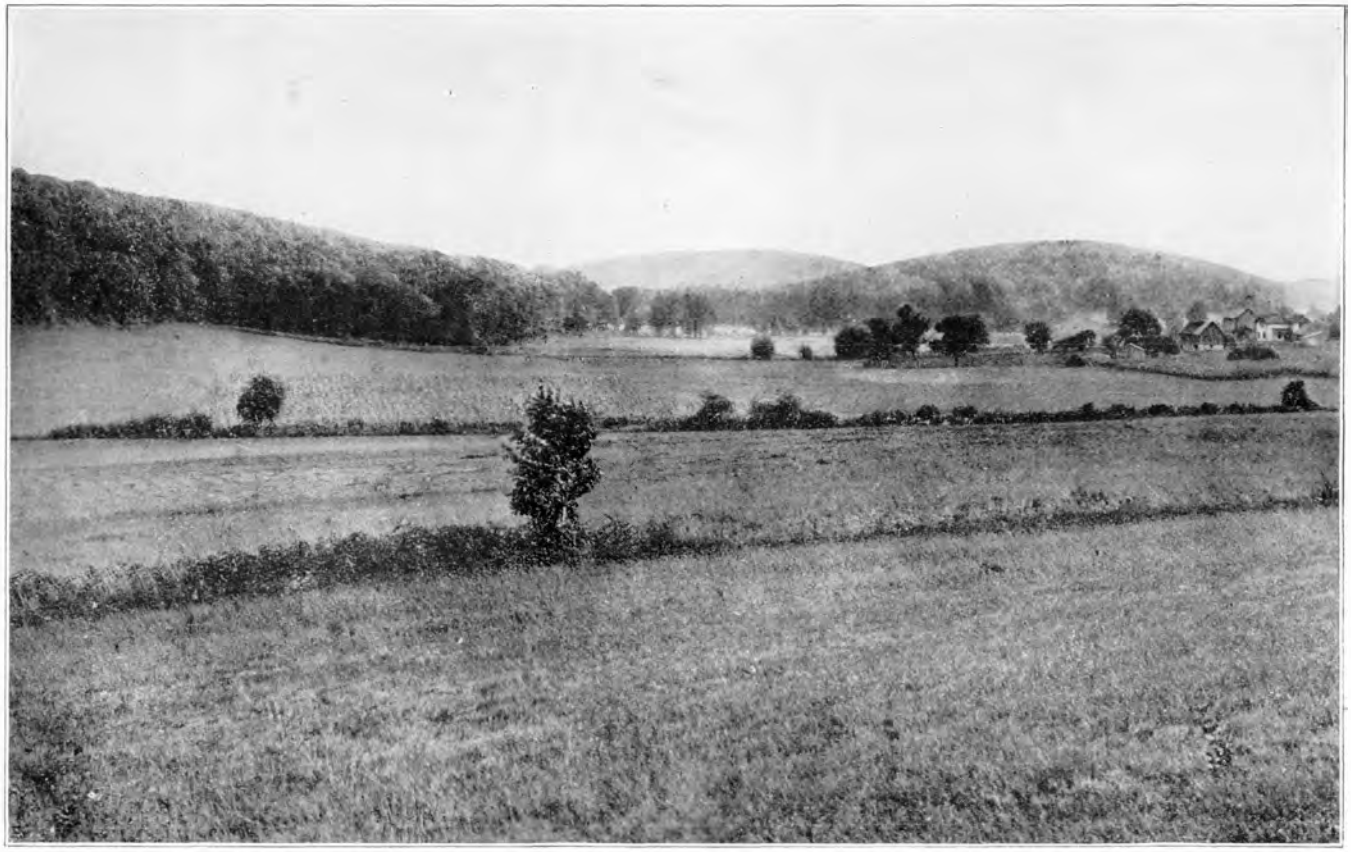
BOONE FINE SANDY LOAM.

Boone fine sandy loam is confined to the southwestern portion of the county where it is associated with Knox silt loam. The surface soil has an average depth of about 10 inches and consists of light brown fine sandy loam, rather low in organic matter. The subsoil usually consists of a yellowish fine sandy loam grading into a sandy clay at about 20 inches. Sandstone occurs at some depth frequently within 3 feet. Both soil and subsoil are variable ranging from a fine sand to a loam, but fine sandy loam is the predominating texture. Frequently the subsoil is quite sandy below 18–22 inches. This type usually occupies steep slopes, and ridges where sandstone is the underlying rock. Drainage is good, and on steep slopes there is considerable damage from erosion. Only the more gently sloping portions of this type are under cultivation, the remainder serving as grazing land.

DODGEVILLE FINE SANDY LOAM.

Dodgeville fine sandy loam occurs only in a few small areas in the southwestern part of the county where it is associated with the Dodgeville silt loam. The soil has an average depth of about 10 inches and consists of a dark brown fine sand or fine sandy loam, which is fairly high in organic matter and in places contains considerable silt. The subsoil is a brownish yellow fine sandy loam, with a small percentage of clay. Fragments of limestone and chert are common in both soil and subsoil, and bed rock is usually encountered at depths of 1 to 2 feet. Outcrops

VIEW LOOKING NORTHWARD FROM NEAR MAZOMANIE ACROSS THE VALLEY OF THE WISCONSIN RIVER.



VIEW SHOWING GENERAL CHARACTER OF THE SURFACE FEATURES OF MIAMI GRAVELLY SANDY LOAM.

This soil covers an area of about 10,000 acres in Dane County.

of the underlying rock are very common. This type occurs on ridges and slopes and for the most part has a rolling or broken topography. Drainage is excessive and the soil is apt to be droughty. Because of the rocky, shallow and droughty nature it can be used only for grazing with the exception of a few small areas where the soil is deeper than usual. As a whole it has a very low agricultural value.

FOX FINE SANDY LOAM.

Fox fine sandy loam is confined chiefly to the valley of the Wisconsin River and to the south central part of the county. The surface soil to an average depth of about 10 inches consists of a brown to light brown fine sandy loam. Litmus-tests indicate a slight acidity in places. The subsoil is a yellow-brown heavy fine sandy loam, becoming lighter in color with depth. Below 20 inches is a yellow fine sandy loam in some places continuing to 3 feet or more, in others to about 2 feet where stratified medium and fine sand is encountered. In one area north of Belleville the surface soil contains more silt than typical. The surface of the type is level to gently undulating and natural drainage is generally good.

WAUKESHA FINE SANDY LOAM.

Soil of this type occurs principally along the Sugar River, in the vicinity of Bass Lake, in Halfway Prairie, and near Mazomanie. The surface soil has an average depth of 12 to 14 inches, and consists of a dark-brown fine sandy loam containing a comparatively high percentage of organic matter. The subsoil is a brownish yellow fine sandy loam grading into stratified sand and gravel at about 36 inches. As found in Sugar River valley and near Bass Lake the soil is a heavy fine sandy loam, while in the Halfway Prairie valley small areas of loam are included. Near the north border of the area adjacent to Mazomanie there is some evidence of wind work, where sand dunes are forming. In such areas the soil is of a lighter color than the average. Litmus paper tests indicate that this soil is strongly acid. It has a level to gently undulating topography and very good natural drainage.

PLAINFIELD FINE SAND.

Plainfield fine sand is confined almost entirely to the valley of the Wisconsin River north of Mazomanie. A few small areas occur in the Sugar River valley and in other parts of the county. The surface soil to an average depth of about 10 inches consists of a brown or light brown fine sand, rather low in organic matter. This is underlain by a light brownish-yellow fine sand, which grades into a yellow fine sand. Below 2 feet there is a yellowish medium sand, and the lower subsoil is quite commonly stratified. Litmus-paper tests indicate an acid condition in this soil. The topography is level to gently undulating, with a roughened surface in places due to wind action. Drainage is good except bordering marshes where it may be somewhat deficient.

GENESEE FINE SAND.

Genesee fine sand is confined to the northwestern part of the county adjacent to the Wisconsin River. The surface soil consists of a light brown loose fine sand of about 8 inches depth, underlain by a yellow fine sand. Variation in color, texture, and depth of soil are common. Low sand dunes have formed through wind action and on the crests of these the soil is very light, while in sloughs and depressions it is loamy and dark colored. Numerous small areas of peat are included in this type. The surface is level, except for undulations caused by wind action. This soil is subject to annual overflow, on account of which but little use is made of the land other than for pasture and a small quantity of wild hay. It is hardly prudent to attempt its cultivation without the construction of levees, and the expense would be much greater than would be justified by the agricultural value of the soil.

CHEMICAL COMPOSITION AND MANAGEMENT OF FINE SANDY LOAMS AND FINE SANDS.

These soil types cover a relatively small fraction of the county but deserve rather more attention than their extent would indicate on account of the fact that they are particularly adapted to special crops and to truck gardening. As a rule soils of the textture of fine sandy loam do not have quite as large an amount of the essential elements as do soils of heavier character. An-

alysis shows that these soils contain from 700 to 800 pounds of phosphorus, and from 1300 to 2000 pounds of nitrogen, and from 18,000 to 25,000 pounds of potassium per acre. The composition varies somewhat within the type. The Miami fine sandy loam being relatively high in phosphorous and the Plainfield fine sand somewhat lower than the others.

As a result of their somewhat coarser texture and consequent readiness with which water percolates through, these soils are quite generally acid.

The principal characteristic of these types is the fact that since they hold somewhat less water than heavier soils do they warm up more quickly in the spring, and this together with the readiness with which they can be worked adapts them to truck and special crops, the growing of which requires more hand labor than is involved in the growing of staple crops. It is necessary to give them somewhat more attention to maintain fertility particularly because of the fact that they are a little 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 growing of these truck and special crops their fertility can be maintained either through the use of rather heavy applications of stable manure or 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 mammoth clover or soy beans which have large powers of gathering nitrogen from the air, and a part of the phosphorus and potash should be used for the growth of this green manuring crop. 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 total amount of fertilizer to be used should be applied on this ground at the time of fitting it for the succeeding crops.

CHAPTER V.

GROUP OF DARK-COLORED, POORLY DRAINED SOILS.

CLYDE SILT LOAM.

*Extent and distribution.**—Clyde silt loam is confined to the central and eastern section of the county, throughout which it is widely distributed. The total area mapped is large, but there are few tracts over 1 square mile in extent. In Medina and York Townships the type occurs as long, narrow belts bordering areas of Peat, while in other places it frequently occupies the entire extent of a low, poorly drained depression.

Description.—The soil of Clyde silt loam to an average depth of 14 inches consists of a dark-brown or black silt loam which contains a very large percentage of organic matter. The surface is frequently covered with a mantle of peaty material 1 to 6 or 8 inches in thickness, but where the land is cleared and cultivated this becomes incorporated with the soil. The subsoil consists of a drab or bluish silt loam which grades into a silty clay loam at about 20 inches. This extends to a depth of over 3 feet, and throughout the subsoil, especially in the lower part, yellow mottlings or stains are usually found. In a few places along the Yahara River and Koshkonong Creek the black silt loam was deposited over fine sandy loam or fine sand. The black silt loam is also found over peat in a few instances. Such variations, however, are of only small extent. The type as a whole is quite uniform. Litmus-paper tests indicate that the soil is not acid.

Topography and drainage.—The surface of this type is level, and the natural drainage is poor. Before cultivated crops can be profitably grown, open ditches or tile drains must be in-

*The material mapped as Rough, stony land in secs. 23 and 26, T 5 N., R 8 E. should be shown as Clyde silt loam.

stalled to carry off the excess water. There is usually some fall, so that most of the areas of this soil can be successfully drained.

Origin.—The Clyde silt loam is largely of lacustrine and alluvial origin. It occurs as old lake beds, ponded valleys, kettle basins, and old sloughs. It also occupies the valleys of present streams. The parent material was doubtless derived from wash from the upland regions, and was either deposited in the quiet waters of lakes or by slowly moving streams. The moist conditions which prevailed favored a rank growth of vegetation, the decay of which accounts for the dark color and high organic-matter content of the soil.

Native vegetation.—The original forest growth consisted of ash, elm, soft maple, and willow. Most of the merchantable timber has been removed, but only a small part of the type has been cleared.

Present agricultural development.—Where open ditches and tiles have been installed some of the largest crops of the region have been produced on this soil. Corn has yielded as much as 80 bushels per acre and oats, 92 bushels. Grass makes a very rank growth, and timothy yields 2 tons of hay per acre. Alsike clover also does well. Small grains are likely to lodge, and the quality of the grain is not quite equal to that produced upon the upland silt loam soils of the county. Small grains can be produced with profit, however, and may well form a part of the crop rotation. Sugar beets yield 12 to 18 tons per acre, and while the sugar content is not as high as on the light-colored silt loam soils, the yield is greater and the net returns are larger. Cabbage can be grown successfully on the Clyde silt loam, but peas produce too rank a growth of vines.

The greatest need of the Clyde silt loam is drainage. It is estimated that the cost of tiling would be $25 or $35 an acre. Where thoroughly tiled, this soil will produce excellent crops.

Chemical composition and management.—The soil of this type has been formed by the drying up of marshes formed at the close of the glacial period and occurs associated largely with the Miami silt loam which was formed by the grinding action of the ice on limestone. These marshes, therefore, received the wash of lime from the upland and the Clyde soil now contains much more lime as a rule than the upland soils do. It is, therefore, practically never acid. The total supply of essential plant food elements in most cases is large; in some small areas soils of es-

sentially a muck character have been included in this type and there is so large an amount of organic matter in them that the mineral elements phosphorus and potassium are somewhat low.

The most marked feature of this type is the fact that the potassium in many cases is of low availability and crops, especially corn, turn yellow at an early stage and make poor growth. In such cases the use of some form of potash fertilizer or of strawy horse manure is necessary to remedy this condition. It ordinarily develops in patches of from one to several acres in extent. The phosphorus is usually ample for a number of years after drainage. But such land must eventually be manured as upland soils are or else commercial fertilizers containing phosphorus and potash must be used. There is ordinarily a much larger supply of nitrogen relatively than of phosphorus and potassium. In many cases which show a marked need of potassium during the first few years of cropping and where the soil is high in organic matter to a depth of a foot or so this special lack of potassium disappears after a few years of cropping as the result of the settling of organic matter so that deep plowing mixes up some of the subsoil high in potassium. In this case the lack of potassium is said to be "farmed out."

The first improvement in this type, of course, is in drainage so as to permit its being used for tilled crops, especially corn, to which it is adapted. In most cases a soil as heavy as a silt loam should be tiled and with the laterals not more than 5 rods apart and on an average not more than 4 rods.

CLYDE LOAM.

Clyde loam is of very limited extent, and only a few small areas are mapped. One of these lies 1 mile west of Brooklyn and another about 2 miles northwest of the same place.

Clyde loam is an extremely variable soil, but there are a few characteristics which are uniform throughout its development. The type averages a black or dark-brown loam to a depth of about 10 to 12 inches. This is underlain by a dark-brown, drab or bluish fine sandy loam or sandy clay loam, which usually grades into a fine sand at lower depths. The subsoil is usually mottled with yellow or brown iron stains. The texture of both soil and subsoil varies, but the surface is always dark, and the underlying material is always considerably lighter in color. The mottled condition is quite uniform. Litmus-paper tests indi-

cate that the soil is seldom in an acid condition. The surface is level and the natural drainage is poor. Before profitable yields can be had, it is necessary to construct tile drains or open ditches.

This soil is of alluvial or lacustrine origin, and has been washed down from the higher adjoining soils and deposited in small lakes or streams. One of the areas mapped lies just outside of the moraine in a region of outwash material. The dark color and high organic-matter content are due to the decay of a rank vegetation, the growth of which was favored by moist conditions. This type occurs in a limestone region, and the wash from the uplands tends to correct any acid condition which might otherwise develop. The original forest growth included elm, soft maple, ash and willow. Although the greater part of the type is still uncleared, the present timber is of little value.

Clyde loam is utilized for grazing, but is too wet for cultivated crops. Where reclaimed by drainage it is adapted to the same crops as Clyde silt loam, and requires the same treatment as that type.

CLYDE FINE SANDY LOAM.

Clyde fine sandy loam is of very limited extent. An area to the north of Middleton occupies an old lake bed. Small areas occur in the vicinity of Fish and Crystal Lakes, and other patches are scattered throughout the northern and southeastern parts of the county.

The surface soil of Clyde fine sandy loam consists of a dark brown or black fine sandy loam, ranging in a few places to a fine sand. It has an average depth of 12 inches. The percentage of organic matter present is high, and there is frequently 2 to 6 inches of peaty material over the surface. When the land is brought under cultivation, this peaty material becomes mixed with the soil. The subsoil consists of a fine sandy loam, much lighter in color than the soil, usually being drab or grayish. This frequently becomes somewhat heavier with depth, until at about 30 inches it is a silty clay loam, mottled with yellow and brownish iron stains. The subsoil, however, is variable, and frequently consists of fine sand or fine sandy loam of a white or grayish color. Litmus-paper tests indicate that this soil is acid in only a few places.

The type lies low and flat, and the natural drainage is deficient. Along the margin of some of the areas the type is high enough for crops to be grown without artificial drainage, but over most of it tile drains or open ditches are necessary for the profitable production of general farm crops.

Clyde fine sandy loam occurs in old lake beds, ponded valleys, and along the valleys of present streams. It is of alluvial and lacustrine origin, having been washed down from the higher country adjoining and deposited in lakes or stream flood plains. The moist conditions favored a rank growth of grasses and water-loving plants, the decay of which accounts for the dark color and the high organic-matter content of the soil. The original forest growth consisted of elm, soft maple, ash and willow.

Only a few areas of this soil are under cultivation at present. In the area north of Middleton, some portions of the tract have become fairly well drained by natural means—a general lowering of the water table of the adjacent lands, and are being cropped. Another tract where the conditions are somewhat similar occurs 4½ miles west of Morrisonville. With a few such exceptions most of this is in need of artificial drainage and at present is used chiefly for pasture and the production of marsh hay. It furnishes good grazing for the greater part of the season and can be used to advantage for this purpose, especially where diarying is carried on. Where properly drained it is adapted to corn, timothy, alsike clover, and small grains. It is not capable of producing small grain of as good quality as that grown on the light-colored upland soils, but profitable crops can be secured. The soil appears to be somewhat deficient in potash and phosphorus. Much the same methods outlined for the management of Clyde silt loam are applicable to this soil.

DUNNING SILT LOAM.

Dunning silt loam has an area of less than a square mile in this county, and is confined to the Wisconsin River Valley a few miles north of Mazomanie.

The surface soil to an average depth of 12 inches consists of a dark-brown to black silt loam, high in organic matter, and containing in places a small percentage of white fine sand grains. The subsoil is a yellowish-brown silt loam containing a rather high percentage of fine sand, grading into a fine sand below 2 feet. The material forming the deep subsoil is stratified, and the

structure is loose and open. Both soil and subsoil are subject to considerable variation, especially as regards the amount of fine sand mixed with the silt, and also the depth at which this fine sand layer occurs.

The surface of this soil is nearly level. It occurs as a marsh-border soil, lying at a very slight elevation above the adjoining marsh. The natural drainage is rather poor.

This soil occurs as a second bottom and is of alluvial origin. The parent material is from the glaciated region. It was carried down when large volumes of water flowed from beneath the ice sheet, and deposited within what was then the flood plain of the river. With the recession of the ice, the stream cut a deeper channel, leaving this soil on a terrace above the present flood plain.

This type originally supported a rank growth of grasses, with scattering timber—oak, elm, willow and alders.

Only a small portion of the type is under cultivation at present, due to the poor drainage conditions. Most of the area is used for pasture, some marsh hay is cut. Before this soil can be utilized profitably the water table of the adjoining marsh will have to be lowered. Because of the open subsoil tiling for under-drainage may not be necessary on all of this soil. When sufficiently well drained, it will produce profitable yields of the general farm crops. In dry years very good yields of corn have been obtained on the higher portions of the type.

Methods of improvement. The methods suggested for the management of Clyde silt loam are very largely applicable to this soil. It differs from the Clyde soils chiefly in having a lower content of lime, with the result that it is frequently acid. In such cases, an application of some form of lime would prove beneficial.

DUNNING FINE SANDY LOAM.

Dunning fine sandy loam occurs in the valley of the Wisconsin River a few miles north of Mazomanie,* and has a small total area.

The surface soil of this type consists of a loamy fine sand to fine sandy loam of a dark-brown color and extending to a depth

*The area surrounding Mazomanie in Secs. 7, 8, 9, 15, 16, 17 T. 8 N., N., R. 6 E. and marked with the letters Df should be Wf—Waukesha fine sandy loam.

of 8 inches. There is frequently a surface covering of a few inches of sandy, mucky material in which the percentage of organtic matter is very high. On cultivation the surface soils seems to become lighter, due to the mixing of the underlying sandy material with the dark surface soil. The subsoil consists of a grayinsh fine sand which extends to a depth of over 3 feet. In a few places the surface soil is a dark-brown or nearly black fine sand without the covering of muck material. Litmus tests indicate that the soil is quite strongly acid.

The surface is level. The largest area of the type, extending through the center part of Mazomanie Township, is of intermediate elevation between the ridge of Plainfield sand to the north and the peat marsh to the south, there being a gradual rise from the marsh northward. Originally much of the type was poorly drained, but through the construction of ditches the water table has been lowered so that at present a considerable portion has fair drainage. A portion of the material in sections 28 and 29 in T. 9 N., R. 6 E. has been influenced to a marked extent by wind action. In sec. 35 there is also a long narrow ridge, and at several points along the south side of the Wisconsin River there is wind worked material which in the field was classified as Dunesand, but which was included with the Dunning fine sandy loam through an error in lithographing.

This soil is of alluvial origin. The dark color is due to an accumulation of organic matter through the growth and decay of grasses when these areas were in a wet condition.

A portion of this type originally supported a heavy growth of grasses. Where timbered, willow, poplar and oak predominate.

About 75 percent of this type is under cultivation. The drainage of much of this soil has been greatly improved by the construction of a town ditch, lowering the general water table and by means of small surface ditches. General farming with dairying is the leading type of agriculture at present. On the heavier phase, fair yields of the general farm crops are obtained. The more sandy portions appear to be low in fertility, and the crops are poor.

Chemical composition and management.—This type is generally deficient in the mineral elements of plant food, especially phosphorus and potassium. These elements can be supplied by the use of commercial fertilizers. The acid condition of the soil should be corrected by the application of at least 1½ to 2 tons

of ground limestone to the acre. This is especially desirable for the growth of legumes, such as clover and alfalfa, as they do not make a satisfactory growth on acid soils.

Thorough drainage is the first step to be considered in the improvement of these lands. With proper fertilization and the correction of acidity very good crops of corn, potatoes, rye, buckwheat, timothy and alsike clover can be produced.

WABASH SILT LOAM.

Extent and distribution.—Wabash silt loam is confined to the valley bottoms of the western portion of the county. Its total area is equivalent to more than a township, and it occurs along most of the streams as long, narrow strips.

Description.—The soil of Wabash silt loam to an average depth of about 14 inches consists of a black or dark-brown silt loam containing large quantities of organic matter. It is underlain by a brownish-drab or bluish silt loam or silty clay loam which is mottled with iron strains below 18 inches. This material extends to a depth of over 3 feet, and it usually becomes heaver in texture with depth. Variations in this type are common, especially along the smaller streams, where small areas might properly be classed as Meadow. In places the surface soil is light brown, and the black silt loam is encountered a few inches below. In other localities there is a peaty covering, a few inches deep, over the silt loam. In small patches both soil and subsoil are quite sandy, but all these variations mentioned are of such limited extent that they can not be indicated on the soil map. The soil as a rule is in slightly acid condition.

Topography and drainage.—The surface of the type is level, or gently sloping towards the stream. The soil is subject to overflow and the natural drainage is poor. Before cultivated crops can be grown successfully much of the land will require tiling.

Origin.—Wabash silt loam is of alluvial origin, it having been washed from the adjoining higher land by erosion, carried by the streams and deposited within the present flood plain. A rank vegetation developed under the moist conditions, and the decay of this accounts for the dark color and the high organic-matter content of the type. In some of the narrow valleys the type is partly colluvial in origin.

Native vegetation.—The original forest growth consisted of

willow, sycamore, elm, soft maple, and ash. Some of the timber is still standing, but it has little value.

Present agricultural development.—As the drainage is poor and the type usually subject to overflow, it is not used extensively for farming. It affords good pasture, however, and is highly prized for this purpose, as it occurs in a section where dairying is carried on extensively. In a few instances where the soil is properly drained, good yields are obtained, corn averaging as much as 60 bushels per acre. The main need of this type is drainage, and with the construction of open ditches and tile drains it should become one of the most productive soils of the county.

Wabash silt loam, culluvial phase.—This phase occurs at the base of valley slopes as narrow strips, between the flood plain and the upland, which have a gentle slope, insuring good natural drainage.

The soil is intermediate between Wabash silt loam and the surrounding upland. The surface soil to an average depth of 14 inches consists of a dark-brown to nearly black silt loam, high in organic matter. The subsoil is a yellowish-brown silt loam, which gradually becomes heavier with depth and grades into a silty clay loam at 20 to 24 inches. The silty clay loam continues to a depth of more than 3 feet. The soil is darkest where it borders typical Wabash silt loam and becomes lighter as it grades into Knox silt loam, which is light colored. In a few small spots the soil is a fine sandy loam.

This soil is largely of colluvial origin, having been washed down the slopes from the higher lands adjoining.

The greater part of the phase is under cultivation, and gives very good yields. All the crops common to the region are grown, and in addition alfalfa is grown successfully in a few places. This soil is usually included in the fields with Knox silt loam or Dodgeville silt, loam, and the methods of farming are the same as on those types.

Wabash silt loam, terrace phase.—Included in this phase are two quite distinct soils of very limited area, which if more extensive would have been shown as separate types.

The first occurs most extensively in the valley of the south fork of the Sugar River and one of its tributaries, 2 to 6 miles southeast of Mount Vernon. There are other small areas in Mounds Creek Hollow, and Norwegian Hollow.

The surface soil of these areas to a depth of 14 inches consists of a dark brown or black silt loam containing a very large quantity of organic matter. The subsoil is a slit loam of a drab color, mottled with iron stains. This extends to a depth of 30 to 40 inches where a drab fine sand is encountered. In a few places the subsoil is a dark-colored carbonaceous silt loam to a depth of 20 inches, where the color becomes lighter. The depth to sand is variable, in some places occuring at 18 inches. In one small area, about 3½ miles northeast of Belleville in NE¼ of Sec. 19, T. 5 N., R. 8 E., the surface soil is a fine sandy loam. The subsoil is of similar texture, but grades into a sandy clay at about 24 inches, and this into a fine sand at about 3 feet.

The surface of this soil is nearly level, with a gentle slope toward the stream along which it occurs. Owing to the topography and to the occurrence of a large number of springs, the natural drainage is poor. The soil has been formed through the weathering of stream terraces or bottoms which lie a little above the present flood plain.

On account of the poor drainage of this soil but little effort has been made to cultivate it. Tile drainage is necessary before much of it can be successfully cropped. With proper drainage the soil is capable of producing large and profitable yields of all the general farm crops.

Included with this type are areas in Black Earth Valley which are intermediate in character between the terrace phase and colluvial phase, and occur in narrow gently undulating valleys and on the adjacent colluvial slopes, with a gently sloping topography, not too steep, however, to be cultivated and with very good natural drainage.

The soil of this portion of the type is a dark brown or nearly black silt loam of about 14 inches depth, which gradually becomes lighter in color with depth, so that the lower part of the surface soil is a medium brown. Below this a yellowish-brown color develops, and the texture becomes heavier, until at 20 inches there is a heavy silt loam or silty clay loam which continues to a depth greater than 3 feet.

Most of these areas occur adjacent to Waukesha silt loam on slopes between it and the surrounding upland and it is usually farmed in conjunction with this soil. Excellent crops of corn, oats, barley and hay are raised. As these slopes receive the wash from the surrounding limestone uplands, the soil is seldom acid and has proven to be an excellent soil for alfalfa.

Chemical composition and management.—Since this soil has been formed recently by alluvial deposit and is largely derived as wash from the silt and finer soil from the land above, it has a larger amount of the plant food elements than older soils have as a rule. It contains from one and a half to two times as much phosphorous as the average silt loam soil and considerably more nitrogen and organic matter than the Knox and Miami types have as a rule. The potassium is approximately the same—that is, about 35,000 pounds per acre to a depth of 8 inches. Moreover, the organic matter of this soil is largely of comparatively recent origin and so is more active than the black resistant organic matter of the Waukesha, Carrington, and Dodgeville types. When this soil can be thoroughly drained and protected from overflow it is one of unusually high fertility. Nevertheless, this fertility should be maintained by proper management rather than permitted to decrease. Unless this land is fully drained it is best adapted to pasture and the growing of hay, and it must be borne in mind that these crops require large amounts of phosphorous and nitrogen and that the use of land even as pasture continually does not maintain either of these elements, and its use as meadow has the effect of exhausting the plant food rapidly. Either stable manure or mineral fertilizers containing phosphorus used in connection with a rotation including a legume which is plowed under to maintain the nitrogen and organic matter must be used.

On account of its situation along streams which are subject to considerable change in volume during the year it is rather difficult to give some tracts of this type the thorough drainage which would be necessary to fit them for tilled crops. A large part of this type of soil, however, can be fully drained by a combination of tiling and surface ditches. The tile should be laid in such a way that the main runs as far down stream as possible in order to use all the fall available. Open ditches should be developed so as to carry the water from the ravines on the side hills across the valley to the stream without permitting it to separate over the surface which has the effect of filling up slight depressions and keeping them wet for a long time after heavy rains.

When thorough drainage can be provided this land is especially suited to tilled crops making a large demand on the plant flood of the soil, such as corn and sugar beets. Acidity to a slight extent has developed in this soil more or less gen-

erally. If the land is to be used for clover or alfalfa this should be corrected; otherwise, it will not lessen the fertility of the soil until it has developed to a considerably greater degree than that at present existing.

WABASH LOAM.

Wabash loam is confined to the stream valleys in the western portion of the county. Patches occur in Dunlap Hollow and along lower Halfway Prairie and Black Earth Creeks, also along the Sugar River 2 miles north of Belleville. Its total extent is small.

This type is extremely variable, but usually the soil to an average depth of 14 inches, consists of a dark-brown to black loam. The subsoil usually is a drab or somewhat bluish loam or fine sandy loam, which is mottled with yellow in the lower depths. The area mapped in the flood plain of Half Way Prairie Creek is predominately a fine sandy loam, but because of its limited extent and variability, was included with the loam type. The tract along the Sugar River north of Belleville is a black fine sand, but is only of about 15 acres in extent. A thin covering of peat occurs in places over the surface. In the lower subsoil fine gravel occurs in places. The material is not uniform over areas of any considerable extent.

The surface is low and flat, or has only a gentle slope toward the stream along which the type occurs, and the natural drainage is poor. It lies within present flood plains and is subject to overflow.

This soil is of alluvial origin, having been carried down the adjoining slopes and deposited in the present flood plain. The moist conditions favored a rank growth of vegetation, the decay of which accounts for the dark color of the soil. The original growth, in addition to grasses, consisted chiefly of elm, ash, soft maple, and willow.

On account of its low position, poorly drained condition and the danger from floods, this soil is used only for pasturage and to some extent for the production of marsh hay.

Draining and protecting the land from floods are the first steps necessary in improving this soil. In many cases, however, the cost of such improvement would not be justifiable. In composition this type is similar to the silt loam, though somewhat

more variable. When drained it is adapted to the same crops as silt loam and may be managed in the same way. In its present condition its use as pasture land is probably the most practicable.

CHAPTER VI.

GROUPS OF MISCELLANEOUS SOILS.

ROUGH STONY LAND.

Rough stony land is very largely confined to the western part of the county, where it is associated with the Knox silt loam. Areas of this type consist mainly of steep, rocky slopes and cliffs, too rough to plow or to cultivate profitably. Where there is a covering of soil over the rocks it is thin, and is usually filled with rock fragments. The texture of the soil varies from a silt loam to a fine sand or fine sandy loam. This type occupies the steepest portions of ravine and valley walls. The outcropping rock consists of limestone and sandstone, while the thin soil covering has resulted from the weathering of these formations and from the wash from higher lying lands. Much of the forest growth, consisting of oak, hickory and a few birch, is still standing. Rough stony land is non-agricultural* and of value only for the small amount of timber and pasturage which it affords.

MADE LAND.

Made land includes poorly drained areas in and about the city of Madison, which have been filled in artificially. Originally the soil was Clyde silt loam, Muck or Peat. In most cases such tracts have been covered by pumping sand from adjoining lakes, but in some instances soil has been hauled from higher lying areas. It is quite common to cover the sand with a thin veneer of "clay." These areas are not used for agriculture, but are platted into small lots and sold for building sites.

MEADOW.

Meadow comprises first bottom land along the Wisconsin River subject to annual overflow, where the texture of the soil

*The material mapped as Rough stony land in sections 23 and 26 in T. 5 N., R. 8 E., should be Clyde silt loam.

is so variable that no satisfactory classification into established types can be made. The texture ranges from a fine to a medium sand, with occasional small areas that are much heavier, while the color varies from light brown to nearly black. In a few places there is a shallow covering of peat. The surface is nearly flat, and lies only a few feet above the level of the adjoining river, so that drainage is deficient in depressions. The soil of these areas is of alluvial origin, having been deposited by the waters of the Wisconsin River. Much of the tract is timbered with ascattered growth of soft maple, willow, elm and ash. About the only agricultural uses to which these tracts can be put are for pasture and hay land.

CHAPTER VII.

GROUP OF MARSH SOILS.

PEAT.

Extent and distribution.—Peat is extensively developed in Dane County, and is widely distributed throughout the glaciated region. The largest areas occur in the northeastern part of the county in Burke, Sun Prairie, Medina, York, Deerfield, Cottage Grove, and Blooming Grove Townships. Smaller areas are encountered in the southeastern, southcentral, and extreme northwestern sections.

Description.—The soil mapped as Peat consists of black or dark-brown vegetable matter in varying stages of decomposition, with which there is incorporated a small percentage of mineral matter. It ranges in depth from 2 to about 20 feet, with an average of probably 5 feet. The greater part of the Peat is quite fibrous, though in a number of places it is fairly well decomposed and tenacious, so that it can be molded into different forms by the hands. When dry this well-decomposed Peat somewhat resembles a black carbonaceous clay. Where encountered in areas of sandy soils the underlying material is frequently sandy, while in regions of heavy upland soils the underlying material is clayey in character. Most of the areas of Peat are underlain by material as heavy as a loam or heavier. The largest areas underlain by sand occur in the valley of the Wisconsin River in the northwestern part of the county. In this region there are a few small sand "islands" in the Peat areas and in places the underlying sand is nearer the surface than usual. Practically all of the other large Peat marshes within the county are underlain by heavy material.

Topography and drainage.—The Peat areas are low, level, and very poorly drained. During early spring some of the marshes are entirely covered with water, while later in the summer many tracts are dry enough and firm enough to bear the weight of farm animals, so that they can be pastured or cut for

hay where there is a growth of wild grasses. The natural drainage courses have been deepened and large open ditchs constructed in a number of the marshes, and a considerable part of this land is being reclaimed and transformed into productive fields.

Origin.—The Peat has been formed through the growth and partial decomposition in the presence of water of a rank vegetation, the black or dark-colored material being formed largely from grasses and sedges, and that having a brown color chiefly from sphagnum moss. About the margin of the larger marshes, and over the greater part of the smaller ones, varying quantities of soil from the adjoining higher land have been washed in and incorporated with the vegetable matter. Wherever this is sufficient to change materially the texture and structure of the material it is separated and mapped as Muck. The peat beds occupy old lake basins, ponded valleys, kettle basins, glacial sloughs, and other depressions in the uneven surface developed by the glacial ice sheet. Peat may also be found within the flood plain of many of the streams. Although the greater part of the Peat occurs within a region where the upland soils are made up in part of limestone material, some of it is in an acid condition. This is usually the case in the center of the larger marshes, while many of the smaller ones are not thus affected.

Native vegetation.—The native growth consists chiefly of several varieties of grasses, sedges, and some arrowhead, cat-tail, and various reeds and rushes. Some of the sphagnum moss peat beds support a growth of tamarack, sumac, huckleberry, and some quaking aspen. Where the Peat is shallow, elm and ash are sometimes found.

MUCK.

Muck consists of vegetable matter in varying stages of decomposition, with which there is incorporated large quantities of mineral matter. It may be considered as intermediate between Peat and the soils of the Clyde series. In some places the surface material is Peat, but is underlain at 10 to 14 inches by silt loam or silty clay loam, and such tracts can not well be classified with the true Peat.

Muck is not of large extent in this county, and it occurs only in small tracts scattered throughout the glaciated section. It occupies about the same topographic position as Peat, and is

VIEW OF RECLAIMED PEAT LAND NEAR DEERFIELD.

There are over 50 000 acres of this kind of marsh land in Dane County, nearly all of which can be reclaimed. At present comparatively little of the marsh land is under cultivation.

VIEW OF CORN GROWING ON RECLAIMED PEAT LAND. THIS IS PART OF THE SAME MARSH SHOWN IN PLATE IX. With thorough drainage, proper cultivation and fertilization these marsh lands are capable of producing large and profitable crops.

poorly drained and usually in a swampy condition. It is so situated that most of it could be drained along with the Peat. With drainage well established the material is very productive. In its present condition, however, its only value is for the pasturage it affords and the marsh hay which is cut from some areas.

AGRICULTURAL VALUE AND DEVELOPMENT OF PEAT AND MUCK.

The large amount of marsh land occurring in Dane County so well located with reference to market and transportation facilities makes it important to consider its agricultural possibilities quite fully.

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 underlaid 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 underlaid 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 to 5 feet below the surface during part of the growing period. When tilled crops, such as corn, cabbage, or potatoes, or small grains are to be grown, the drainage must be more certain, and over the greater portion of our marsh lands this will mean the installation of 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 the elements phosphorous and potassium. The marsh lands of Dane County are rarely acid since the acidity which ordinarily

develops in marsh land is kept neutralized by the lime carried down from surrounding uplands. 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 phosphorous 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 commercial fertilizers containing phosphorous and potassium 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 commercial fertilizers are 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, therefore 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 Dane County, potatoes and early varieties of corn on marsh lands are seldom injured by frost.

The large water-holding capacity of marsh 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 phosphorous 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 marsh land having insufficient drainage to be adapted to corn or other crops requiring tillage.

CHAPTER VIII.

GENERAL AGRICULTURE OF DANE COUNTY.

Agriculture was first practiced in Dane County about 1830. The first settlers selected the rolling timber land because of the ease of obtaining wood and water, and also on account of the protection from the winter weather. Settlers from Ohio and Illinois who were accustomed to farming on prairie land located more often along the edge of the prairies, and as the population increased the prairie lands were gradually taken up.

The early agriculture consisted mainly of grain production, with the growing of enough garden and truck crops to supply the needs of the family. For many years the grains, including wheat, oats, barley, rye, and flax, were by far the most important crops grown, and of these wheat was much the most important. For a number of years it exceeded all other crops combined. Wheat was in many cases grown in the same field for a long period of years. At first the virgin soil produced excellent yields, but the continued cropping, together with the ravages of the chinch bug, so reduced the yields that the crop could not be produced with profit. Grain production gradually gave way to a more diversified system of farming. Corn and oats proved to be profitable, and the raising and feeding of stock gradually developed into an important dairy industry. Tobacco was introduced into Dane County by settlers from Ohio as early as 1853, and was grown on the "prairies" in the southeastern section. From this beginning tobacco developed into an important crop. It is still grown extensively, mainly by Norwegians, in the southeastern part of the county.

The type of agriculture most extensively followed in Dane County at the present time consists of general farming in conjunction with dairying. A number of special crops receive attiontion, and among these tobacco is by far the most important. Peas, sugar beets, and potatoes are grown. The general farm

crops are corn, oats, barley, rye, wheat, buckwheat, timothy, clover, and alfalfa.

Corn is grown more extensively than any of the other cultivated crops. In 1909, according to the census, 107,182 acres were devoted to corn, with a production of 3,501,937 bushels. White and yellow dent varieties are most popular. The corn is usually cut with a harvester and husked from the shock, the stover being stacked in the field or shredded and stored in the barn for coarse winter feed. In recent years many silos have been built and a large part of the corn is now used for ensilage.

Oats are second in importance to corn. The census of 1910 reports 99,968 acres in oats in the county, with a production of 3,157,306 bushels. Practically the entire crop is used for feed on the farms, comparatively little being placed on the market. Miami silt loam and the better areas of Knox silt loam produce oats of the highest quality, though Carrington silt loam and other black prairie types often give larger yields per acre.

Barley is an important crop in many sections. With a number of farmers it is the chief cash crop grown. In 1909 there were 34,873 acres in barley, producing a total of 910,388 bushels. The acreage devoted to this crop has been gradually decreasing, chiefly because of a reduction in the yields obtained. The barley is grown almost entirely on the heavy soils of the county.

Rye is not grown extensively, but in some parts of the county it is an important crop. From 3,247 acres in 1909 a total volume of 46,003 bushels was harvested. The growing of rye is confined almost entirely to the sandy types of soil. It is planted as a grain crop, for green manuring, and for pasturage. On the sandy loam types very satisfactory yields are usual, and during years of at least normal rainfall good crops are often obtained on some of the more sandy types.

The acreage devoted to wheat, which was at one time the most important crop in the county, is at present small. The 1910 census reports 2,522 acres in wheat, with a production of 48,595 bushels. Although the average yields are low, where grown in a good crop rotation wheat usually gives very satisfactory yields.

Buckwheat is grown to a very small extent and is confined largely to the low sandy soils of the county. In 1909, 225 acres in the county were devoted to buckwheat, producing 4,218 bushels.

Of the hay crops grown in Dane County timothy and clover are the most important. It is the common practice to sow these together, with some small grain as a nurse crop. The medium red is the most popular clover grown. Some difficulty has been experienced in getting a good stand of clover during recent years, owing to winter-killing in the late winter, when the ground is alternately freezing and thawing. On certain types of soil an acid condition exists, which is detrimental to best results with leguminous plants, including clover. On the heavier soils and where drainage is somewhat deficient alsike is being grown to a considerable extent, as a stand can usually be obtained more easily than with the medium red clover. Mammoth clover does well on the lighter soils, but on the heavy types it is coarse and not so satisfactory as the medium red. Both timothy and clover are sometimes seeded alone and cut for seed as well as for hay. Over the low, marshy tracts within the county many tons of marsh hay are cut each year, but this is of inferior quality.

Alfalfa is becoming a very important crop, especially in the dairy districts. Three cuttings can always be counted on, and the average yield per acre is 3 tons per year. Alfalfa can be grown on many of the different soil types in the county when the soil is put in proper condition. A good stand is always gotten where the field is inoculated, well supplied with stable manure, and in a sweet condition. It is a good practice to sow a small quantity of alfalfa seed with clover and timothy so as to get the field inoculated for the alfalfa crop.

The acreage of emmer and spelt grown in Dane County in 1909 was small. A total of 226 acres produced 7,875 bushels.

In addition to the general farm crops, several others which may be classed as special crops are produced, and among these the most important are tobacco, potatoes, sugar beets and peas.

Dane County holds first place in Wisconsin in the production of tobacco. In 1909, of a total acreage of 40,458 acres devoted to this leaf within the State, 16,789 acres were in Dane County, and the output for the county is reported as 20,932,967 pounds. Almost one-half of this was produced in the four southeastern townships of the county. Stoughton, in Dane County, and Edgerton, just across the line in Rock County, are approximately the center of Wisconsin's tobacco-growing section. Most of the tabocca grown is of the Comstock's Spanish variety. About 85 per cent is sold as binder tobacco, and the remainder,

consisting chiefly of broken leaves and stems, as filler. Binder tobacco usually sells for 7 to 14 cents a pound, and filler for about 2 cents a pound. The average yield is about 1,200 pounds per acre. Tobacco is grown most extensively on Carrington and Miami silt loams. The choicest land for tobacco appears to be near areas of Carrington fine sandy loam where there is just a little sand mixed with the silt.

The crop is fertilized with stable manure, very little commercial fertilizer being used. In order to maintain the productiveness of the tobacco land and provide a very rich soil, 20 to 40 loads of manure are applied per acre. As about 10 acres of tobacco are grown on the average by each of the planters in the tobacco section, it takes all of the manure produced on the farm to supply this one field, and as a result the remainder of the farm can not be manured.

This practice of applying practically all the manure of the farm to the tobacco fields has a bad effect on the remainder of the farm which in many instances is not farmed profitably. When tobacco or any other special crop requiring heavy manure is grown, some method of increasing the nitrogen and organic matter should be used so that a part at least of the manure can be used on the other parts of the farm. It would be possible on most farms on which tobacco is grown to use two fields for this crop alternately. After tobacco has been grown three years on a field, this field could be planted the next year to corn, the second to oats seeded to clover, and the second growth of clover grown during the third year should be plowed under to increase the organic matter and to secure the nitrogen which tobacco needs. If on this clover sod a good application of commercial fertilizers containing right amounts of phosphorus and potassium is made, this will make unnecessary the use of manure on the field for that year, and the amount for the next year may be lessened, so that about one-half the manure would be available for other fields on the farm.

If in addition to this, proper rotation be maintained on the remainder of the farm so that clover be grown every third or fourth year, and as far as possible the second growth of clover plowed under, this will overcome much of the difficulty of maintaining the fertility on tobacco farms.

This practice of growing clover alternately will also reduce the amount of erosion or washing which is often quite serious

on tobacco fields on side hills. It is probable that some kind of green manuring crop could also be sown in the tobacco field at the last cultivation so as to still further increase the supply of organic matter. This interchange of fields for tobacco will also assist in preventing the development of diseases to which this crop is subject.

Potatoes, while not an important crop commercially, are grown quite generally in small fields in the sandy sections of the county, and in all parts the tuber is grown to a sufficient extent to supply home needs. The 1910 census reports 5,883 acres in potatoes in 1909, with a production of 679,675 bushels. The Early Rose, Early Ohio, Rural New Yorker, and Peerless are among the varieties most commonly grown.

Sugar beets are grown quite extensively on some of the heavier types of soil, chiefly Carrington silt loam and Miami silt loam. In 1909, from 1,247 acres, a production of 14,060 tons is reported. A beet-sugar factory is located at Madison, and a large percentage of the best tonnage is shipped to this point. It is customary for the farmers to put in the crop and attend to the implement cultivation, while the factory furnishes labor to do the hand work, such as thinning, weeding, and topping, for which a charge of $20 per acre is made. Yields range from 8 to 18 tons per acre, and the usual selling price f. o. b. is $5.50 to $6 per ton, depending upon the sugar content. The sugar content of beets grown on Miami silt loam is a little higher than that of those grown on Carrington silt loam or other dark-colored soils, but the yield is usually higher on the dark soils, and the net returns usually a little larger than from the light-colored types. The sugar beet is a heavy feeder and the soil must be highly fertile to produce the largest yields which are necessary to profit in the growing of this crop. If sugar beets are to be grown regularly to any extent proper care must be taken that they are not grown at the expense of other crops by the use of the largest part of the manure of the farm on the beet field. If they are grown on land on which a good second growth of clover or other legume has been plowed under and to which some commercial fertilizers have been added, the amount of manure used can be greatly lessened. This will not only assist in maintaining the fertility of the farm as a whole but will reduce the difficulty in keeping the beet fields free from weeds. The proper fertilizers to use in this way will depend on the type

of soil. When beets are to be grown on upland light-colored soil or clay loam soil, the fertilizers should be one containing chiefly available phosphorus, such as acid phosphate or ground steamed bone meal. When the beets are being grown on black or marshy soil fertilizers should be high in potash but should also contain phosphorus.

Peas for canning and also for seed are grown quite extensively in the northeastern part of the county and to a small extent in the northwestern section. One canning factory is located within the county, at Sun Prairie. A large factory is operated at Columbus, which is but a few miles distant from the northeastern corner of the county. Another factory is located at Sauk City, a few miles from the northwestern corner of the county. Yields range from 2,000 to 2,200 pounds per acre of shelled peas for canning, for which the farmers received 2 to 2½ cents per pound. In order to obviate long hauls viners are located throughout the pea-growing sections, making possible the extension of the industry beyond the immediate vicinity of the canning factory. In sections too far removed from factory and viners seed peas are grown. The usual yields range from 15 to 20 bushels per acre, and the price varies from $1.50 to $2 per bushel. The varieties chiefly grown are the Alaska, a very early pea, and the Advance, Admiral, and Horseford, which are later. Peas are proving to be profitable, and, being a legume, they get part of their nitrogen from the air through the nodules on the roots but probably do not take nearly as large a part of their nitrogen in this way as do clover and alfalfa. Moreover where the vines are removed from the farm nearly all the nitrogen goes with them as the root system is small. On the whole therefore it is best to think of the pea as one would of corn and grow in rotation on a clover sod or on land which has been manured.

The pea is greatly benefited by the use of ground limestone on land which is acid. Miami silt loam has been found especially suited to peas. They also do well on Carrington silt loam, but the quality is not quite so high as of those grown on Miami silt loam.

The growing of truck crops on a commercial scale has been developed in the immediate vicinity of Madison, where most of the common vegetables are grown for the city market. Some of the sandy types of the county are very well adapted to the truck-

ing industry. Nearly every farm has a garden in which most of the common vegetables are grown for home use, but there are only a few places in the vicinity of towns where trucking is engaged in on a commercial scale.

The fruit industry has not been developed commercially, except in a few orchards, chiefly in the vicinity of Madison, where small fruits and berries, such as raspberries, blackberries, currants, and strawberries, are grown. Apples are grown in small orchards on many of the farms, but there are no large commercial orchards within the county. There are a large number of excellent orchard sites, especially in the western and southwestern parts of the county, where the soils are favorable for apple culture, and it would seem that apple growing could be profitably developed on a commercial scale.

Considered from the standpoint of returns, dairying is the most important industry in Dane County. In 1913 there were within the county 90 cheese factories, 50 creameries, and 4 skimming stations, and a large condensery is located at Middleton.

In the western and southwestern sections of the county, where the surface is quite rough and broken, and where corn can not be grown as profitably as in other sections, mainly on account of the danger from erosion on the steep slopes, farming conditions are somewhat different from those in sections where the topography will permit the extensive growing of all intertilled crops. The Swiss cheese industry which centers in Green County to the south is developed to a considerable extent in the southwestern part of Dane County. A somewhat higher altitude and consequent cooler nights together with the fine quality of the pasture grasses are favorable conditions for this variety of cheese. In other sections of the county creameries are more numerous, corn is grown more extensively, and hog raising is a more important branch of agriculture.

In the production of beef cattle Dane County ranks first in the State. Throughout the tobacco-growing section, where dairying is of little importance, it is a common practice to fatten cattle each year in conjunction with the general farming operations which are carried on by the tobacco growers. In other parts of the county the feeding of beef cattle is a minor activity.

Horses are raised on many farms, but seldom as the main pro-

duct. Most farmers raise their own work stock, and frequently horses are sold. The quality of the sires used is gradually being improved, with the result that larger and better work horses are taking the place of the smaller stock.

Sheep are raised only to a comparatively small extent. It is a fact that sheep are not raised as extensively in the rougher portions of the county, where there is a large acreage of grazing land, as in the sections where land values are higher and where the soil is well adapted to a large variety of cultivated crops. There are several flocks of purebred sheep, but the total number of sheep in the county is small. It would seem that the rougher land in the southwestern part of the county would be very well adapted to the sheep raising business. The use of side hills for pasturage would greatly reduce the erosion or wash to which this land is subject when in cultivated crops.

Hog raising is carried on quite extensively in all parts of the county except the southwestern section, where cheese production is important. Hogs are most numerous in sections where butter is the chief dairy product.

Farmers are beginning to realize the value of the adaptation of crops to soils. It is generally recognized that certain crops produce higher yields and are of better quality on certain soils than on others. Peas, for instance, appear to do best on Miami silt loam. Corn makes its best growth on the dark-colored soils, such as Carrington silt loam, Dodgeville silt loam, and Waukesha silt loam. On these dark soils, having a large percentage of organic matter, small grains are likely to lodge and the quality of the grain is not so good as on the light-colored heavy soils of the county. The grasses appear to do best on the dark-colored soils of heavy texture. Potatoes of the best quality are grown on the sandy and sandy loam types. Local conditions, however, often are such as to make it impossible to conform strictly to the growing of crops best adapted to a given soil. Since a rotation of crops is almost imperative in order to assist in the eradication of weeds and to make it possible to apply the manure on the farm to the crop most needing it, it is impossible to adapt the crop completely to the type of soil on which it is grown, but the system of farming followed on each farm should be that in which the crops best suited to the predominating type of soil are grown as extensively as possible. That is to say, on dark colored prairie soils corn should be grown and used to a large extent, while relatively less small

grain should be grown. On a more rolling land of lighter-colored soils pasture should be used more extensively, more small grains should be grown and less dependence put on corn.

A rotation quite common for the light-colored, heavy-textured soils of the county consists of corn one year, followed by oats, and then barley, or wheat seeded with timothy and clover. Hay is usually cut for two years before the field is again plowed for corn. On the prairie soils corn is quite often grown two years in succession, and followed by grain and hay crops.

The most troublesome weeds in Dane County probably are the Canada thistle, quack grass, wild mustard, and wild morning glory. The amount of damage caused by such pests is not fully appreciated, and there is a general need of additional efforts toward their eradication.

The farm buildings throughout the county, as a rule, are well constructed, substantial, and kept in good repair. The silo forms a part of the equipment of most of the dairy farms. The fields are generally well fenced, and woven wire is coming into common use.

Windmills are quite common, though on many farms gasoline engines are used for pumping water and running various kinds of the lighter machinery. In general the appearance of the farmsteads indicates thrifty and prosperous agricultural conditions.

The supply of hired help for the farms is usually limited. The members of the family do most of the farm work. Farm laborers are usually paid $30 to $40 per month with board. During haying and harvesting, day laborers are paid $1.50 to $2, and sometimes as much as $2.50. During the season of 1913, tobacco laborers hoeing and harvesting the crop, received $3 and $3.50 per day.

The census of 1910 reports a total of 6,058 farms in Dane County, comprising 95.7 per cent of its area. Of these farms, 73.2 per cent are operated by the owners, the remainder being divided in the ratio of about 3 to 2 between share and cash tenants. The average size of the farm is 122 acres, of which on an average 88 acres are improved.

The value of farm land varies widely with the different types of soil. The highest priced land in the county is in the tobacco growing section, where small farms of choice tobacco lands are held at prices in the vicinity of $200 to $250 an acre, and some at even a higher figure. Larger farms on Carrington silt loam

and Miami silt loam are valued at $125 to $150 an acre. On the other hand, some of the farms on the sand types are held at $25 to $40 an acre. In the driftless region land values depend on the percentage of rough, steep land included in a farm, and the prices range from $40 to about $125 or more an acre. Location, character of soil, and improvements are factors which determine the value of farm land. The average value of land in Dane County was reported in the 1900 census as $41.20 an acre. In 1910 the average value is given as $72.73.

Although the agriculture of Dane County is in a comparatively high state of development, there are certain lines along which improvement is needed. One great deficiency of all the light-colored soils of the county is organic matter. This is effectively supplied by supplementing the stable manure with green-manuring crops, of which the legumes are the best. By increasing the supply of organic matter, not only is plant food added but the water-holding capacity of the soil is increased and the structure of the heavy soils is improved. Litmus tests made during the progress of the survey indicate that an acid condition exists in some of the types. This condition can be corrected by the application of ground limestone or some other form of lime. Before alfalfa can be grown successfully the soil should be in a sweet condition and inoculated. There is a general need for greater attention to the systematic rotation of crops in order to secure combinations best suited to soil conditions on the farm. More thorough methods of cultivation, especially of intertilled crops, are needed. Thorough cultivation helps to conserve soil moisture. As a rule the selection of seed does not receive proper attention.

With certain special crops, such as tobacco and sugar beets, commercial fertilizers, properly tested, are valuable as a supplement to stable manure, of which the supply is usually inadequate. The growing of alfalfa and of other legumes, such as peas and beans, is beneficial to the soil and could be profitably extended.

The drainage of wet lands affords an extensive field for development. Aside from the large marshes, there are on many farms small patches of wet land which could be tilled at little expense, materially increasing the productive area of the farms. Many areas of Peat, with proper drainage, are capable of producing profitable crops. Land values are so high as to encourage the reclamation of nonproducing tracts.

CHAPTER IX.

CLIMATE.*

"Among the factors which influence the agriculture of a State none is more important than the climate. The class of crops which can be grown is largely determined by the length of the growing season and the amount and distribution of the rainfall, so that the climate may determine the type of agriculture which can be practiced to best advantage."

"The distribution of rainfall over Wisconsin is remarkably uniform, the average yearly precipitation ranging from 28 to 34 inches, while the mean for the State as a whole is 31 inches. This is a slightly heavier rainfall than is received by eastern England, northern France and most of Germany and Sweden. As compared with other sections of this country, Wisconsin has a total rainfall equal to that of central Oklahoma and Kansas, northern Iowa, Michigan, northwestern New York, or the Puget Sound Basin of Washington. Owing to its northern location, however, the lessened evaporation probably makes the precipitation as effective as that of Arkansas, Illinois, or Virginia."

The local distribution of rainfall varies, however, from year to year, the variation being caused by the movement of cyclonic storms. Since authentic records have been kept the average rainfall for the State during the driest year was 21.4 inches and during the wettest year 37 inches. For Dane County the total precipitation for the driest year recorded was 13.49 inches and for the wettest year 52.91 inches. The mean annual precipitation is 31.25 inches.

"Of equal importance in agriculture to the total amount of rainfall is its seasonal distribution, and in this respect Wisconsin is favorably situated, since about half of the total rainfall occurs in May, June, July, and August, and nearly 70 per cent

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*Ths chapter has been taken largely from Wisconsin Bulletin 223 on The Climate of Wisconsin and its Relation to Agriculture. This bulletin should be consulted if more information is desired concerning climate. All quotations indicated are taken from this bulletin.

from April to September, inclusive. The rainfall is heaviest in June, averaging 4.01 inches, while in July it averages 3.8 inches and in May 3.66 inches. The precipitation during the winter, on the other hand, is slight, December, January, and February each averaging somewhat over 1.5 inches. The average rainfall for the State during the winter is 3.9 inches, during spring 8.3 inches, summer 11.4 inches, and fall 7.4 inches. For Dane County it is 4.85 inches during the winter, 8.28 inches during the spring, 10.96 inches for the summer months, and 7.16 inches for the fall. Most of the rainfall occurs just preceding and during the period of plant growth; thus, the growing season—April to September, inclusive—has an average of 20.24 inches, which is as much rain as is received during the same months by eastern Texas, Illinois, Ohio, or eastern New York. Owing to the small winter precipitation, on the other hand, there is practically no leaching of fertility from the soil or erosion.''

Another phase of rainfall distribution of great importance is its variation within a period of a few weeks. Frequently periods of drought and periods of unusually heavy rainfall occur, continuing for one week to four weeks and occasionally longer. Observations taken at Madison over a period of thirty years, from 1882 to 1911, inclusive, show that there are on the average three ten-day periods during each growing season when the amount of rainfall is so slight that crops on a moderately heavy soil, such as the Miami silt loam, actually suffer from lack of moisture.

The eastern and southeastern sections of Dane County are included within the Rock River Basin, which is one of the 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 that of central Indiana or Ohio, and about equal to that of the Valley of Virginia and that of central Maryland. The mean annual temperature in Dane County is 45.7° F. The winters here are cooler than along the Lake, and the springs and summers are warmer. 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 southwestern Pennsylvania, while in winter it is comparable with that of southern Vermont, northern Iowa, or Montana. During seven summer days on the average each year the thermometer may go as high as 90° and during five winter mornings on an average it may

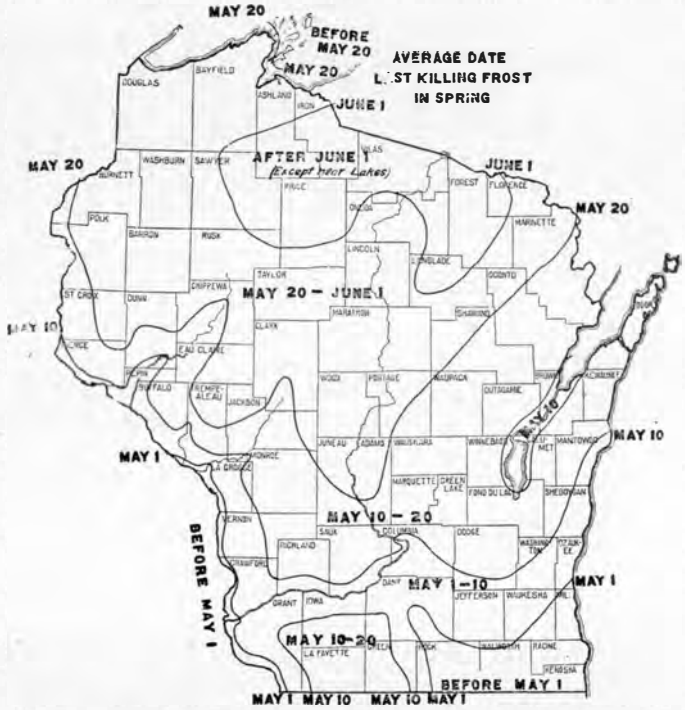

FIG. 2. Sketch map showing the average dates of the last killing frost in the spring.

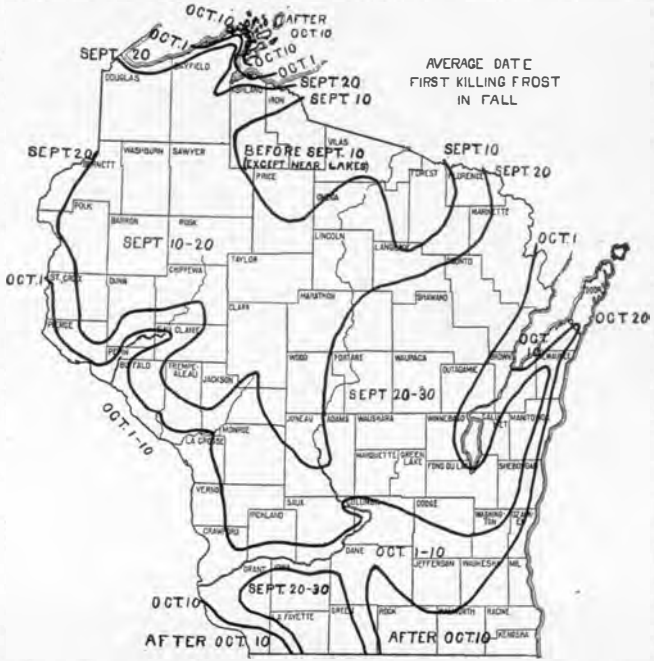

FIG. 3. Sketch map showing the average dates of the first killing frost in the fall.

fall to 10° below zero or lower. The highest temperature recorded in the county is 104° F., and the lowest—29° F. Such extremes are of rare occurrence and of short duration. The southwestern and a part of the western sections of Dane County have a somewhat shorter growing season, and are included in what is known as the Southern Highlands. The average elevation is somewhat greater than that of the eastern and southeastern parts of the county and the growing season ranges from ten to twenty days shorter.

The average date of the last killing frost in the spring is April 22; the latest date of killing frost recorded is May 13. The average date of the first killing frost in the fall is October 18, while the earliest date recorded is September 29.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation as recorded by the Weather Bureau station at Madison:

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

Month	Temperature.			Precipitation		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	22.8	60	—28	1.72	1.80	1.32
January	16.9	58	—29	1.63	1.12	2.05
February	18.7	63	—28	1.50	0.26	5.42
Winter	19.5	.....	.....	4.85	3.18	8.79
March	30.4	86	—12	2.08	0.27	4.34
April	45.6	86	8	2.54	1.06	1.50
May	57.6	90	23	3.66	2.58	4.25
Spring	44.5	.....	.....	8.25	3.91	10.09
June	67.3	98	38	4.01	0.59	4.15
July	72.0	104	48	3.80	1.21	9.47
August	69.8	96	46	3.15	2.08	0.56
Summer	69.7	.....	.....	10.96	3.88	14.18
September	62.3	93	29	3.08	0.91	8.17
October	50.0	84	12	2.32	0.58	9.12
November	35.1	69	—14	1.76	1.03	2.56
Fall	49.1	.....	.....	7.16	2.52	19.85
Year	45.7	104	—29	31.25	13.49	52.91

SUMMARY

Dane County is located in the south-central part of Wisconsin, and comprises an area of 1,202 square miles, or 769,280 acres. The surface varies from level or gently undulating prairies and outwash plains to hilly and broken country. From the standpoints of physiography and geology the county falls naturally into two broad divisions—the driftless western part of the county, where the surface configuration is largely the result of erosion, and the remainder of the county, which has been greatly influenced by glacial action and has a more even topography.

The drainage of the northwestern part of Dane County is directly into the Wisconsin River. The remainder is drained through the Yahara and Sugar Rivers and their tributaries into the Rock River and thence into the Mississippi.

The first permanent settlements in Dane County were made about 1830. The first settlers were interested in mining, but agriculture soon developed, and the county is now one of the most highly improved in the State. Madison, the county seat and the capital of the State, is an important railroad center and has a population of 25,531, according to the 1910 census. The population of the county is reported as 77,435. The entire county is well supplied with transportation facilities, and all sections are well settled.

The climatic conditions in this part of Wisconsin are favorable for the development of general farming and dairying. The mean annual temperature at Madison is 45.7°, and the mean annual precipitation is 31.25 inches. On the average, during each of the months of May, June, July, August, and September, there is more than three inches of rainfall. The rainfall is usually fairly well distributed, but there are occasionally short periods of drought or of excessive rainfall.

The general type of agriculture in Dane County consists of general farming in conjunction with dairying. In 1913 there were 90 cheese factories and 50 creameries in the county. The common farm crops are corn, oats, barley, clover, timothy, alfalfa, wheat, and rye. In addition a number of special crops are grown, including tobacco, potatoes, peas, and sugar beets.

Some beef cattle are fed, chiefly in the tobacco-growing districts, but the raising of beef cattle is unimportant as compared

with the dairy industry. Hog raising is carried on quite extensively, and a few sheep and horses are raised in the county.

Agriculture is highly developed in nearly all sections. Land values range from about $25 an acre in the sandy and rough areas, to $250 or even more an acre in the sections containing the most highly improved farms. In 1910 the average value was $72.73 an acre.

The geologic formations which form the surface rock in Dane County and have largely given rise to the soils are, in order of their occurrence, the Potsdam sandstone, Lower Magnesian limestone, St. Peters sandstone, and the Trenton and Galena limestone. The greater part of the county was traversed by two glacial ice sheets of different age. The older is known as the pre-Wisconsin glaciation, and its debris covers only a very small part of the county. The younger is known as the last Wisconsin glaciation, and material from this source covers over half of the county. In addition to these sources of material a mantle of loess has been deposited over most of the unglaciated section and over a part of the glaciated section.

In Dane County 13 soil series and 31 soil types, including Rough stony land, Madeland, Peat, Muck, and Meadow, are recognized.

The Carrington series consists of dark-colored, upland prairie, glaciated limestone material. Some of the highest priced farming land in the region is included in the silt loam and its shallow phase. The fine sandy loam is not important. Most of this land is cultivated. General farming is the chief activity, with tobacco growing an important special industry.

The Miami series consists of light-colored, upland, forested, glaciated limestone material. The fine sandy loam and silt loam are extensive and valuable agricultural types, the former well suited to truck crops. The silt loam and its deep phase support chiefly general farming. The gravelly sandy loam is of small extent and mostly in pasture. The loam is also inextensive, but largely in cultivation.

The Rodman gravelly fine sandy loam includes light-colored assorted glacial material which occurs chiefly as kames and eskers. It has a low agricultural value, and is of small extent.

The Fox series includes light-colored, forested soils mainly in glaciated limestone regions where the material occupies outwash plains or stream terraces. The series in this county is not extensive, but the three types encountered are well improved.

The Plainfield series is represented by one type, the fine sand. It is an alluvial terrace soil derived from glacial debris. About half the type is cultivated and used for general farming. It has a rather low value.

The Waukesha series comprises dark-colored, prairie or semi-prairie soils derived from reworked glacial material, deposited as outwash plains or terraces. It includes good agricultural land. The types mapped are Waukesha fine sandy loam and silt loam.

The Clyde series is represented by three types, the fine sandy loam, loam, and silt loam. These are dark-colored soils within the glaciated limestone region, where the material is of alluvial or lacustrine origin and occurs as old lake beds, ponded valleys, or as first-bottom land along the streams. They are low and poorly drained, but well suited to crop production when drained, especially the silt loam, which can be made very productive.

The Dunning series includes dark-colored soils of alluvial origin from which the lime has been very largely removed. The natural drainage is very poor. Dunning silt loam and fine sandy loam are recognized.

The light-colored, forested upland soils of the unglaciated region, where the material is largely of loessial origin, are classed with the Knox series. Knox silt loam is extensively developed and includes a large area of good farm land. It is mostly in cultivation to general farm crops. The steep phase is less valuable.

The Dodgeville series includes dark-colored, upland prairie soils of the unglaciated region where the material has been derived in part from the loesslike mantle covering a part of the county, and in part from the weathering of limestone. Dodgeville silt loam makes very good general farming land except where shallow. The fine sandy loam is of low agricultural value.

The Boone series includes light-colored forested soils where the material has been derived from the weathering of sandstone, in this county, chiefly the St. Peters sandstone. The series is of rather low agricultural value. The types mapped are the Boone fine sandy loam and loam.

The Wabash series comprises dark-colored soils of the unglaciated region of alluvial origin which occur as first-bottom land. Wabash loam and silt loam are recognized. For the most part the soils are poorly drained and subject to overflow. Only a small portion of the land is under cultivation.

The Genesee fine sand is a very inextensive light-colored soil which occurs as first-bottom land. The material is alluvial in origin and consists of reworked glacial debris. The land is subject to inundation.

Rough stony land comprises steep, rocky slopes where the slope is too steep or the land too rocky to be of value for cultivated crops and is of use only for pasturage and forestry.

Madeland consists of small, poorly drained areas of filled-in material.

Peat consists of vegetable matter in various stages of decomposition, with which there are usually incorporated small quantities of mineral matter. In its present condition it is poorly drained and of little value. When drained and reclaimed it makes very valuable land. Peat is an extensive type in Dane County.

Muck includes highly organic soils intermediate between Peat and soils of the Clyde series. It is not extensive in Dane County.

Meadow includes first-bottom land subject to overflow, where the material is so variable that it cannot be separated into recognized soil types. It is of very limited extent.

KEEP THE MAP

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