WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

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

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# SOIL SURVEY

OF

# DOOR COUNTY

## WISCONSIN

BY

A. R. WHITSON, W. J. GEIB, AND H. V. GEIB

OF THE

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

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MILTON WHITNEY, CHIEF
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# INTRODUCTION

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

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

It is the object of this survey to make an inventory of the soils of the State, and to be of practical help to farmers by locating and describing the different soils, by determining their

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

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

Water holding capacity and other physical properties of soil all depend chiefly upon *texture,* which refers to the size of the individual soil grains, or particles. A coarse sandy soil, for example, will not retain moisture so long as a loam soil, or clay loam, because the finer the soil grains, the greater will be the total soil-grain surface area to which moisture may adhere.

Texture is determined in the field by rubbing the soil between the thumb and fingers, and with experience one soon becomes expert at judging the size of soil grains. This field judgment is verified in the laboratory by a *mechanical analysis,* which is made by a simple method of separating soil grains into different groups, of which there are seven. These are known as clay, silt, very fine sand, fine sand, medium sand, coarse sand and fine gravel.

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

## SOIL CLASSIFICATION.

Soils are grouped according to texture into soil classes, a soil class being made up of soils having the same texture, though differing in other respects. A fine sand, for example, may be light colored and of alluvial origin, while another fine sand may be dark in color and of residual origin, while a third fine sand may have been blown into sand dunes by the wind, yet all of

these soils would belong to the same class, because the greater proportion of the soil grains have the same size or texture. Thus we may have different kinds of clays, loams, sands, etc., and the class to which any soil will belong depends upon the size of the individual soil grains of which it is composed, and not upon its color, origin, topographic position, or agricultural value.

### SOIL CLASSES

#### Soils Containing Less Than 20% Silt and Clay

Coarse sand.—Over 25% fine gravel and coarse sand, and less than 50% of any other grade of sand.

Sand.—Over 25% fine gravel, coarse and medium sand, and less than 50% fine sand.

Fine sand.—Over 50% fine sand, or less than 25% fine gravel, coarse and medium sand.

Very fine sand.—Over 50% very fine sand.

#### Soils Containing Between 20—50% of Silt and Clay

Sandy loam.—Over 25% fine gravel, coarse and medium sand.

Fine sandy loam.—Over 50% fine sand, or less than 25% fine gravel, coarse and medium sand.

Sandy clay.—Less than 20% silt.

#### Soils Containing Between 20–50% of Silt and Clay

Loam.—Less than 20% clay, and less than 50% silt.

Silt loam.—Less than 20% clay, and over 50% silt.

Clay loam.—Between 20 and 30% clay, and less than 50% silt.

Silty clay loam.—Between 20 and 30% clay, and over 50% silt.

Clay.—Over 30% clay.

Soils may be grouped in another way. Where soils are closely related through similar sources of the material from which derived, mode of origin, topographic position, etc., so that the different soils constitute merely a graduation in texture of otherwise uniform material, such a group is called a *soil series*. It corresponds to the family which is made up of different individuals having the same parentage. The Miami series, for examples, includes light colored, glacial material where the soils have been derived largely from the underlying limestone, and the soils in the series range in texture from a clay loam to sand and gravel. The Plainfield series includes light colored soils in

regions where no limestone is present, where the parent rock was largely sandstone, and where the material occurs as outwash plains or stream terraces. The soils in this series also have a wide range in texture. The name used for a soil series usually indicates the locality where that particular series was first recognized and mapped by the Soil Survey. By uniting the soil class with the soil series we get the *soil type* which is the basis or unit of classifying and mapping soils. A *soil type* thus, is a soil which is uniform throughout its entire extent in texture, color, topographic position, and other physical properties, and having a distinct agricultural 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 DOOR COUNTY, WISCONSIN

## CHAPTER I.

### GENERAL DESCRIPTION OF THE AREA.

Door County is situated in the eastern part of Wisconsin, forming part of the peninsula which separates Green Bay from Lake Michigan proper. Washington Island, which forms part

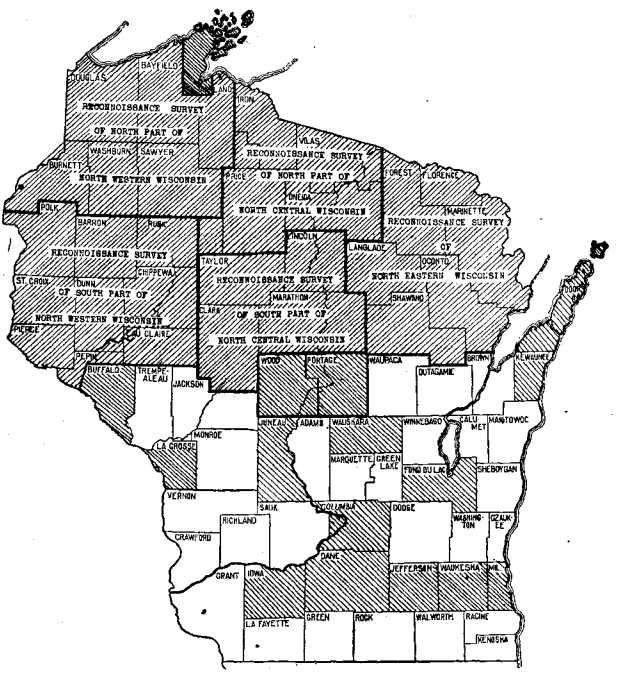



Fig. 1.—Sketch Map Showing Area Surveyed.

of the county, is separated from the mainland by Porte des Morts Passage, about 4 miles across at its narrowest point.

Door County is bordered by Kewaunee County on the south. It is nearly cut in two by Sturgeon Bay; in fact, since the com-

pletion of the Sturgeon Bay ship canal the northern end of the peninsula is really an island. The peninsula is 18 miles wide at the base and gradually tapers to a width of about 4 miles. Its shores are very irregular, being indented by numerous bays and harbors. There are over 200 miles of shore line in the county. The distance from the extreme southwest corner of the county to Gills Rock, at the northern point of the peninsula, is nearly 60 miles. From Gills Rock to the northernmost point of Washington Island is 10 miles. The county comprises a total area of 469 square miles, or 300,160 acres.

The most prominent topographic feature in the county is the long line of rugged bluffs bordering Green Bay, extending almost unbroken from a short distance north of Sturgeon Bay to the northeast point of the peninsula. In some places the bluffs reach the water's edge; elsewhere they may be some distance back from the shore. Government Bluffs, on Sturgeon Bay in Nasewaupee Township; Eagle Bluff, at Ephraim; and the bluffs at Fish Creek and Ellison Bay are the highest and most striking in the county. They rise to elevations of 20 to 200 feet above the lake. From the top of these bluffs there is a gradual slope toward the eastern side of the peninsula, where a low narrow strip of Beach sand, or in places beach gravel, occurs. Just back of this beach are extensive areas of Peat. In the town of Claybanks high bluffs occur less than one-fourth mile back from the lake shore, in contrast to the conditions existing to the north of the Sturgeon Bay ship canal. The topography of the county in general is undulating to gently rolling, very little of the land being too rough for ordinary agricultural use. Some nearly level areas occur, principally in the swamps. Limestone escarpments and rock outcrops are quite abundant in that part of the county north of Sturgeon Bay. The surface here is typical of a glaciated region, with swamps and depressions scattered throughout the rolling upland. The southern part of the county is less rolling than that portion north of Sturgeon Bay, and marshes are smaller and more numerous than farther north, where most of the Peat occurs in a few large areas. A few small terraces occur on both shores of the peninsula. The topography of Washington Island is similar to that of the northern part of the county, varying from undulating to gently rolling. Chambers Island in Green Bay is nearly level, and is practically

free from stone and rock. The elevation of the mainland of the county probably averages 100 to 150 feet above Lake Michigan, which lies 580 feet above sea level.

Door County has no large streams within its borders. The largest is the Ahnapee River, which flows south through Forestville and enters Lake Michigan at Algoma in Kewaunee County. That part of the county north of Sturgeon Bay has a few short streams, some of which are dry during a large part of the year. The southern part of the county is quite well traversed by small streams, some flowing into Green Bay and some into Lake Michigan, but owing to the heavy nature of the soil and subsoil drainage is in many places deficient.

Door County was formally opened for settlement in 1831. In 1835 the first white settler located on what is now called Little Sturgeon Point. The county was organized in 1851. In 1852 a colony of Moravians settled at Ephraim, in the northern end of the peninsula. In 1853 a colony of Belgians took up settlement at Brussels, in the southern part of the county. A settlement was very early made on Washington Island. In the northern end of the county, especially in the neighborhood of Ephraim, Baileys Harbor, and Ellison Bay, the population consists largely of Scandinavians. Quite a number of Germans and Poles live in the county. Other nationalities are also represented, some of the settlers coming from neighboring counties and some from other States. In 1910 the population of Door County was 18,711, all but 4,262 of which was classed as rural.

Sturgeon Bay, the county seat, with a population in 1910 of 4,262, is the largest town. It is surrounded by an excellent farming community. Sturgeon Bay is the center of a large cherry growing section and a distrubuting center for the greater part of the county. Egg Harbor, Fish Creek, Ephraim, Sister Bay, Ellison Bay, Baileys Harbor, and Jacksonport are small coast towns north of Sturgeon Bay. Some of these towns, notably Fish Creek, Ephriam, and Sister Bay, are noted summer resorts, attracting thousands of tourists every year. The agreeable climate, the large bodies of water, the excellent roads, and the fine scenery combine to make Door County one of the most famous summer resorts in this section of the United States. Peninsula Park, the largest of the State parks, includes the

whole peninsula between the villages of Fish Creek and Ephraim and covers about 6 square miles. Fishing is an important industry in the towns and bays along the coast. Many people depend on fishing for a livelihood, and at numerous points it is engaged in on a very large scale during the entire year. Washington Island is noted for its fisheries and summer resorts.

The Ahnapee & Western Railroad, which runs from Green Bay to Sturgeon Bay, is the only railway in the county. Two automobile stage lines carrying freight and passengers, one from Sturgeon Bay to Ellison Bay on the west side of the peninsula, and the other from Sturgeon Bay to Baileys Harbor on the east side, make daily trips in both directions. Lake steamers make regular stops at Sturgeon Bay, Egg Harbor, Fish Creek, Ephraim, and Washington Harbor during the summer season and at less frequent intervals during the spring and fall, giving direct communication with Milwaukee, Chicago, and other lake parts.

The main roads of Door County are as good as any in the State. On both sides of the peninsula there are excellent macadamized roads, one from Sturgeon Bay to Ellison Bay and the other from Sturgeon Bay to Baileys Harbor. In 1916 there were 125 miles of macadamized road in Door County, and the mileage has been extended since then. The abundance of limestone makes possible the construction of good roads at a comparatively low cost. In the heavy red clay section in the southern part of the county the roads which have not been macadamized are usually difficult to travel during rainy seasons and in the spring and late fall.

Rural mail-delivery routes reach practically every farm in the county. The stage from Sturgeon Bay brings mail to post offices in the northern part of the county, and from these stations rural routes reach all sections. Mail is delivered daily to Washington Island from Ellison Bay.

Sturgeon Bay furnishes a market for considerable farm produce and provides a shipping point for fruit and other products. More fruit is shipped from Sturgeon Bay than from any other city in Wisconsin. Much of the farm produce is shipped by water.

## SOILS.

Door County, in common with all northern and eastern Wisconsin, owes the general character of its surface materials to glaciation. Three more or less distinct periods of glaciation have existed, but the Late Wisconsin drift is the surface formation over practically all the county. The bedrock, which is frequently exposed, is the Niagara limestone. The soils are all derived from glacial or lacustrine material, or both. In the southern part of the county lake-laid material has been deposited, probably during interglacial times. Its most characteristic feature is the occurrence of heavy red clay in the subsoil and frequently in the surface soil. Since its deposition this material has been more or less modified by the moving ice sheet, which changed the topography from nearly level to rolling and very materially altered the texture of the surface soil.

The underlying limestone has entered largely into the formation of the glacial surface covering, but the occurrence of granitic bowlders and other rocks foreign to the region indicates that the soil material has come in part at least from distant areas. While the entire county was undoubtedly covered by ice during the Late Wisconsin glaciation, some of the soil has strong indications of being of residual origin. This is true of the shallow soils of the Miami series. It is probable that the glacier in passing scraped all the soil from some of the highest land, and after receding left areas of bare rock exposed. Since then various agencies have changed the exposed rock to soil, giving rise to some of the shallow soil occurring in different parts of the peninsula.

Since the glacial period, numerous changes in the surface material have taken place. Stream action, weathering, accumulation of organic matter, and other processes have been important factors in changing soils to their present condition. Soils of 6 separate series with 4 miscellaneous types, have been mapped in Door County. The Miami series includes the light-colored timbered upland soils derived from glaciated limestone material. The soils of glacial-lake origin are classed in the Superior, Poygan, and Clyde series, and those occupying outwash plains or terraces in the Fox and Plainfield series.

The Miami is the most extensive series in Door County. The Miami soils are light brown to brown, with a lighter colored subsoil which grows somewhat heavier with increased depth. As a rule these soils are quite shallow and stony, and contain numerous outcrops of the underlying limestone. They are derived from the weathering of glacial material of a generally calcareous nature. The topography is undulating to rolling, and the natural drainage is excellent.

The Superior series is developed in Wisconsin in the region bordering Lake Michigan and Lake Superior and in the Lake Winnebago region. It is characterized by grayish to reddish-brown or red surface soils, underlain by red or pinkish-red, heavy clay subsoils. The soil material was laid down originally as glacial-lake deposits, but it has been plowed up by subsequent glaciation and mixed with varying quantities of gravel and stony material. The topography varies from level or gently rolling to rolling, and the natural surface drainage is usually good, though the under drainage is often deficient. Where soils of this series are rolling and naturally well drained this phase has been separated from the level portions and indicated on the soil maps by a distinct color.

The surface soils of the Poygan series are dark brown to black. The subsoil is a heavy red clay, similar to that of the Superior soils. The series is closely associated with the Superior and has the same origin, except that it occupies low, wet depressions in which the decay of a luxuriant growth of vegetation has resulted in a black color of the surface soil.

The soils of the Clyde series are dark brown to black, overlying gray, brown or yellowish subsoils. The Clyde soils have been formed in lakes, ponds, or other low, swampy areas along streams or on the borders of swamps, and are confined to glaciated limestone regions. Through the influence of poor drainage and the accumulation of decayed vegetation the surface soils are black and very high in organic matter.

The Fox series consists of light-brown to brown surface soils and yellowish-brown subsoils. In topography, location, and origin the series is similar to the Plainfield, but it differs in being derived largely from limestone material. It occurs on outwash plains, in filled-in valleys, or on terraces along streams or lake shores. Occurring in a limestone region and containing

considerable limestone these soils are ordinarily not acid, or only slightly so. Soils lighter than fine sandy loam seldom occur in this series.

The Plainfield series includes light-brown soils with yellow subsoils. The material has been derived largely from sandstone and deposited on stream or lake terraces, in filled-in valleys, or as glacial outwash. The surface is level or gently undulating, and the subsoil is stratified. The series is confined chiefly to noncalcareous glaciated regions, but is encountered also in unglaciated sections of the United States in filled-in valleys and on stream terraces, and also in limestone regions where through excessive leaching all the lime carbonate has been removed and the soil is acid. The lighter types predominate in this series, and the soils tend to leachy and droughty.

Peat includes low, wet areas of partially decomposed plant remains, containing varying amounts of mineral matter. Muck includes low, wet soils high in organic matter, intermediate between Peat and the soils of the Clyde series.

Beach sand consists of material which has been washed up on the shore by the waves. Much of it, especially the areas of fine sand, has been blown by the wind to such an extend as to produce a broken surface.

Rough stony land includes steep, rocky slopes, extensive rock outcrops, extremely stony areas, and land otherwise unfit for cultivation, and valuable only for the small amount of timber and grazing it supplies.

In the following pages of this report the various soils of Door County are described in detail and discussed in their relation to agriculture. The distribution of the soils is shown on the accompanying map, and the table following gives the name and the actual and relative extent of each type.

*Areas of Different Soils.*

| Soil. | Acres. | Per cent. |
|---|---|---|
| Miami loam | 94,720 | 31.5 |
| Superior loam, rolling phase | 53,760 | 17.9 |
| Peat | 41,408 | 13.8 |
| Miami fine sandy loam | 30,528 | 10.2 |
| Superior clay loam | 3,008 | 1.0 |
| *Rolling phase* | 17,600 | 5.9 |
| Beach sand | 8,192 | 2.7 |
| Miami silt loam | 7,680 | 2.6 |
| Miami gravelly loam | 7,616 | 2.5 |
| Miami gravelly sandy loam | 6,780 | 2.3 |
| Clyde loam | 6,208 | 2.1 |
| Rough stony land | 5,696 | 1.8 |
| Coloma fine sand | 4,800 | 1.6 |
| Poygan loam | 3,584 | 1.2 |
| Plainfield sand | 1,894 | .7 |
| Muck | 1,792 | .6 |
| Clyde silt loam | 1,536 | .5 |
| Superior fine sand loam, rolling phase | 1,344 | .4 |
| Plainfield fine sand | 1,152 | .4 |
| Fox silt loam | 768 | .3 |
| Total | 300,160 | ..... |

# CHAPTER II.

## GROUP OF HEAVY SOILS.

### MIAMI SILT LOAM.

*Extent and distribution.*—There are 7,680 acres of Miami silt loam in Door County. It occurs largely in the town of Sevastopol. Small areas are scattered over the northern part of the county.

*Description.*—The surface soil of the Miami silt loam consists of a brown mellow silt loam extending to an average depth of 8 inches. The content of fine sand is quite high, and when dry the soil has a loamy appearance. The subsoil is a light-brown or grayish silt loam, usually quite compact and sticky, in the lower depths. The heavy subsoil is characteristic of this type. Most of the type is more than 3 feet deep. Directly above the bedrock there is a heavy, reddish layer which contains numerous small fragments of limestone. There are usually a few limestone pebbles in the subsoil, and in places stones occur on the surface.

This soil is quite uniform. The most important variation is in the depth to bedrock, which varies from 1 to more than 3 feet. In very few places is the bedrock within 1 foot of the surface. Some rock outcrops occur, but the type is not as stony as the Miami loam and fine sandy loam.

*Topography and drainage.*—The surface varies, as in Miami loam, from gently undulating to rolling. This type is not as rolling and in some places, as in sec. 21 and the NW.¼ of sec. 22, T. 28 N., R. 26 E., and in the immediate vicinity of the Institute, there are some nearly level areas. In the rolling sections the surface drainage is excellent, but in the more level areas where a heavy subsoil occurs the underdrainage, and even the surface drainage, is quite commonly deficient.

*Origin.*—The Miami silt loam is derived from glacial débris laid down mostly in the form of a ground moraine. The surface soil, which is quite silty, may have been deposited in part by winds. The gravel and stones are largely limestone, and it is probable that limestone from the bedrock has entered largely into the formation of the type. The subsoil does not show an acid reaction, but the surface material has been leached to such an extent that a slightly acid condition has developed in places.

*Native vegetation.*—The original forest growth on this type consisted of maple, basswood, elm, balsam, birch, white pine, and different varieties of oak. All the valuable timber has been removed, and approximately 60 per cent of the type is now under cultivation. Part of it is still uncleared and used as woodlots or for permanent pasture

*Present agricultural development.*—This is a very valuable type agriculturally. The chief line of farming carried on is dairying. All the common farm crops are grown and produce good yields. Corn, small grains, and grasses are well adapted to this soil. Some cherries and apples are grown, and good results are obtained where the surface is sufficiently rolling and the subsoil is not so heavy as to prevent good drainage. Some cherry orchards set out on level areas with the heavy subsoil have made poor growth or died.

This type is somewhat harder to work than the other Miami soils and requires more thorough cultivation to maintain a proper physical condition. On account of its heavy subsoil, it remains wet until late in the spring. Stable manure is the only fertilizer used, and where cherries are grown the greater part of this is applied to the orchard. The rotation commonly followed consists of corn, a small grain for 2 years, and timothy or clover. This soil seems best suited to dairying and the growing of general farm crops. * *

## SUPERIOR CLAY LOAM.

*Extent and distribution.*—The Superior clay loam with its rolling phase occupies a toal of 20,608 acres, of this total amount 3,008 acres are classed as the typical soil having a level surface, and 17,600 acres is classed as the rolling phase

* * For a discussion of the chemical composition of this soil, and methods for its improvement see page 25.

because of its more uneven surface features. The level phase is found most extensively in the Town of Brussels, although there are a number of small tracts scattered throughout the southern portion of the county. There is none of this soil north of Sturgeon Bay.

*Description.*—The typical Superior clay loam to a depth of 6 or 8 inches consists of a dark-brown to reddish-brown clay loam. In places the surface soil is gray. The subsoil is a heavy, compact, red clay, extending to depths below 3 feet. Occasionally a little gravel occurs on the surface, and there is usually some gravel in the subsoil. Very few stones occur in this type.

Some variations occur in color and texture. In the area just south of Brussels and in section 25 of Union Town the surface soil is darker than typical, but not dark enough to be typical of the Poygan soils. Near the edges of marshes and bordering soils of the Poygan or Clyde series the surface soil is usually dark colored. In some places the surface soil is more nearly a loam than a clay loam. The red clay is seldom exposed at the surface.

*Topography and drainage.*—Owing to the level to vary gently undulating surface and heavy texture, the drainage of this soil is very deficient. In many places, especially in depressions, water stands until late in the spring and after heavy rains at other seasons of the year.

*Origin.*—This soil has been derived largely from lacustrine material, but has been modified somewhat since its first deposition by the action of ice. The original level surface was only slightly changed by the passing glacier, and little gravel and but few stones were mixed with the soil.

*Native vegetation.*—The original timber consisted of maple, elm, oak, ash, hickory, some beech, and in places pine.

*Present agricultural development.*—A considerable portion of this type is under cultivation. Part of it still supports the original forest, and some areas are covered with a second growth of poplar. The chief crops grown are oats, barley, rye, corn, clover, and timothy. In wet seasons crops often produce very poor yields. In ordinary years the yields are good. The yield of hay is especially good.

The Superior clay loam is a difficult soil to handle, and requires very thorough tillage to maintain a satisfactory seed be. When plowed too wet it is apt to puddle, and in the heavier areas large clods are frequently turned up. The type, especially in the low, wet spots remains wet and soggy until late in the spring. Stable manure is the only fertilizer used.

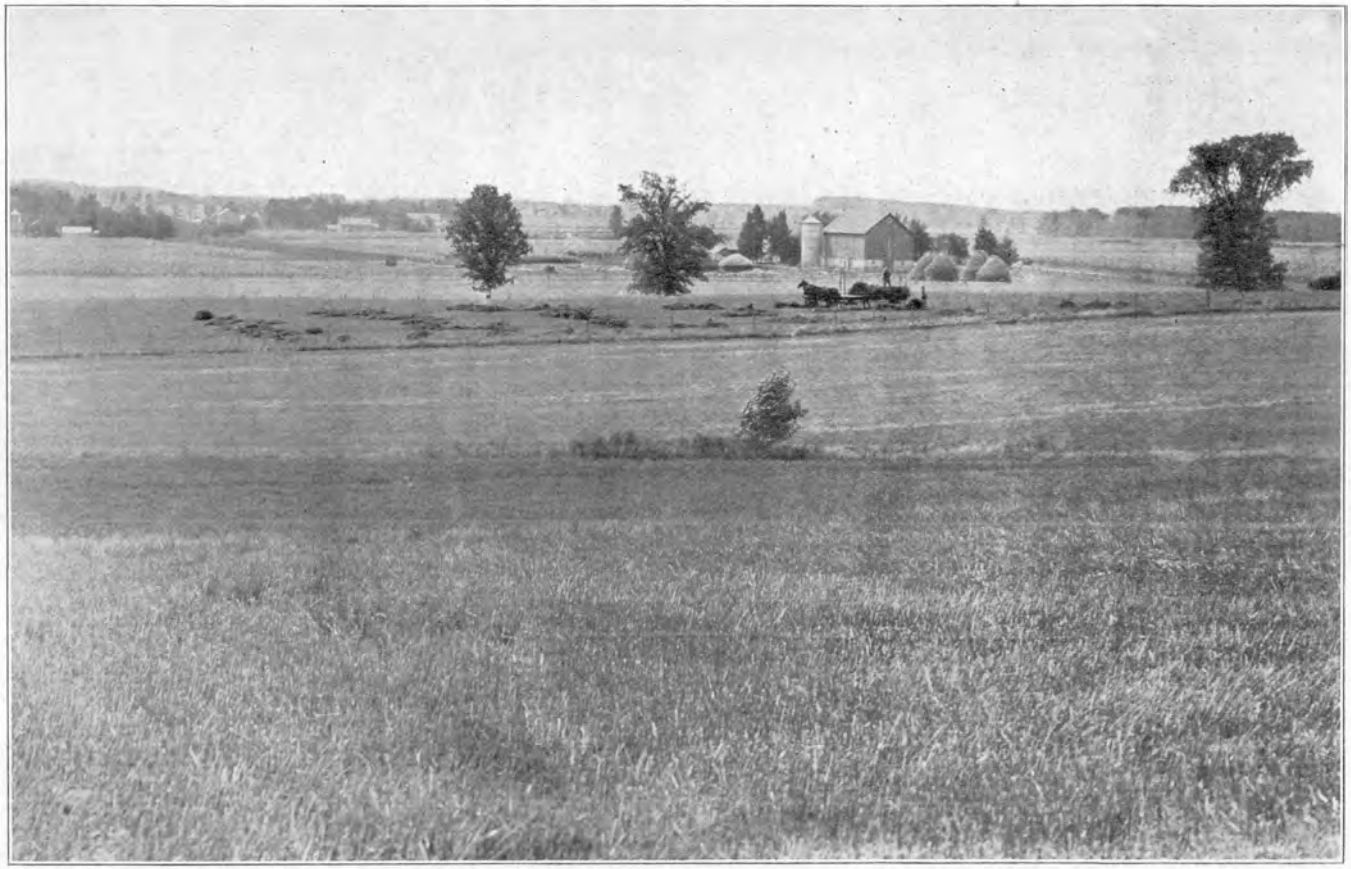
### SUPERIOR CLAY LOAM

### (ROLLING PHASE)

*Extent and distribution.*—Next to the Superior loam, rolling phase, this is the most extensive and important soil in the southern part of the county. The most extensive tracts are found in the Town of Brussels, with a number of smaller tracts in the Town of Garden, and other scattering patches throughout the region south of Sturgeon Bay. This soil is associated chiefly with other types of the Superior series, and it also borders Miami soils in a few instances.

*Description.*—The rolling phase of Superior clay loam to an average depth of 8 inches consists of a reddish-brown clay loam which contains a high percentage of silt and is low in organic matter. Gravel, stones and bowlders are scattered over the surface in places. The subsoil consists of a heavy, compact, red clay loam, which extends to the underlying limestone rock. In the subsoil, especially just above the bedrock, angular gravel, bowlders, and small fragments of limestone are encountered, but the gravel is not as abundant as in the loam. A small percentage of the gravel and bowlders is of rocks foreign to the region, such as granite, quartz and gneiss.

The depth and color of the surface soil vary somewhat. In depressions and on gentle slopes the soil is deeper and darker than typical, while on hills and knolls the red clay is frequently exposed. The depth to bedrock also varies. In some places the depth is less than 3 feet and elsewhere it may be 15 feet or more. In sections 4, 5, 8, 17, and 24, of Gardner Town, and on the plateau-like formation in sections 21, 22, 28, and 29, Brussels Town, the depth to the underlying rock is less than typical, being in many places less than 3 feet. A number of outcrops also occur in these sections. In sections 22, 23, and 26, in the town of Brussels, the surface is less rolling than typical, but



VIEW OF SUPERIOR CLAY LOAM, ROLLING PHASE, SHOWING CHARACTERISTIC TOPOGRAPHY

There are over 17,000 acres of this soil in the southern part of Door County. But very little of it is found north of Sturgeon Bay. It is devoted chiefly to general farming and dairying, to which it is naturally adapted.

the soil is hardly sufficiently level to be included with the Superior soil.

*Topography and drainage.*—The surface varies from undulating to gently rolling, and in a few places to very rolling. The area surrounded by the rock escarpment in sections 20, 21, 28, and 29, Brussels Town, is elevated considerably above the surrounding country and presents a plateau like appearance. The surface here is more nearly level than is typical. The type is more poorly drained than the Kewaunee loam and tile drains can profitably be installed especially where the surface is nearly level or where depressions occur.

*Origin.*—The soil was originally laid down in a lake bed and later reworked by the glaciers. Some of the underlying Niagara limestone was broken up and mixed with the soil, and the surface features changed from level to undulating or rolling. The lime content increases with depth. In some places leaching has left the surface material in an acid condition.

*Native Vegetation.*—The native forest growth consisted chiefly of maple, beech, oak, hickory, elm, ash, with some hemlock and pine.

*Present agricultural development.*—This soil is naturally very productive and the greater part of the type is under cultivation. The chief crops grown are oats, wheat, rye, barley, corn, potatoes, clover, and timothy. Excellent yields of hay are obtained and the other crops produce well. New varieties of corn mature, but corn does not always ripen. It can always be depended upon, however, to reach the stage where it makes good silage. Dairying is the most important line of farming followed. The soil is ideal for growing hay and for maintaining good pasture.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Superior clay loam, rolling phase.

*Mechanical analyses of Superior clay loam, rolling phase.*

| Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Soil | 0.5 | 3.3 | 4.4 | 20.0 | 11.4 | 35.3 | 25.2 |
| Subsoil | 1.0 | 3.5 | 4.7 | 19.9 | 14.0 | 29.5 | 27.4 |

FOX SILT LOAM.

There are only 768 acres of this kind of land in Door County, and it is the least extensive of any of the soils. Small patches occur near Sturgeon Bay and elsewhere in the northern part of the peninsula. It is confined to the region of Miami soils.

The Fox silt loam to an average depth of 8 inches consists of a grayish to dark-brown, friable silt loam, which has a smooth feel when moist and assumes an ashen-gray appearance when dry and pulverized. The subsoil consists of a gray or yellowish-brown loam or fine sandy loam. The deep subsoil is often stickly and sometimes consists of a light-colored marl-like material. The limestone bedrock usually is encountered within 3 or 4 feet of the surface. The soil is usually neutral or calcareous.

The surface is level to very gently undulating and the natural drainage is frequently somewhat deficient.

The Fox silt loam occurs on outwash plains, in filled-in valleys, or on lake or stream terraces, and consists of material deposited by water chiefly by streams issuing from the glacier. The soil has been formed from glacial débris ground mainly from the limestone underlying this part of the State.

The original forest growth on this soil consisted chiefly of elm, ash, birch, and maple, with willow in the lower situations. Some areas are under cultivation, and where drainage conditions are favorable the yields average about the same as on the Miami silt loam and loam. Corn, oats, barley, and hay do well. This soil usually forms parts of fields in which the Miami loam is the predominating type, and the methods of cultivation, crop rotation, and fertilization are practically the same as on the latter soil.

Some small areas of a fine sandy loam are included with the Fox silt loam. This coarser soil consists of an average of 8 inches of friable, dark-brown fine sandy loam, with a sub-soil of light-colored fine sandy loam which becomes lighter in texture with depth. The deep subsoil is usually a pale-yellow very fine sand. In some places a sticky layer of sandy clay may occur at about 2 feet, but this layer is usually underlain by sand. This coarser soil occupies a total area of less than 1 square mile.

The largest area occurs on Washington Island, in the vicinity

of Detroit Harbor. A few small patches occur in other parts of the county, all north of Sturgeon Bay. The surface is level, but drainage is fairly good on account of the sandy subsoil. The soil is derived from the weathering of glacial outwash material, and contains considerable limestone gravel. It differs from the Plainfield soils in that it has been derived largely from limestone; while the Plainfield soils have been derived largely from sandstone. A considerable part of this fine sandy loam soil is under cultivation. It produces good yields of the common crops. It can be easily worked into good tilth.

### CHEMICAL COMPOSITION AND IMPROVEMENT OF HEAVY SOILS.

In chemical composition these types of soil are quite similar. They all contain approximately 1200 pounds of phosphorous in the surface 8 inches per acre.

The total amount of potassium is large in all of these types, varying from apporximately 44,000 to 55,000 pounds in the surface 8 inches of an acre. The problem of the potassium supply for crops on these soils is chiefly that of having sufficient organic matter to produce the necessary chemical changes in the inert potassium compounds of the soil to render them available to plants. The total amount of organic matter is approximately 3 per cent, or 60,000 pounds per acre. This is relatively small and should be increased by every practical method. The total nitrogen content is also relatively small and should be increased by the growth of legumes in all rotations.

The amount of lime or lime carbonate contained in these soils is extremely variable. As a rule, fields which have been cropped for a number of years have lost nearly or quite all the lime originally contained in the surface soil, and have in some cases become acid. The subsoil, however, often still contains very large amounts of this material, sometimes running as high as 20 per cent, but for the insurance of good growths of plants requiring lime, especially alfalfa, this will have to be supplied in all cases where the surface shows a distinct acid reaction.

* The "Truog Test" for determining soil acidity is a new method which has just been perfected by E. Truog of the Soils Department of the University of Wisconsin, by which the relative degree of acidity can be accurately determined in the field or laboratory in a few minutes time. For a detailed description of this method write the Soils Department, College of Agriculture, Madison, Wis.

In the improvement of this group of soils the factor which may well be given first consideration is a means of increasing the amount of organic matter and the supply of nitrogen. As the supply of stable manure is usually inadequate, it should be supplemented by green manuring crops of which the legumes are the best. Plowing under a second crop of clover once during each rotation will greatly assist in increasing the productivity of the soil. This will not only increase the supply of nitrogen in the soil but it will also improve the physical structure, which is highly desirable, especially in the case of the Superior clay loam. The presence of a large amount of organic matter will also assist in making available for the plant a larger amount of potassium.

As indicated by various field experiments, the Superior clay loam,* responds very well to the application of phosphate fertilizers supplementing the stable manure.

By using ground rock phosphate to supplement manure the yield of clover hay was increased 43 per cent over plots which received only stable manure. Likewise the yield of potatoes was increased 47 per cent by the use of ground rock phosphate. The rock phosphate may be applied at the rate of about 600 pounds per acre, once during each crop rotation. As the phosphorus in this form is only slowly available there will be but little, if any, loss if larger applications are made.

Similar results may be expected on the Miami and Fox silt loams, with rock phosphate. The element phosphate may also be supplied in the form of acid phosphate and as such becomes available immediately to the plants. Application should be from 200 to 300 pounds per acre, and may be made to small grain or corn at the time of planting.

Whenever an acid condition is found to exist on any of these soils this should be corrected by the application of ground limestone. About two tons per acre will be required, but the exact amount will depend upon the degree of acidity. The limestone may be applied at any convenient time as it is slowly soluble and will remain in the soil for a number of years. It should be applied evenly to the surface of a plowed field and harrowed or disked in so as to be thoroughly mixed with the soil. It should not be plowed under.

* For more information on heavy clay soils consult Bulletin 202, Wisconsin Experiment Station on "How to Improve Our Heavy Clay Soils"

The question of drainage* is a very important one, especially on the typical Superior clay loam where the surface is level and where the water moves off slowly. Practically all of this soil would be greatly benefited by tile drains, and while their use is not essential to the production of profitable yields, it is known that when properly placed they will pay for themselves in the course of a few years. As land values in this section are high it is important that every portion of the farm should produce maximum yields, but such yields cannot be secured unless the soil is well drained. Because of wet conditions which often pevail in the spring, planting is frequently delayed and it is not uncommon to see numerous low spots in a field which produce nothing. There are a number of places on the rolling phase of the Superior clay loam, and on the Miami silt loam which would also be benefited by tile drains. Open ditches may frequently be used to advantage to supplement the tile drains, but they should not be depended upon entirely. Where the surface is level the land may be plowed in narrow strips leaving dead furrows from 2 to 4 rods apart. When these are kept clean the surface water will flow through them into open ditches along the side of the field. This system has given very good results when used by itself, but the drainage of the land is much more complete, and better results are obtained when such surface drains are used to supplement a system of tile drains.

Another factor which is very important in the improving of heavy soils is cultivation. The Superior clay loam is more difficult to handle than the silt loam types in this group, and great care should be exercised in all cultural operations. All working of heavy clay soils should be done only when dry enough not to puddle. Plowing when too wet will have a bad effect in 3 or 4 years. Before a crop is planted the soil should be thoroughly pulverized and the seed bed in a loose, mellow condition. All after cultivation of intertilled crops should be sufficiently frequent to maintain a good surface mulch, to conserve the moisture and to permit a free circulation of air through the soil.

The silt loam types may be worked under a considerably wider range of moisture conditions than the clay loam, and

* See Wisconsin Bulletins 229 and 284.

fields can be kept in good physical condition with a smaller amount of labor, but the necessity of thorough cultivation on all of the soils should not be overlooked.

On the Superior clay loam a 4 or 5 year rotation seems to give the best results. The first crop may be small grain, such as rye, oats, barley or wheat, seeded down to clover, with a little timothy mixed in it. The second year the clover will be grown, the first cutting for hay and the second left to grow for seed. The third year, crops of mixed clover and timothy will be harvested. Manure may be spread on the sod either before plowing in the fall or on the plowed land in the winter. The fourth year the land should be put into cultivated crops. In this scheme of crop rotation, one-fourth of the land is in grain, one-fourth in clover, one-fourth in mixed clover and timothy and one-fourth in cultivated crops. This same system may well be followed on the silt loam types, but minor modifications may be necessary to fit the conditions of individual farms.

While the dairy industry is highly developed on these soils it could be profitably extended to still greater proportions. Alfalfa has proven to be a successful crop, and it should be grown on every dairy farm. Sugar beets, mangels, rutabagas and turnips do well and may often be added to the list of profitable crops. When green manuring is to be practiced the second crop of clover may be plowed under and followed by corn, and two small grain crops grown in the rotation in place of one.

# CHAPTER III.

## GROUP OF LOAMS AND FINE SANDY LOAMS.

### MIAMI LOAM.

*Extent and distribution.*—Miami loam is the most extensive and important type of soil in Door County. It covers a total of 94,720 acres or 31.5 per cent of the county. It is the predominating soil throughout the country north from Sturgeon Bay, occurring in association with other types of the Miami series.

*Description.*—The surface 6 to 8 inches of the Miami loam consists of a yellowish-brown to grayish-brown loam. The subsoil consists of a yellowish-brown loam or fine sandy loam grading into a thin layer of compact, reddish loam which contains fragments of partially decomposed limestone. This heavy layer rests upon the bedrock, which typically occurs within 3 feet of the surface. The type grades into a fine sandy loam on one hand and into a silt loam on the other, but so gradually that a sharp boundary cannot always be drawn. As this was originally a forest region the soil is somewhat deficient in organic matter. In virgin areas there are numerous bowlders and fragments of limestone. The stoniness is quite a serious handicap in farming especially in the northern end of the peninsula where the soil is particularly shallow and bowlders numerous. In some small areas where the soil is extremely shallow angular limestone gravel occurs. These areas are indicated on the map by symbol.

The type is quite uniform in texture, although it does include small areas in which the surface soil is either too light or too heavy to be typical, and others in which the subsoil is too heavy to be typical. The most important variation is in the depth to the underlying rock, which varies from 1 to 3 feet. Areas in which the soil is less than 1 foot deep, as well as those in which it is more than 3 feet deep, are indicated on the map by symbol. The typical Miami loam has a depth of soil of 1 to 3 feet.

*Topography and drainage.*—The topography is undulating to gently rolling. In some sections large plateaulike elevations rise to a considerable height above the surrounding land. A large orchard north of Sturgeon Bay is located on such a plateau. In places there are very pronounced steep slopes or escarpments. Beginning several miles north of Sturgeon Bay there occur rugged limestone cliffs ranging in height from 20 to over 100 feet. These are confined largely to the Green Bay side and to the north end of the peninsula. Owing to the undulating topography, the natural drainage is good except in a few small depressions.

*Origin.*—The Miami loam has been derived from glacial material which has undergone considerable weathering. The drift contains considerable limestone material, but bowlders of other kinds of rock also are intermixed with the soil. It is probable that most of the soil was originally ground by the glacier from the underlying limestone.

*Native vegetation.*—The original vegetation consisted of oak, maple, basswood, elm, balsam, beech and white pine. In numerous unimproved areas a second growth of poplar has sprung up.

*Present agricultural development.*—About 60 per cent of the Miami loam is under cultivation. Aside from fruit growing, which is a very important industry on this soil, general farming is the most important type of agriculture. Until a few years ago the tendency was to go more and more extensively into fruit growing, but within the last year or two dairying is becoming more important. The principal crops produced are oats, barley, rye, peas, hay, and corn. Corn does not always mature before the first killing frost in the fall, but it always makes sufficient growth to produce good silage. In the vicinity of Sturgeon Bay, where a pea cannery is operated, a considerable acreage is devoted to the growing of peas for canning. The most important fruit grown is the cherry. Apples, plums, currants, grapes, strawberries, and other small fruits and berries are also grown on a commercial scale.

This soil is not hard to handle. The drainage is nearly always thorough, and the soil is sufficiently loose and mellow to make tillage easy. Where the soil is shallow, that is, only slightly over 1 foot deep, crops soon suffer in dry periods. The type is almost invariably plowed in the fall except in the case of or-

VIEW OF YOUNG CHERRY ORCHARD ON MIAMI LOAM.

There are over 94,000 acres of this soil in Door County, and the fruit industry has been most highly upon this type of soil. This view shows the usual surface features of Miami loam.

Small fruits and vegetables are frequently planted between the rows in young orchards.

PICKING CHERRIES IN DOOR COUNTY.

It is claimed that Door County now has the largest cheery orchard in the world. The picking season offers employment and recreation to large numbers of people from the cities.

chards, which are usually plowed in the spring. Stable manure is the only fertilizer used for general farm crops. Where cherries or other fruits are grown there is a tendency to apply much of the manure to the orchard, at the expense of the other crops.

There are included with the Miami loam on the map and indicated by means of symbols, isolated areas which differ only in their extreme stoniness. The surface 8 inches consist of a friable, brown loam, which is underlain by a lighter colored loam or sandy loam. The depth to bedrock is variable, but is usually less than 3 feet. Bowlders, large and small, are scattered over the surface. Excepting the Rough stony land, it is the most stony soil in the county. It is of very small extent and of little importance. Small areas are scattered throughout the northern part of the county in association with the other Miami soils. Only a small proportion of the land is cleared, and this is used almost wholly for pasture, as the stoniness practically prohibits cultivation. The soil is not included with the Rough stony land because of the possibility that the stones may eventually be removed and the land placed under cultivaiton, while the Rough stony land apparently will always be nonagricultural.

Areas of the Miami loam in which the underlying limestone rock is more than 3 feet below the surface are distinguished on the map from the typical soil by means of symbols. The surface soil to an average depth of 8 inches consists of a rather heavy, brown loam. With a few exceptions it is practically free from gravel, and stones are not as numerous as in the typical areas. The subsoil consists of a yellowish-brown loam which usually becomes slightly heavier with depth. In some areas, which are indicated on the map by symbols, the subsoil is so heavy and sticky that the drainage is very deficient. The deep areas of Miami loam occur largely in the towns of Sturgeon Bay and Sevastopol. Smaller areas are scattered through the county. The surface varies from gently undulating to undulating, with some small nearly level areas in hollows or other depressions. In places where the heavy subsoil occurs, and where the drainage is deficient unless the slope is quite steep, cherry trees do not thrive as well as on the shallower soils where the heavy subsoil is lacking, and in several instances cherry orchards have

died. The soil retains moisture well, and crops suffer less during long dry spells than on most of the other soils of the county. The deep areas of Miami loam are productive, and probably over 80 per cent of the soil in under cultivation. The remainder is still in forests or is used as pasture. The original timber growth was the same as on the typical soil. Some of the finest and oldest cherry orchards in the county are located on the deep areas of Miami loam. Where the subsoil is not too heavy cherries do better than on any other soil. Farm crops of all kinds produce good yields. Oats, barley, rye, potatoes, corn, and hay are grown extensively. Clover and alfalfa do well and are increasing in acreage each year. Dairying is becoming quite an important industry, a considerable number of pure-bred dairy herds being kept. In general, the same methods of farming are followed as on the typical soil. The drainage is not as thorough in all places, however, and tile drains could profitably be installed.

A shallow variation of the Miami loam is also distinguished on the map. It consists of a brown, friable loam, which remains unchanged until just above the bedrock, where a thin, compact layer of loam or clay loam occurs. This lower layer contains numerous fragments of partially decomposed limestone, and angular limestone pebbles often occur on the surface and through the soil. Bedrock is invariably reached at depths of 3 to 12 inches below the surface. Stones are quite numerous, in many places seriously retarding cultivation. Rock outcrops are more numerous than in the areas of typical Miami loam. The shallow variation is rather unimportant soil. It occurs in small areas in various parts of the county, associated with the other types of the Miami series. The surface is mainly undulating to gently rolling, but there are small plateaulike areas where the surface is nearly level. While this soil occurs in the glaciated region it is probably in part of residual origin. In passing, the glacier scraped the rock free from soil and left no deposit. The weathering of the rock has produced the thin mantle of soil. The angular gravel, stones, and fragments of the bedrock mixed with the soil indicate that it is largely of residual origin. A smaller proportion of this shallow soil is under cultivation than of the typical Miami loam. Some of it is used for pasture and some is still forested, the timber consisting chiefly of oak,

maple, balsam, and pine. Cherry trees are grown considerable success on this shallow soil, as the roots enter cracks and crevices in the rocks. The same methods of farming, fertilization, and crop rotation are followed as on the typical Miami loam.

The selling price of land of the typical Miami loam is quite variable, depending upon the location and development. In the vicinity of Sturgeon Bay the price is high, but in the northern end of the county near Ephraim and Ellison Bay improved land can be purchased for $40 to $60 an acre. Thrifty cherry or apple orchards which have come into bearing sell for $400 to $600 an acre.

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

*Mechanical analyses of Miami loam.*

| Description. | Fine gravel. | Coarse sand. | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Soil | 1.4 | 4.1 | 5.4 | 28.2 | 17.5 | 34.2 | 9.0 |
| Subsoil | 1.6 | 4.2 | 5.8 | 33.3 | 19.8 | 25.9 | 9.6 |

MIAMI FINE SANDY LOAM.

The Miami fine sandy loam is quite widely distributed throughout the county, chiefly north of Sturgeon Bay, where it occurs in association with other soils of the Miami series. It is most extensively developed in the towns of Sevastopol and Liberty Grove. More than one-third of Washington Island is occupied by this soil. It covers a total area in the county of 30,528 acres, and is one of the four most extensive types of soil in Door County.

The surface soil consists of a friable, brown to grayish-brown fine sandy loam, about 8 inches deep. In some areas gravel occurs on the surface and in the soil mass, while in other places the texture may approach that of a sandy loam. The line separating this type from the Miami loam could not everywhere be sharply drawn. Bowlders in considerable numbers were originally found upon the surface, and rock outcrops are quite

common. The subsoil to within about 2 inches of the bedrock is composed of a yellow light-brown fine sandy loam. In some places the material in the lower depths is quite sandy, but directly overlying the rock there is a thin layer of darker colored, sticky loam which carries scattered fragments of partially decomposed limestone.

There are only slight variations in this type. The depth to bed-rock varies considerably, although it is usually less than 3 feet. On the highest hills and in the most rolling areas there is usually a considerable depth of glacial débris above the bedrock. In sections 9, 16, 20, 21, and 29, Claybanks town, the subsoil is heavier and the depth to the underlying limestone much greater than typical. In places the deep subsoil is a red clay, and in some of the road cuts this clay appears at depths varying from 3 to 7 feet.

The surface of the type varies from undulating to quite rolling. Occasionally it occupies long ridges. On account of the surface relief and the sandy texture the drainage is excellent. In the most sandy areas it is excessive and the soil tends to be droughty.

The Miami fine sandy loam has been derived from the weathering of glacial drift which occurs chiefly in the form of ground moraine, although there are a few kames and drumlins included in the type. Ground-up material from the underlying limestone has entered largely into the composition of the soil, although the presence of granitic bowlders shows that at least a portion of the drift must have come from farther north.

The original forest growth consisted chiefly of maple, birch, balsam, basswood, white pine, and different varieties of oak.

The Miami fine sandy loam is an important type agriculturally. Probably over 60 per cent of it is under cultivation, the remainder being in woodlots or used for permanent pasture. While the average yields of general farm crops are not quite as high as on the Miami loam, it is a fairly good soil. It is best adapted to such crops as potatoes, corn, rye, and truck gardening. While there are a number of fairly good cherry orchards on this soil the general opinion seems to be that it is not as well adapted to cherries and other fruits common to the region as is the Miami loam type of soil.*

* For a discussion of the chemical analysis and methods for the improvement of this soil see page 33.

## SUPERIOR LOAM.

### [ROLLING PHASE.]

*Extent and distribution.*—The Superior Loam, rolling phase, is the most extensive and important soil in the southern part of Door County, and it is the second soil in extent in the whole county. The total area is 53,760 acres. With the exception of a small area in section 5 in the Town of Sturgeon Bay, and another in section 7 in the Town of Sevastopol it is confined entirely to the portion of the county south of Sturgeon Bay. Here it is closely associated with Superior clay, from which it was frequently difficult make a clear distinction.

*Description.*—The surface soil consists of a grayish-brown loam varying in depth form 10 to 20 inches. It contains some angular gravel and fragments of limestone in places, bowlders are abundant on the surface in some areas, and here and there the bedrock outcrops. As in the case of the other timbered upland soils, the supply of organic matter is low. The subsoil consists of a brownish-red to chocolate-colored clay loam which contains sufficient sand and other coarse material to give it a gritty feel. The gravel, rock fragments, and bowlders consist largely of limestone, but some rocks foreign to the region are encountered. The depth to the limestone bedrock varies, but is more than 3 feet in most places. The subsoil of this type in Door County is somewhat different from that of the typical Superior loam as it occurs on the shores of Lake Superior. It contains much more coarse material and therefore lacks the smooth, plastic feel of the typical subsoil. Glacial action is doubtless responsible for the modification.

The texture of this soil type is very uniform. The principal variations are in the depth of the underlying rock and in the quantity of stones on the surface. In the northern part of Nasewaupee Town, in much of Gardner Town, and in sections 3 and 4 of Brussels Town, the depth of bedrock is less than usual, being in many places less than 3 feet. Rock outcrops and stones are more numerous here than in the typical areas. In the immediate vicinity of outcrops and where stones are numerous, both which conditions are shown on the map by symbols, the soil is usually shallow.

*Topography and drainage.*—The surface varies from gently undulating to gently rolling. In general it is not rolling as are the Miami soils, and only a very small part of the type is excessively rough or broken. In the town of Claybanks high bluffs rise a short distance back from the lake shore. The natural drainage of the type is good except in depressions or along the borders of marshes or of low-lying soils like the Poygan. In such places tile drains could be profitably installed. On the tops of some of the knolls and hills the surface soil has been washed away, leaving the subsoil exposed. Such spots, however, are rare, and erosion is not serious.

*Origin*—The Superior loam, rolling phase, has originated partly from lacustrine and partly from glacial material. The red clay was deposited in the quiet waters of a lake before the Glacial Period. The glacier mixed this clay with gravel bowlders, and rock fragments, and left the surface undulating and broken. The underlying limestone was broken and crushed, giving rise to fragments which now are scattered through the soil and subsoil. Through the long intervening period of weathering the lime has been leached from the surface material, so that it is now usually in an acid condition.

*Native vegetation.*—The original timber growth on this type consisted of both pine and hardwoods. In some sections white pine predominated, in other areas hardwoods alone grew, while in still others hemlock, pine, and hardwoods formed a mixed growth. The principal hardwoods were maple, birch, basswood, beach, elm, and some oak and hickory. All the valuable timber was removed long ago, and in many places a second growth of birch and poplar has sprung up.

*Present agricultural development.*—The Superior, loam rolling phase is highly improved, and the greater part of it is under cultivation. Some of the largest and most up-to-date farms in the county are on this soil. General farming, with dairying as the principle side line, is carried on. The most important crops produced are oats, peas, barley, rye, corn, timothy, clover, and potatoes. On most farms the chief source of income is dairying, which is rapidly becoming more important. Many pure-bred herds, principally Holstein and Guernsey, are kept. The soil produces excellent yields of hay, while corn, although it does not always mature, never fails

to reach the stage where it can be used for silage. Many farms are now equipped with silos, more of which are being constructed yearly. In the vicinity of Sawyer some peas are grown for canning, and in areas near the water cherries and apples are grown. The type, however, is not as well adapted to the growing of fruit as are the Miami soils. Oats are grown more extensively than any other grain. Yields ordinarily range from 30 to 50 bushels per acre. Barley yields 20 to 35 bushels, rye 15 to 20 bushels and potatoes 125 to 200 bushels. Timothy and clover produce heavy crops.

Land of this type sells for $75 to $125 an acre, depending on the location and improvements.

This soil works up readily and is on the whole quite easily handled, in spite of the heavy subsoil. Fall plowing is practiced almost exclusively. In some of the more nearly level areas some system of artificial drainage should be installed. Stable manure is the only fertilizer used to any extent. Often the crop rotation followed is not the one best suited to conditions. The organic content of this type is low.

The following table shows the results of mechanical analyses of samples of the soils and subsoil of the Superior loam, rolling phase.

*Mechanical analyses of Superior loam, rolling phase*

| Description | Fine gravel | Coarse sand | Medium sand. | Fine sand. | Very fine sand. | Silt. | Clay. |
|---|---|---|---|---|---|---|---|
| | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* | *Per cent.* |
| Soil | 1.0 | 3.6 | 4.5 | 20.8 | 23.1 | 37.6 | 8.9 |
| Subsoil | .7 | 3.7 | 5.2 | 22.8 | 19.1 | 30.2 | 18.5 |

SUPERIOR FINE SANDY LOAM.

[ROLLING PHASE.]

This is a soil of minor importance, there being only 1344 acres in Door County. The largest tract occurs in sections 27 and 28 in the town of Union. Small areas are also found near the bay shore in sections 30 and 31 Sevastopol Town.

The upper 8 inches of this soil consists of a brown fine sandy loam which is underlain by a lighter colored fine sandy loam to fine sand which extends to an average depth of about 30 inches. The deep subsoil consists of a heavy, red clay which extends to the bedrock. Some gravelly material occurs in the soil and subsoil, and bowlders are scattered over the surface in places. In a number of places the surface soil is lighter in texture than typical. In the town of Claybanks just back of the strip of lowland along the lakeshore much of the material classified as Miami fine sandy loam is like the Superior series in the presence of a red clay substratum, but the depth to this stratum is so great as to have little influence on the soil and it therefore is mapped with the Miami series.

The type has a gently rolling to rolling surface. In section 30, Sevastopol Town, it occurs on a long, high hill, with a few rock outcrops on the slope. The type has good natural drainage, and on account of the clay subsoil it retains moisture very well, except possibly in the area of Sevastopol Town, where the rock is close to the surface.

In origin this soil is similar to other types of the Superior series, being partly lacustrine and partly glacial. The surface is very often found to be acid, owing to the leaching of the lime carbonate. The red clay subsoil usually contains considerable carbonates, especially in the lower depths.

The original timber consisted chiefly of maple, beech, basswood, oak, hickory and some pine.

Agriculturally this soil is unimportant. A considerable proportion is still unimproved. The area north of Sturgeon Bay is largely forested and has an unfavorable topography. Where under cultivation this soil is easy to handle, and good yields of the general farm crops are secured. The methods followed are practically the same as on the Superior loam.*

CHEMICAL COMPOSITION AND IMPROVEMENT OF LOAMS AND FINE SANDY LOAMS.

* * * * *

These soils are more open in texture than the group of heavy soils. They have a water holding capacity which is suf-

*For a discussion of the chemical composition of this soil and its improvement see page 37.

ficient to insure good pasture, where the land is in grasses. Because of the more rolling surface, the higher content of fine sand in the surface soil, and the open or rocky subsoil the natural drainage is much better than on the heavy level lands and the soil thus warms up earlier in the spring and does not have the tendency to bake and crack which is characteristic of some of the heavier soils. These qualities make these types better adapted to such crops as corn and potatoes, and also to the growing of fruit. It is on this group of soils chiefly that the extensive fruit industry of Door County has been developed.

The total amount of the plant food elements phosphorus and potassium is nearly but not quite as large in the loams and fine sandy loams, as in the group of heavy soils previously described. The amount of organic matter is somewhat smaller, as is also the supply of nitrogen. Because of this and the coarser texture the rate of chemical change may not always be as rapid as in the heavier soils. For this reason the increase in the supply of active or fresh organic matter and the use of available plant food either in the form of stable manure or commercial fertilizer becomes more important, especially when crops are grown which are sold from the farm.

An increase of the supply of active organic matter in these soils is of great importance. It is desirable to have nearly twice as much organic matter in the soil as these types now contain. The plowing under of legumes, such as the second crop of clover, or a crop of soy beans is a good way of securing this result. The supply of stable manure is usually too limited to meet the needs of the entire farm.

As in the group of heavy soils in this county, and as is quite common in most of the state the phosphorus content of these soils is below normal, and should be increased. Even the use of stable manure will not itself supply the amount of phosphorus needed, and it is a good plan to supplement the use of stable manure with a phosphate fertilizer. Acid phosphate is the most quickly available and under present conditions is doubtless the most profitable form to use. This may be applied with small grain which is seeded to clover and about 250 to 300 pounds per acre should be used. When used with corn it may be drilled in the row with a fertil-

izer attachment to a corn planter, or drilled in with a regular lime and fertilizer sower just before the corn is planted.

Where general farming is followed and it is desired to build up the organic matter supply the following rotation is a good one to use:—Corn or a cultivated crop one year, followed by a small grain with which clover is seeded, the first crop the following year cut for hay, and the second plowed down as a green manuring crop to be again used for a cultivated crop. When commercial fertilizer is used it may be applied with the small grain or to the corn crop. Where a second crop of clover is not turned down it should be fed and the manure returned to the field in as liberal amounts as can be secured.

The growing of alfalfa could be greatly extended on these soils and every farmer should consider the question of starting a small acreage.

In connection with the handling of these soils for fruit growing it may be said that the use of commercial fertilizers has not come into general practice. In some other regions, however, it has been found that the use of nitrate of soda has greatly increased both vigor and production, and in some cases mixed fertilizers have also given profitable results. The work in Wisconsin along this line, however, has been so limited that it is not considered advisable to attempt to give specific recommendations for the use of commercial fertilizers for fruit growing.*

In some cases the surface soil of these types is found to be somewhat acid. Where this is the case ground limestone may be applied at the rate of 2 tons per acre or more, depending upon the degree of acidity. The limestone may be applied at any convenient time but it is probably best to put it on the small grain crop which is being seeded to clover. It may be applied with a regular lime sower after the ground has been prepared for seeding. It should be worked well into the soil but should not be plowed under.

* The Agricultural Experiment Stations in New York, Pennsylvania, Ohio, and Indiana have given this question study and those interested are directed to consult the publications issued by these Stations on the fertilization of orchards.

# CHAPTER IV.

## GROUP OF POORLY DRAINED SOILS.

### POYGAN LOAM.

There are only 3, 584 acres of Poygan loam in Door County and this occurs in tracts of from 20 to 200 acres mostly in the Towns of Brussels, Garden, and Nasewaupee, in the southern part of the region covered by the survey. It is associated chiefly with the Superior soils.

The Poygan loam, to a depth of 8 to 10 inches, consists of a heavy, black loam, high in silt. The subsoil is a heavy, red clay, similar to that of the Superior series, but below 24 inches the red clay is usually mixed with fragments of partially decomposed limestone. Bedrock is sometimes encountered within 3 feet of the surface.

The Poygan loam has a level surface, and on account of its low, swampy position and heavy, tenacious subsoil the drainage is very deficient. In some areas water stands on the surface a large part of the year.

The type is largely of lacustrine origin, but has probably been influenced slightly by glacial action. The decay and accumulation of a dense growth of vegetation through long periods has resulted in the dark color and high content of organic matter. The surface soil is acid, but the subsoil ordinarily is neutral or calcareous.

Only a very small percentage of the Poygan loam is under cultivation. Much of it remains just as it was left after the timber was removed. The forest growth consists of cedar, ash, elm, birch, and hemlock, with a second growth of poplar in some areas. In other sections of the State similar soils have been drained and made to produce good yields of the common crops. The type is well adapted to the growing of grasses. It is heavy and quite difficult to handle and before it can

be worked successfully and made to produce profitable yields it must be thoroughly drained.*

### CLYDE SILT LOAM.

This is a soil of minor importance, there being only 1,536 acres in the county. It occurs in patches of from a few acres to about 100 acres and is scattered throughout nearly all parts of the county.

The Clyde silt loam, to a depth of 8 to 12 inches, consists of a very dark colored silt loam. This is underlain by a subsoil of heavy, slightly mottled, bluish silt loam or clay loam. The lower depths contain considerable limestone fragments and gravel.

Variations occur in texture, color, and depth to bedrock. In some depressions a shallow layer of peat may occur on the surface, while in other spots the surface soil may approach a loam in texture. In some places the subsoil may be sandy. The depth to bedrock varies, the minimum being about 2 feet.

The surface is level, and owing to its low position and heavy subsoil the type is wet, soggy and the natural drainage is very deficient.

The type is of both glacial and waterlaid origin. Large accumulations and decay of organic matter in the presence of moisture have resulted in the high content of organic matter and the dark color.

Only a small part of this type has been cleared and most of this is used for pasture. The original forest growth consisted of elm, ash, cedar, birch, and willow. The principal need of the type is better drainage. Most of it can be drained and made into good land, as it is inherently productive. In other parts of the State similar soils when drained produce good yields of corn, cabbage, hay, and various other crops.

### CLYDE LOAM.

The Clyde loam covers a total area of 6,208 acres, and is found in small tracts scattered throughout the greater part of Door County. It is associated chiefly with the Miami soils, and occupies depressions between hills or along streams, or along

* For a discussion of methods for the improvement of this soil and the chemical composition see page 46.

the border of marshes. The size of tracts varies from a few acres to 100 or more acres.

The Clyde loam consists of about 12 inches of black, mellow loam containing considerable silt and organic matter, underlain by a subsoil of grayish fine sandy loam which becomes lighter colored and lighter in texture with depth. The deep subsoil is reddish in color, heavy, and compact.

The type is subject to some variation. In depressions there may be a thin layer of peat on the surface. In places 5 or 6 inches of fine sand may be encountered immediately underlying the surface soil. The texture of the subsoil may vary from a fine sandy loam to a clay loam. The depth to bedrock ranges from 2 feet to several feet.

A lighter textured soil is included with this type on account of its small extent. To an average depth of 8 inches it consists of a very dark colored fine sandy loam, underlain by a grayish fine sandy loam which becomes lighter colored with depth. In all other respects it is similar to the Clyde loam. Owing to the level surface and low position the natural drainage is poor. The water table is within a few feet of the surface and during heavy rains in the spring and early summer the water stands on the surface for a long time.

The surface soil of this type is slightly acid in places owing, it is thought, to acids formed by the decay of organic matter in addition to the leaching out of lime from the soil.

This type of soil occurs in depressions where the material has been washed in to some extent from adjoining higher land. Where it is found along streams it is partly alluvial and in other places it is largely glacial, but it has all been modified by the addition of large amount of decaying vegetable matter, which accounts for the dark color.

A large part of the Clyde loam is still unimproved. In its present undrained condition it can be used only for pasture. Much of it is too wet and too thickly covered with brush to be used even for this purpose. The timber growth consists of elm, ash, willow, and cedar, with some birch and alder and other water-loving trees.

Where thoroughly drained this soil is well suited to nearly all the common farm crops, and especially to grasses. The virgin soil is high in organic matter. In other parts of the

State similar soils when improved have given excellent yields, returning the cost of drainage in a comparatively short time.

### CHEMICAL COMPOSITION AND IMPROVEMENT OF POYGAN LOAM, CLYDE LOAM AND SILT LOAM.

Since these soils are formed along the border line between upland light colored soils and peaty and muck marsh soils, they are intermediate in chemical composition between these two extremes. Moreover, their position is such that they have received a considerable deposition of fine silt from the higher land with its larger content of plant food. These soils have in the surface 8 inches approximately 2000 pound of phosphorus per acre; from 30,000 to 40,000 pounds of potassium; and approximately 10,000 pounds of nitrogen. Since they are surrounded by highland, the subsoils of which are rich in ground limestone which is being continuously dissolved and carried to the lower lands by percolating waters, they are as a rule not acid, and in fact usually contain considerable quantities of lime carbonate.

In spite of their large content of both phosphorus and potassium, it is not infrequently true that these soils show low availability of these elements, especially of potassium. This is probably due to the inert condition of much of the organic matter which protects the earthy part of the soil. Where thoroughly good artificial drainage has been developed and nevertheless poor crops secured, this result will usually be found to be due to lack of available potassium and in some cases also of phosphorus. A direct experiment should be made in these cases with potassium and phosphate fertilizers, as suggested in the bulletins of the Experiment Station.[1]

The most important question in the improvement and management of these soils is one of drainage. Practically all areas are in need of drainage, and tile drains will be found most practical in the majority of cases. When properly drained and well managed, very satisfactory yields can be secured.

* For more information write to Wisconsin Experiment Station for bulletins on drainage and fertilization of low, poorly drained tracts of land.

For special information on drainage, see Bulletin No. 229 of the Wisconsin Experiment Station.

Cabbage, onions, and sugar beets are some special crops which can be successfully raised on these soils, aside from the general farm crops, such as timothy, alsike, clover, and corn. Stable manure should not be applied to these soils as the nitrogen is not needed. The mineral elements, where needed, may be supplied in the form of commercial fertilizers, as indicated above.

### PEAT.

There are approximately 60 square miles of Peat in Door County. A little more than half the type occurs in that part of the county south of Sturgeon Bay. The largest area is mapped near the east shore of the peninsula in the northern part of the county, extending from a point just north of North Bay to Baileys Harbor. Between the shore and the swamp there is a narrow strip of high land. The points projecting into North Bay, Mud Bay, and Baileys Harbor are extremely rocky. This marsh covers about 13 square miles. Another large marsh extends from a point about 3 miles south of the Sturgeon Bay ship canal to Clark Lake, reaching one-half mile to about 1½ miles inland. Like all the large marshes along the Lake Michigan shore it is separated from the lake by narrow strips of high land, mainly beach sand. To the north of Sturgeon Bay the western part of the county is practically free from peat marshes; the only two of importance are the one extending southeast from Ephraim and the one extending southeast from Ellison Bay. In the region of the Superior soils to the south of Sturgeon Bay there are numerous areas of Peat of various sizes. The largest is the one in sections 20, 21, 22, 26, and 28, Gardner Town. Other areas of over 1 square mile occur in Nasewaupee, Forestville, and Brussels Towns.

Peat includes several kinds of swamp and marsh land the soil of which consists chiefly of roots, grasses, sedges, leaves, moss, and other organic matter in various stages of decomposition. There is usually incorporated a small amount of mineral matter. The soil is dark brown to black in color and 8 inches to several feet in depth, being shallow at the border of the marsh and deeper near the center. In some of the marshes the subsoil consists of extensive deposits of marl.

All the Peat lands are level and low lying. The drainage is poor, owing to the lack of drainage outlets or because of a

heavy, impervious subsoil below the organic soil. In the southern part of the county the subsoil is heavy, but in the large areas along the lake shore north of Sturgeon Bay it is more sandy and porous. In these large areas there occur islands of sand which are not shown on the map.

Most of the Peat areas of Door County are wooded, the growth consisting of cedar, tamarack, ash, willow, and some elm and spruce. Where the peat is deepest tamarack predominates, but along the border of the marshes or where the Peat is shallow ash, elm, and willow predominate. The largest open marsh in the county is the one extending from Ellison Bay to Rowley Bay.

Most of the Peat areas are wet the greater part of the year, and in the spring and during the wet seasons water stands on the surface. The slope is nowhere sufficient to drain the excess water without open ditches or tile. The large marshes along the Lake Michigan shore do not lie very much above the level of the lake, and drainage here would be quite difficult. Very little of the Peat land has been reclaimed, although many areas could be drained and profitably cultivated. Many small marshes could be drained at comparatively low cost. Reclamation of the larger ones would require large expenditures and the organization of drainage districts.

### MUCK.

Muck consists of vegetable matter in varying stages of decomposition, with which there are incorporated large amounts of mineral matter. It is more thoroughly decomposed than Peat, contains more mineral matter, and may be considered as intermediate between Peat and the soils of the Clyde series. Practically all of the Muck is relatively shallow, and in some places the type as mapped consists of Peat underlain at 6 to 10 inches by silt loam or fine sandy loam. When plowed the soil here consists of a mixture of Peat and silt loam which has nearly the composition of true Muck.

Muck occurs only in small areas. These are scattered throughout the area, mainly along streams or at the border of areas of Peat. It occupies about the same topographic position as Peat, and is poorly drained and swampy. With drainage well established the soil is very productive, but in its present un-

drained condition it is only of value for the pasture it affords and the marsh hay which is cut from some areas.

CHEMICAL COMPOSITION AND IMPROVEMENT OF PEAT AND MUCK.

Peat has been largely formed by the accumulation of vegetable matter, particularly sphagnum moss and certain sedges and grasses. It is very low in earthy matter, running from 80 to 95 per cent of organic matter. The amount of mineral elements is consequently low, the total weight of phosphorus being approximately 600 pounds per acre to a depth of 8 inches, and of potassium, 700 pounds. It will be seen, on comparison of these statements with those made on the composition of such soils as Miami silt loam and Fox silt loam, that the total amount of potassium, in particular, is extremely small, the amount in peat often being less than 2 per cent. of that found in upland silt loam soils. While the total amount is small, a large proportion of it is available to plants, especially if the surface has been burnt over, and the supply may be sufficient for from 1 to 3 crops. It is to be expected, therefore, that profitable cropping is possible over a long period of years, only by the use of some form of potassium fertilizer, either barnyard manure, wood ashes, or the usual commercial fertilizers containing this element. The total supply of phosphorus is rather low, though the difference between the amounts present in Peat and upland soils is very much less than in the case of potassium. In the Muck soils there is a somewhat larger supply of phosphorus and potassium than in the Peat, because of the larger amounts of fine earth which are present. The total amount, however, is much lower than in good upland soils. In view of the enormous quantity of nitrogen contained in these soils, the average amount of which is over 15,000 pounds per acre 8 inches, it is unnecessary to use stable manure, the most valuable element of which is the nitrogen, so that on farms including both Peat or Muck land and upland soils, the stable manure should be used on the upland, and commercial fertilizers containing phosphorus and potash, if needed, on the lower land, unless, indeed, there is sufficient manure for the entire farm, which is rarely the case. These marsh soils are rarely acid on account of the percolation of lime-containing water from higher lands, though occasionally patches of Peat are found in the

larger marshes. This acidity, however, is not so dertimental in the case of marsh lands as in the case of sand and clay soils, since the chief objection to acidity is that it interferes with the growth of those legumes, such as clover and alfalfa, which are needed on the higher lands to secure nitrogen, but which are not needed on the marsh soils for this purpose, and to the growth of which, indeed, the marsh soils are not so well adapted physically.

In the improvement of Peat the question of drainage* is the first step to be considered. Both open ditches and tile drains can be utilized in reclaiming the marshy tracts. The major portion of Peat areas in Door County can be drained and improved, and efforts are now being extended along this line through the establishment of drainage districts. Some drainage work is also being carried on by individual farmers to reclaim small marshy tracts which have sufficient fall so that an outlet can be readily secured.

When thoroughly drained, properly cultivated and fertilized Peat will produce profitable crops of timothy and alsike clover, small grains, buckwheat, root crops, and in some regions such special crops as celery and peppermint are grown. When small grains are grown there is danger of lodging, but the use of commercial fertilizers will tend to produce a stronger straw. Corn can be grown also on Peat land but the danger from frosts is considerable greater than on the adjoining upland in the same vicinity.

* For special information concerning drainage, write the Soils Department of the Wisconsin Experiment Station.

# CHAPTER V.

## GROUP OF MISCELLANEOUS SOILS.

### MIAMI GRAVELLY SANDY LOAM.

The Miami gravelly sandy loam is not an extensive or important type. It covers a total area of 6,784 acres, or 2.3 per cent of the county. It occurs in all but the southern part of the county, occupying small areas associated with other types of the Miami series. Some rather large areas occur on Washington Island.

The Miami gravelly sandy loam is a somewhat variable type, but the greater part of it is either typical or included in a variation which is characterized by a level to undulating surface. The typical soil which has a rolling topography consists of a loose, light-brown sandy loam to an average depth of about 8 inches. Gravel and bowlders in varying quantities and sizes occur on the surface and through the soil. The sub-soil is a reddish-brown, gravelly sandy loam. The gravel content increases with depth, and the subsoil in places is a bed of pure gravel. The undulating areas have a typical surface soil, but the soil here is shallow. It occurs on the points projecting into Lake Michigan and near the shore on the east side of the peninsula. Bowlders and outcrops of limestone are common, and the bedrock occurs at depths varying from 1 to 3 feet.

The topography of the typical areas is rolling to broken and bumpy, consisting to a considerable extent of hills, knolls, and long narrow ridges. The drainage is thorough and rapid. The gravelly nature makes the soil rather droughty, but in seasons of sufficient rainfall fair yields are produced.

The typical Miami gravelly sandy loam has been derived from glacial material, and occurs in the form of eskers, drumlins, and moraines. The undulating variation also has been derived from the weathering of glaciated material, but this

was not left in morainic form as in the case of the typical soil.

A considerable proportion of this type is under cultivation. Some of it is still in forest. The original timber growth consisted chiefly of oak, pine, maple, and some other hardwoods. This class of land is used chiefly for general farming, but because of its rather coarse texture, open structure, and consequent droughty condition average yields are considerable lower than on the heavier soil types of the Miami series. Profitable crop production on this soil requires careful management.*

### MIAMI GRAVELLY LOAM.

This soil covers an area of 7,616 acres or 2.5 per cent of the county. While of limited extent it occurs in numerous areas varying in size from a few acres to one-half section or more. It is confined to that part of the county north of Sturgeon Bay and is associated with other types of the Miami series.

The surface soil of the Miami gravelly loam consists of a friable, brown loam, which extends to an average depth of 8 inches. There is a large amount of gravel on the surface and through the soil. Much of the gravel is angular, and frequently the particles are quite large. The surface soil grades into a light-brown or yellow gravelly fine sandy loam. The content of gravel increases with depth, and it is usually impossible to penetrate the deep subsoil on account of the gravel.

This is one of the most rolling soils in the county; in fact, the rolling topography is one of its most characteristic features. It occurs on drumlins or eskers or in areas of choppy or broken land in the morainic sections. The rolling topography and gravelly subsoil make the type droughty. Erosion is active in periods of heavy rains.

Agriculturally this is not an important soil although a considerable portion of it is cleared and some of it is cultivated. While about the same crops are raised upon it as on the heavier soils, the average yields are much lower. Most of it can be used to best advantage for grazing.*

* For a discussion of the chemical composition and improvement of this soil see page 49.

* For suggestions on the permanent improvement of this soil see page 49.

### MIAMI FINE SAND.

There are 4,800 acres of Miami fine sand in Door County. This occurs in small patches on Washington Island and over most of the Peninsula as far south as the region of red clays in the southern part of the county.

The Miami fine sand consists of a yellowish-brown fine sand, 6 to 10 inches deep, underlain by a pale-yellow fine sand which becomes a little coarser with depth. The soil is loose and open and very low in organic matter. When the surface is bare it is sometimes blown by the wind.

The surface is gently rolling to rolling, and owing to this and to the loose, open character of the sand crops suffer from drought except when the rainfall is heavy and well distributed. This soil has been farmed with varying degrees of success. Much of the type is still uncleared, although the original timber has long since been removed. This consisted largely of pine and of oak, with varying proportions of other hardwoods.

In wet seasons when the rainfall is well distributed good yields of the common farm crops are obtained. Potatoes, corn, rye, oats, buckwheat, and truck crops give the best results. Some cherry orchards have been planted on this soil, but they have either made a very poor growth or died out entirely.

The Miami fine sand is easily plowed and cultivated. It becomes dry and warm very quickly, and can be worked earlier in the spring than the heavier soils and under a much wider range of moisture conditions. On the other hand, it is low in water-holding capacity and subject to wind erosion.*

A few widely scattered areas of coarser sand are included on the map with Miami fine sand. It is similar in origin, topography, and all other features except texture. The surface soil of the sand type to an average depth of 8 inches consists of a yellowish-brown sand of medium texture. It is loose and open in structure, and low in organic matter. The subsoil is a pale-yellow sand which becomes a little coarser with increased depth. Most of this type is still uncleared, although the original timber has long been removed. This consisted chiefly of pine and oak, with scattered balsam and hardwoods other than oak. The soil has the same agricultural adaptation as the typical

*Methods for the improvement of this soil are discused on page 33.

Miami fine sand, and it should be handled in the same way in order to obtain profitable yields.

### PLAINFIELD SAND.

This type is confined to Chambers Island in Green Bay and a small area south of Clark Lake in Sevastopol Town. Chambers Island, which has an area of about 4 square miles, is occupied almost entirely by Plainfield sand.

The Plainfield sand consists of a light-brown, loose sand to a depth of 8 to 10 inches. The subsoil is a light-colored sand which assumes a marked yellowish tinge in the lower depths. The little gravel that occurs consists maily of chert, quartz, or quartzite. The soil is very uniform throughout its development.

The surface of this type is level to gently undulating. It was originally more nearly level than at present, wind and other agencies having changed the topography slightly. The crops suffer from lack of water during at least a part of nearly every season.

Only a very small total area of the Plainfield sand is cleared and under cultivation. The original timber growth consisted largely of white pine, with various kinds of oak, maple, and other hardwoods in varying amounts. On Chambers Island a thrifty growth of young timber, mainly pine, is springing up. The principal use of the type here is for a game preserve and for summer homes.

In wet years when manured heavily this soil has given fairly good yields of different crops. Corn, potatoes, rye, buckwheat, and truck crops are well adapted to the Plainfield sand.

### PLAINFIELD FINE SAND.

The Plainfield fine sand covers less than 2 square miles and is one of the least important types in the county. It is confined to two areas, one on each side of the peninsula. One area occupies a narrow terrace lying between the foot of the high bluffs and the Lake Michigan shore in Claybanks Town; the other occurs along the Green Bay shore in sections 28, 21, and 16, Union Town.

The surface soil of the Plainfield fine sand is a light-brown to dark-brown fine sand or loamy fine sandy, about 8 inches

deep. The subsoil is a lighter colored fine sand, with a marked yellow tinge in the lower depths. Red Clay is usually encountered at 3 to 6 feet below the surface. In the area at the foot of the bluffs along the lake shore.

The surface of the type is level to slightly undulating, and it lies only 5 to 15 feet above the level of the lake, but the natural drainage is good except at the foot of the bluffs, where seepage from the highland keeps the soil wet.

This soil has been brought to its present position by the action of water. The terrace on the Lake Michigan side was probably formed when the water level was higher than it is now, the sand in both areas being undoubtedly Beach sand. The red clay subsoil which underlies the sand is also waterlaid.

Only a small proportion of the Plainfield fine sand is under cultivation. The original timber growth consisted of scrub oak, mixed hardwoods, and some white pine and hemlock. The yields of the common farm crops are lower than on the heavier soils, but such crops as potatoes, strawberries, and truck do very well.

The area in Union Town is low in organic matter Stable manure, is the only fertilizer used. The soil is well adapted to the growing of truck, and trucking could well be more highly developed.

### CHEMICAL COMPOSITION OF FINE AND MEDIUM SANDS.

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These soils are of limited extend and for their highest development require more careful management than the heavier types of soil above described.

They are quite dificient in organic matter and nitrogen. The nitrogen content usually ranges from 1000 to 1500 pounds per acre in the surface 8 inches. The phosphorus supply is also low and averages from 850 to 900 pounds per acre. The potassium in the surface 8 inches per acre is approximately 25,000 pounds which is only about half the amount present in the heavy soils of the county.

The management of these soils to maintain the fertility will depend to a considerable extent on the crops grown and on whether or not stock is maintained to which the produce of the farm is fed. When dairying or other live stock farming is prac-

ticed it will be less difficult to maintain the supply of the essetial elements of plant food—phosphorus, potassium, and nitrogen. But even when stock is maintained, it is very probable that the moderate use of some form of phosphorus fertilizers will be found profitable, and some means for increasing the organic matter in addition to the use of stable manure should be made use of as far as practicable. The growth of a crop of soybeans or clover occasionally all of which is to be plowed under as a green manuring crop will be found profitable in its effect on the succeeding crop of corn or grain.

When these soils are used for the growing of potatoes or other special crops to a considerable extent the use of commercial fertilizers containing phosphorus and potassium will be found necessary to maintain the soil at a point of productivity for a considerable number of years. Clover or some other legume must be grown regularly in the rotation to maintain the nitrogen and organic matter, and part or all of this should be plowed under. It is often desirable to use the commercial fertilizers containing phosphorus and potassium in order to secure a good growth of this clover, and there is little loss in so doing since essentially all of the phosphorus and potassium applied to the soil for the clover becomes available to the succeeding crop through the decomposition of the organic matter.

The use of lime in some form and also the inoculation of the soil is of the utmost importance when alfalfa is to be grown and will be found helpful on the older fields even for the growth of medium red or mammoth clover.

In the improvement of these soils it will be found that the fine sand will respond more readily than the sand, because of the difference in texture. On the fine sand potatoes can be grown in rotation with greater profit than on the sand. For the extremely sandy soils of medium texture better results are secured when corn is used as the cultivated crop in a rotation. For the sand a rotation of corn, small grain and clover is good, while on the fine sand potatoes may be substituted for the corn. In both cases the second crop of clover should be plowed under.

### ROUGH STONY LAND.

Rough stony land includes areas so rough, broken, or rocky as to be of little or no value for farming. It occurs largely

in long, narrow strips in the form of high bluffs, slopes, or steep cliffs. It is practically all confined to the west side of the peninsula, where it occurs either on the shore or a short distance back from the shore, and represents either the present or a previous shore line. The longest area of Rough stony land extends from a point about 5 miles northwest of the city of Sturgeon Bay to a point about 3 miles north of the village of Egg Harbor. The type includes the bluffs at Fish Creek, Ephraim, Sister Bay, and Ellison Bay, and those in the State park. On the point of land between North Bay and Mud Bay the type is much more nearly level than typical, but the extensive rock outcrops, the stoniness, and the extremely shallow soil render the land practically valueless for agriculture. On the slopes and cliffs extensive outcrops of limestone occur.

The timber growth on the Rough stony land consists of maple, birch, balsam, pine, and poplar. The best of the timber has been removed, but considerable remains and should be left to protect the slopes from washing.

Over some of the slopes there is only a shallow covering of soil, while some areas are well covered. The soil varies from fine sandy loam to loam. No attempts have been made to cultivate this land, but it may furnish some pasturage.

### BEACH SAND.

The type mapped as Beach sand consists of a grayish fine or very fine sand which continues with little change throughout the 3-foot section, except that the subsoil has a marked pale-yellowish tinge. There is little or no organic matter in the soil.

This type is confined largely to a narrow strip bordering Lake Michigan from a point a short distance south of Sturgeon Bay ship canal to the north end of the peninsula. It varies in width from three-fourths to less than one-fourth mile, but is not continuous along the entire east side of the county. The widest and most typical area occurs at Jacksonport. Some small areas are mapped on Washington Island.

The surface of this soil varies from undulating to very rolling or bumpy, being typically quite rolling. Drainage is excessive, and crops suffer from lack of water except in very wet seasons.

Beach sand consists of material washed onto the shore by the waves. Much of it has been drifted by the wind, forming the broken, bumpy surface, and a considerable proportion consists of shifting sand dunes.

On account of its low productiveness and other unfavorable features only a small part of this soil is under cultivation. The timber consists mainly of pine and oak, neither of which grow very large or dense. The type is not likely to be farmed extensively for some time. Rye, oats, corn, and potatoes, are grown, but the yields are low except very near the shore, where the water of the lake is but little below the surface of the land.

The system of farming on this soil should be such as to increase its content of organic matter and its water-holding capacity. Stable manure should be supplemented by green-manure crops, the soil should be limed, and commercial fertilizers used. Great care should be taken to guard against wind erosion. The type is better adapted to the production of truck crops than to general farming, but owing to the long distance to market the trucking industry has not been developed.

Some small areas of gravel are included with the Beach sand as mapped. The soil in such areas consists of about 4 inches of gravelly sandy loam underlain by beds of gravel and sand. It occurs in very narrow strips along the shore, largely on the Green Bay side of the peninsula, and is of little importance. The point of land extending into the bay at Fish Creek is largely occupied by this soil. Another small area occurs along the shore in sec. 34, Sturgeon Bay Town, and in sec. 3, Claybanks Town. The surface is level to undulating. The soil represents a beach formation consisting of material washed up on the shore by the waves. No effort has been made to grow crops on this soil, and it may be classed as nonagricultural.

# CHAPTER VI.

# GENERAL AGRICULTURE AND CLIMATE.

## AGRICULTURE.

The first white settler in Door County located on Little Sturgeon Point in 1835. Agricultural development, however, did not begin until 1852–1855, when a settlement of Moravians was made at Ephraim and a large number of Belgians settled at Brussels, in the southern part of the county. The entire county was originally covered with a dense stand of timber, which was removed long ago. The early agriculture consisted mainly of grain production, with the growing of enough vegetables and fruit to supply the family. As was the case in nearly every other section of Wisconsin, wheat was at first the principal crop. Until about 1900 the wheat acreage was larger than that of any other cereal. From 1880 to 1900 over 200,000 bushels of wheat were produced annually. Wheat growing proved profitable for a long periol, but gradually, owing to poor cultivation, lack of fertilization, and continued cropping without any attempt to follow a systematic rotation, the soils produced such poor yields that some other line of farming had to be introduced. In 1909 only 3,474 acres of wheat were grown and 52,070 bushels produced, as compared with 16,616 acres seeded and a production of 239,000 bushels in 1899. Wheat production gradually gave way to a more diversified system of farming. Hay, oats, barley, rye, corn, and potatoes proved profitable crops, and dairying was begun. Fruit growing was taken up in place of wheat production. The principal field crops grown at present, named in order of acreage, are hay, oats, rye, barley, wheat, peas, potatoes, corn, flax, and buckwheat.

The total area devoted to tame hay in 1909 was 32,750 acres, from which 42,581 tons were obtained. About two-thirds of this consisted of clover and timothy mixed, about one-fifth timothy

alone, and one-tenth of clover alone. Very little alfalfa is grown, although over much of the county the soils are well adapted to this valuable legume. Only small quantities of marsh hay are cut. Most of the hay produced is fed to stock, but some farmers sell part of the crop each year.

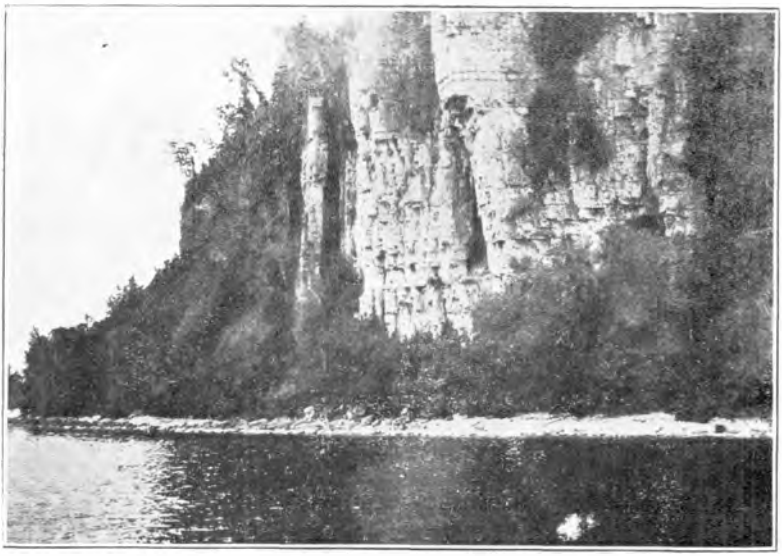
Since the decline in wheat production, oats have been the leading small grain crop. In 1909 oats occupied 16,812 acres, on which 492,382 bushels were produced, or about 30 bushels per acre. The crop is well adapted to the soils of the county, and every farmer grows it. Some of the crop is sold, but the greater part is fed to stock on the farm.

Next to oats rye is the most important grain. In 1909 there were 8,468 acres in this crop, producing 130,260 bushels, or 15.4 bushels per acre. Barley is grown quite extensively. In 1909, a production of 128,166 bushels was obtained from 5,272 acres, the yield averaging about 25 bushels per acre. Considerable income is derived from the sale of barley, but part of the crop is fed on the farms. Wheat, while it has declined greatly in importance in the last 15 years, is still grown to some extent. In 1909 the crop was grown on 3,474 acres and produced 52,070 bushels, an average of 15 bushels per acre. Since that year, however, the growing of wheat has become less important.

Potatoes produce fairly good yields on most of the soils. The 1910 census shows a production of 225,391 bushels from 2,273 acres, and average yield of about 100 bushels per acre. Potatoes are grown mostly for home use.

Corn is not grown very extensively at present, but the acreage is being increased each year. In 1909 only 1,417 acres of corn were grown in the entire county, but since that year the growth of the dairy industry and the building of silos have led farmers to devote more land to the crop. The soils in that part of the county north of Sturgeon Bay are better adapted to the growing of corn than is the heavy clay soil in the southern part. Corn does not always mature, but it never fails to reach the stage where it makes good silage. Certain early maturing varieties, recently produced through scientific selection and breeding, have been grown with much success.

The growing of peas for canning was for a time an important industry in the vicinity of Sturgeon Bay. Two large canning



VIEW ALONG THE SHORE OF GREEN BAY IN PENINSULA STATE PARK.

Peninsula State Park consists of 3,800 acres situated on the Green Bay shore of Door County 25 miles north of Sturgeon Bay, and between the villages of Fish Creek and Ephriam. It is noted for its scenic beauty and is visited by thousands of tourists every season.

This cliff is Niagara Limetone, which is found underlying the entire county.

GOOD ROADS TRAVERSE DOOR COUNTY.

When this survey was made there were 125 miles of water bound macadam roads in Door County. Each year has added materially to this mileage. An abundance of excellent road building material immediately at hand makes the cost of road construction here much less than in many places.

plants, one at Sturgeon Bay and the other at Sawyer, handled the peas grown on a large acreage. In 1913 the output of the cannery at Sturgeon Bay was 3,000,000 cans. The census reports a total of 21,845 acres devoted to peas in 1909, producing 307,739 bushels. In the past few years the pea canning industry has rapidly declined, owing chiefly to diseases of this crop.

Trucking has been developed quite extensively in conjunction with fruit growing, especially in the vicinity of Sturgeon Bay. For several years while the fruit trees are growing and even after they have come into bearing there is considerable cultivable land between the rows of trees, and this is utilized for the growing of truck crops. Strawberries and blackberries raspberries are grown to a considerable extent, and vegetables are produced in quite large quantities. The 1910 census reports 101 acres in small fruits, of which strawberries alone occupied 72 acres.

Aside from fruit growing, dairying is the most important specialized industry. Dairy farming is developed most extensively in the southern part of the county on the heavy clay soils, but it is growing in importance each year even in the fruit districts. Quite a number of orchardists keep a dairy herd and find the combination of fruit growing and dairying very satisfactory, as it distributes the labor over the entire year and insures some income in case the fruit crop is a failure. The soils in the southern part of the county are very well adapted to dairying, as they produce good crops of hay and corn and supply good pasturage. The Superior soils are natural grass soils, producing heavy yields of hay and furnishing excellent pasturage. Perhaps the most thriving dairying community is the so-called Belgian settlement in the vicinity of Brussels. There are a number of fine pure-bred dairy herds in the county. Holstein and Guernsey are the most popular breeds. Most of the dairy animals are of grade or scrub stock, but the type is rapidly being improved by the use of pure-bred sires. There are 55 cheese factories and 15 creameries in Door County. Most of the cheese factories are in the southern part of the county, but the section north of Sturgeon Bay is rapidly developing in dairying, and more cheese factories are being built each year. There is a condensary in Sturgeon Bay which receives from 50,000 to 60,000 pounds of milk daily.

The raising of beef cattle receives little attention in Door County, although there are numerous steep and rocky areas which are better suited for grazing than for general farming. Only a few farmers make a specialty of raising beef breeds, and most of the stock sold for slaughtering consists of mixed types. Many calves, the surplus of the dairies, are sold for veal. The horses throughout the county, notably in the Belgian settlement at Brussels, show more careful breeding than do the cattle. Heavy draft horses are common. Many colts are raised each year, and farmers frequently have a team to sell. In 1909 there were 7,405 sheep in the county. Sheep raising has never been important, but it will probably increase in the future. Hog raising is carried on in conjunction with dairying. Practically all the farmers produce enough pork for their own use and many have considerable income from the sale of hogs.

The common crops are grown promiscuously on nearly all the soils of the county. The predominant soil in the southern part is the Superior loam, rolling phase, while in the northern two-thirds the Miami loam predominates. On the heavy Superior soils hay, corn, and small grains for feeding dairy cows are grown. These soils are well adapted to such crops. The soils in the southern part of the county are in general very well adapted to dairying, but not to fruit growing. The fruit industry is confined largely to the Miami loam, which is very well adapted to orcharding in both texture and topography. More attention has been given to soil adaptation in fruit growing than in connection with other crops.

Only a few farmers study the question of crop rotations and follow a fixed rotation from year to year. The same rotations are followed on nearly all the soils, regardless of their suitability. A rotation well suited to most of the soils consists of one or two years of small grain, with which grass seed is sown. Hay is cut for one or two years, after which the sod is plowed up and a cultivated crop like corn or potatoes planted. If desired the field may be pastured for one year while it is in grass, thereby increasing the length of the rotation. On the Superior soils it is advisable to keep the land in hay longer than on the Miami soils.

The methods of cultivation followed are not in all cases those best suited to the needs of the soil. This is especially true

on the Superior clay loams. Poor drainage keeps the soil wet until late in the spring, and in many cases the fields must be cultivated before the soil is dry enough to work up properly. This frequently leads to puddling of the soil, which requires considerable time and labor to correct. Fall plowing is done in most cases and gives good results, as the alternate freezing and thawing in the winter and spring breaks up the lumps and kills weed seeds and numerous insect and fungous pests. The stable manure produced is in general carefully preserved and put back on the land. The tendency is to cultivate the orchards with more care than the land used for other crops. On most of the larger orchards up-to-date machinery is used for cultivation.

Three noxious weeds are very abundant and troublesome in Door County. The Canada thistle is the most common. Many fields are completely overrun with this pest, and others are overrun with wild mustard. Quack grass is very troublesome in places. These weeds are quite difficult to eradicate, but they can be gotten rid of even where most abundant.[1]

The farm buildings throughout the county as a rule are substantial and in good repair. On many of the dairy farms good silos are in use, and more are being built yearly. In the extremely stony sections stone fences are common. In the southern part of the county and in areas where stones are less numerous the fields are well fenced with barbed or woven wire.

The supply of hired help for the farm is usually insufficient, and outside the fruit-growing sections members of the family do most of the work except during extremely busy seasons. In the fruit sections large numbers of workers, including boys and girls of all ages, are brought in from outside cities during the picking season. They are paid by the amount of fruit picked.

The 1910 census reports 2,310 farms in Door County, with an average size of 109 acres. Over 84 per cent of the land in the county is in farms, and 53.4 per cent of this land is improved, giving each farm an average of 58 acres of improved land. Practically all the farms are operated by the owners. Only 3 per cent are leased to tenants, and less than 1 per cent are operated by a hired manager. It is the custom of the large orchard owners to engage skilled managers.

[1] See Bul. Wis. Agr. Expt. Sta., Eradication of weeds.

The price of farm lands depends largely upon the type of soil, the quantity of stone present, and the location. The highest-priced land in the county is in the fruit-growing section. In the northern end of the county, where most of the soil is shallow and stony, improved land can be purchased for $50 to $75 an acre. Farms on the Kewaunee loam not too far from the railroad are valued at $100 or more an acre. Farms on the sandy soils sell for $20 to $40 an acre. The 1910 census gives the average assessed value of land in Door County as $37.90 an acre. Since that year, however, the average value has greatly increased. Cherry orchards in full bearing and in good condition sell for **$400 to $600 an acre.** Cherry trees produce their maximum yields when 10 to 20 years of age. Orchards which have not reached the full-bearing stage—that is, orchards about 5 or 6 years old, sell for $300 to $400 an acre, and young orchards about 2 years old for $250 to $300 an acre. These prices are the average for cherry orchards in the vicinity of Sturgeon Bay. In the northern end of the peninsula the selling price is about $100 less an acre for each class of cherry orchards.

## FRUIT GROWING.

Fruit growing in Door County really began in 1983 when 10 acres of plums were set out near Sturgeon Bay. In 1896, 3 acres of cherries were set out. During the next 10 or 15 years farmers in the vicinity of Sturgeon Bay and in other parts of the county made considerable plantings of cherrries, apples, plums, and small fruit. Immense crops of excellent strawberries were produced. Until 1910 no very large plantings of cherries had been made, only a few orchards being more than 10 acres in extent. In the spring of 1910 one company set out 40 acres of cherries and 20 acres of apples. During the winter of 1911 many stock companies were organized and in the spring thousands of cherry, apple, and plum trees were planted. One company alone set out 200 acres of cherry trees, which have since been increased to 700 acres. This is, as far as known, the largest orchard of sour cherries in the world.

*** For more detailed information on the planting and management of orchards, see Buls. No. 201, 207, 269, Wis. Agr. Expt. Sta. Also reports of the Wisconsin Horticultural Society.**

During 1912 and 1913 planting was caried on to an even greater extent, not only at Sturgeon Bay but also at many other points along the Green Bay side of the peninsula. At the present time the acreage in fruit is estimated at 3,500 acres of cherries, 1,700 acres of apples, and 200 acres of plums. Besides this a considerable acreage is devoted to strawberries, currants, raspberries, and other small fruits.

The Richmond and Montmorency are practically the only varieties of cherries grown. The apples grown most extensively on a commercial scale are the Wealthy, Oldenburg, Fameuse, McIntosh, Dudley, Northwestern, Tolman, and McMahon. Some other varieties have been tried. The chief varieties of plums grown are the Burbank, Lombard, Gueii, and Bradshaw.

Some grapes are produced in different parts of the county. The varieties grown are Campbell, Moore, and Norton.

Door County is so well adapted to the growing of fruit, especially cherries, largely on account of its favorable climate and soils. The Miami loam, on which most of the fruit is grown, is a mellow loam soil ranging from 1 to about 4 feet in depth, overlying limestone rock. Cherry trees have a peculiar ability to take root and flourish on very shallow soil, and in numerous cases trees planted in soil so shallow that holes had to be blasted in the rock have made splendid growth and produced heavy yields. The roots penetrate the seams and crevices and apparently obtain moisture and plant food from the very rock. The rolling topography induces good drainage, without which cherry trees can not grow well.

The climate of Door County is extremely well adapted to fruit growing. The waters of Lake Michigan and Green Bay delay the occurrence of frosts in the fall, permitting the fruit to ripen, the buds to develop, and the new growth to mature while the foliage is still on the tree. In the spring the cold winds from these waters retard blossoming until danger from frost is past. The summers are cool, with comparatively little change in temperature from day to night, also a condition favoring the proper development of the fruit. On the Green Bay side of the peninsula the season is on the average about two weeks earlier than on the Lake Michigan side, owing to the fact that the waters of Green Bay warm up quicker in the

spring than the waters of Lake Michigan. Cherries and other fruits grown on the Green Bay side of the county ripen and can be put on the market two weeks earlier than fruit grown on the lake side. For this reason cherry growing is confined largely to the west side of the peninsula. In the fall, however, the killing frosts occur earlier on the Green Bay side, owing to the fact that the lake cools more slowly.

The principal problem which confronts the cherry grower is to get the labor to care for the orchard and to pick the fruit. An orchard to be profitable requires careful plowing and cultivating and regular spraying, and the fruit must be picked as soon as it ripens. On the average it takes five good pickers per acre for a mature orchard in a good season. Some of the larger orchard owners bring in a large number of pickers from Milwaukee, Chicago, and other cities each season. The pickers are housed in buildings or tents erected on the grounds. For the last few years a summer Y. M. C. A. camp has been maintained at Sturgeon Bay during the cherry-picking season. This camp furnishes a large number of pickers. In the immediate vicinity of Sturgeon Bay children and other persons out of employment are engaged to pick cherries. The farther the fruit grower is from Sturgeon Bay the more difficult it is to obtain competent help. Each season more and more pickers will be needed, as only a small proportion of the trees planted have reached maturity. Since the spring of 1913 no extensive plantings have been made except the replacing of trees that have grown too old or have died. The average life of a cherry tree is about 20 years. Even if no more trees are set out it is probable that the present acreage is all that can be cared for when the trees mature. All the trees now growing will not reach maturity, as some orchards are planted on soil unfit for cherry culture, where the subsoil may be too heavy, the topography too level, and the drainage deficient. Some orchards have been greatly injured or even ruined by improper care or poor methods of cultivation. Spraying, which yearly becomes more important with increase in fungous diseases and insect pests, is sometimes neglected.

The first step toward solving the problem of marketing cherries and other fruits so as to obtain the highest prices was taken in 1910, with the organization of the Door County Fruit

Exchange. This organization sells all the fruit collectively and does away with local competition. This has recently been reorganized into the Door County Fruit Growers' Union. This organization also has a canning factory for fruits of all kinds. The business is handled by a manager elected by the board of directors. The highest market prices are received and the results obtained are much more satisfactory than before organized marketing existed. Most of the cherries are marketed in Minneapolis, St. Paul, Duluth, and other cities of the Northwest.

In the future the acreage devoted to apple will undoubtedly increase. Apples are not nearly so perishable as cherries, they do not require so many pickers per acres, and are not necessarily marketed immediately after being gathered as is the case with cherries. The life of an apple tree is considerably longer than that of a cherry tree. Door County is situated near good markets, such as Chicago, Milwaukee, and the Twin Cities and can successfully compete with western apples.

Clean, thorough cultivation is essential in cherry growing. The orchards are cultivated at regular intervals until about the 10th of July. In young orchards a cover crop is sown in the late summer or early fall. This serves as a protection during the winter and when plowed under in the spring it increases the supply of organic matter in the soil. In young orchards various cultivated crops are sometimes grown between the rows of trees. The soil would require thorough cultivation even if no crops were grown and this use of the land gives the owner a source of income before the orchard comes into bearing. Potatoes, beans, and strawberries are the crops usually grown in orchards. In old orchards no cover crop is ordinarily grown, weeds being allowed to grow up after cultivation is over for the season. The mature orchards are not plowed each year as are the young orchards, but are first worked with a disk harrow and cultivated during the season with some other harrow or cultivator. Most of the growers practice hoeing around the trees where the harrow can not be used. This not only kills the weeds but also covers up the old, fallen leaves in which are harbored fungous and other diseases.

Up to the present time the only fertilizer used in cherry growing has been stable manure. Best results have been obtained by applying manure yearly around the trees to cover

an area somewhat larger than the spreading branches. With young trees just coming into bearing there is danger of manuring too heavily, as heavy applications of fertilizer high in nitrogen may produce tree growth instead of fruit. It is probable that commercial fertilizers will have to be resorted to before long.

Spraying is recognized as a necessity in orcharding. To be effective, spraying must be done thoroughly at the proper time, and with the proper materials. The three most common cherry pests are the shot-hole fungus, the brown rot, and the black aphis. The most common pests of the apple are the codling moth, aphis, scab, oyster-shell scale, and fire blight.

"In the earlier days of cherry culture, when the life history of the shothole fungus was not fully known, its ravages ruined some orchards. Recently it has been shown that it overwinters on the fallen leaves, and with this understanding the burying of the leaves by early spring culture combined with a revised spraying program has given adequate control".*

The care and management of apple and plum trees is practically the same as that for cherry trees, except that the time of spraying and the kind of spray materials vary, with difference in the fungus and insect pests.

*From statement of Prof. L. R. Jones, Division of Plant Pathology, University of Wisconsin. This Division is constantly studying and investigating various plant diseases and pests which do injury to farm, garden and orchard crops. New programs for spraying, and improved methods of fighting these pests are being worked out. For special information concerning plant diseases, insect pests, and how to combat them, those interested should write the Wisconsin Agricultural Experiment Station, Madison, Wis.

## CLIMATE.

The climate of Door County is milder on the Green Bay side of the peninsula than on the Lake Michigan side. This is due to the fact that the lake being a much larger body of water is influenced much more slowly by the seasonal changes in temperature than are the waters of Green Bay. As the waters of the Bay warm up earlier in the season, and also reach a higher temperature than the waters of the lake, the land bordering these respective bodies of water is influenced accordingly.

The average annual precipitation for Door County is a little over 31 inches. The greater part of the precipitation comes during the growing season, when most needed. During each of the six months from April to September, inclusive, the mean rainfall reaches 2.5 inches or more. There are times, however, during nearly every season when crops suffer from lack of moisture.

The Weather Bureau Station at Sturgeon Bay is located on the Ship Canal near Lake Michigan, and but little above the level of the lake As the following records were secured from this station they represent only the condition which prevails along the Lake Michigan shore. Observations over a number of years, and the practical farming experience of the region indicates that the growing season on the Green Bay side of the peninsula is approximately two weeks longer than on the lake side.

The mean temperature for the three winter months as recorded at Sturgeon Bay is 20.4° F. and for the months of June, July, and August, 63.9° F. The average date of the first killing frost in the fall as recorded at Sturgeon Bay for the seven-year period 1909 to 1915, inclusive, is October 2 and that of the last in the spring May 25, giving the region in the immediate vicinity of the Weather Bureau Station an average growing season of 129 days. This is practically as long as the growing season at North Yakima, Wash., and Hamilton, Mont., the centers of the two leading fruit districts of the West.

The favorable climate of Door County is the principal factor in making it such an important fruit growing district. The winters are milder than in regions farther south removed from lake influences, they are freer from prolonged cold snaps, and the snow which covers the ground almost continually from De-

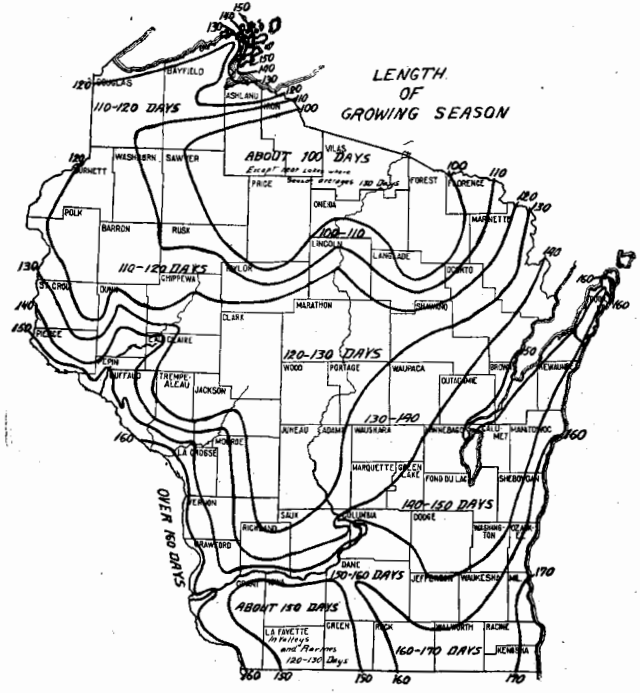



Fig. 2.—Map showing length of growing season for corn.

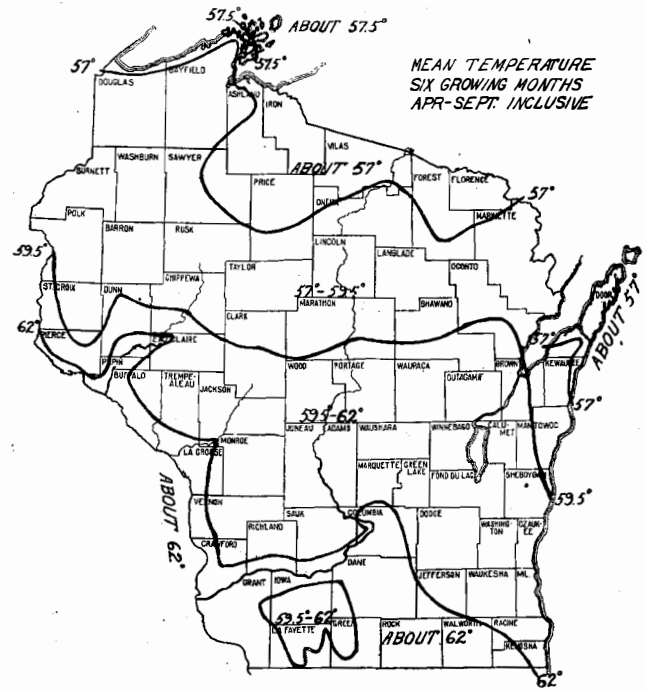



Fig. 3.—Map showing average temperature for the six growing months April to September, inclusive. Note that the difference between the average temperature for the area surveyed, and the southern portion of the State is only slight.

cember 1 to April 1 prevents deep freezing of the soil. There is an absence of the extremes in temperature which permit of alternate freezing and thawing in the winter. The cool waters of Lake Michigan and Green Bay cause late springs, which retard blossoming until the danger from frost is passed. The summers are cool and clear, with a comparatively uniform temperature from beginning to end, so that the fruit develops properly and produces good quality and color. In the fall the surrounding water, being warm from the summer's heat, prolongs the season and wards off early frost, enabling the fruit buds to develop properly and the new growth to mature.

In the following table are shown the normal monthly, seasonal, and annual temperature as recorded at Sturgeon Bay, and the normal and extreme monthly, seasonal, and annual temperature and precipitation as recorded at Green Bay:

*Temperature and precipitation at Sturgeon Bay and Green Bay.*

| Month. | Temperature. | | | | Precipitation at Green Bay. | | |
|---|---|---|---|---|---|---|---|
| | At Sturgeon Bay | At Green Bay. | | | | | |
| | Mean. | Mean. | Absolute maximum. | Absolute minimum. | Mean. | Total amount for the driest year. | Total amount for the wettest year. |
| | °F. | °F. | °F. | °F. | Inches. | Inches. | Inches. |
| December | 24.7 | 21.3 | 52 | −21 | 1.81 | 1.78 | 0.99 |
| January | 18.7 | 14.6 | 51 | 36 | 1.69 | 1.96 | .91 |
| February | 17.9 | 17.2 | 59 | −33 | 1.60 | .74 | .83 |
| Winter | 20.4 | 17.7 | 59 | −36 | 5.10 | 4.48 | 2.73 |
| March | 26.6 | 26.8 | 82 | −23 | 2.40 | .41 | .87 |
| April | 39.7 | 40.7 | 84 | 11 | 2.44 | 1.21 | 2.75 |
| May | 49.0 | 54.5 | 91 | 26 | 3.57 | 4.28 | 4.42 |
| Spring | 38.4 | 40.7 | 91 | −23 | 8.41 | 5.90 | 8.04 |
| June | 60.4 | 65.1 | 100 | 34 | 3.55 | 2.37 | 8.68 |
| July | 65.7 | 69.5 | 100 | 43 | 3.51 | 1.44 | 4.95 |
| August | 65.7 | 67.0 | 98 | 40 | 3.10 | 3.71 | 5.25 |
| Summer | 63.9 | 67.2 | 100 | 34 | 10.16 | 7.52 | 18.89 |
| September | 59.5 | 59.1 | 95 | 25 | 3.12 | 1.24 | 4.86 |
| October | 47.6 | 47.1 | 84 | 8 | 2.37 | .40 | 1.73 |
| November | 34.7 | 32.5 | 69 | −12 | 1.96 | 1.50 | 1.78 |
| Fall | 47.3 | 46.2 | 95 | −12 | 7.45 | 3.14 | 8.37 |
| Year | 42.6 | 43.0 | 100 | −36 | 31.12 | 21.04 | 38.03 |

SUMMARY.

Door County is situated in the eastern part of Wisconsin, on Lake Michigan. It lies within the glaciated-limestone region and its surface varies from undulating to gently rolling. Over much of its area the soils are shallow and quite stony. Its total area, including Washington and Chambers Islands, is 469 square miles or 300,160 acres.

The first permanent settlements in Door County were made about 1852. The county was originally heavily wooded, and for a long period lumbering was the chief industry. Nearly all the desirable land in the county is now in farms, and much of the soil is under cultivation.

The population, 1910, was 18,711. Sturgeon Bay, the county seat, had, in that year, a population of 4,262.

There are only about 15 miles of railroad in the county, but good wagon roads and automobile stage lines reach all sections.

The Late Wisconsin drift is the surface formation covering Door County. The bedrock is Niagara limestone. The red clay extensively developed in the southern part of the county is of lacustrine origin, but since its deposition has been modified more or less by glacial action.

Excluding Rough stony land, Peat, Much, and Beach sand, 6 soil series are recognized in the county.

The Miami series consists of light-colored, timbered upland soils derived from glacial limestone material. This is the most extensive and important series in the county. The loam is the predominating type, and it is on this soil that most of the cherries are grown. The silt loam is well adapted to general farming, and dairying is becoming an important industry.

The Superior series is derived from both lake-laid and ice-laid material, and is characterized by having heavy, red clay in either the surface soil or subsoil. The loam is the predominating type, but there is also considerable acreage of the clay loam and fine sandy loam. The soils of this series make an excellent general farming land, well adapted to dairying.

The Poygan loam is closely associated with the Kewaunee and Superior soils and is of the same origin, but it has a black surface soil with a red clay subsoil. It occupies low, wet, and poorly drained areas where there has been a large accumulation of organic matter.

The Clyde series consists of black soils of alluvial or lacustrine origin occupying old lake beds, ponded valleys, or first-bottom areas along the streams. These soils are low and poorly drained, but they are very productive and give good yields when drained and improved.

The Fox series includes light-colored soils in glaciated-limestone regions occupying outwash plains or stream terraces. The series is not very extensive in this county.

The Plainfield sand and fine sand are of small extent and of little importance. They are light-colored soils of alluvial origin, derived largely from sandstone formations. They are loose and open, and droughty during at least a part of each growing season.

Peat occurs in numerous areas of varying size in different parts of the county. It consists of vegetable matter in various stages of decomposition, with small amounts of mineral matter. At present most of this land is wet and undrained and of no agricultural use whatever, but much of it can be drained and made into valuable land.

Muck includes highly organic soils intermediate between Peat and the Clyde soils. It is not very extensive in Door County.

Beach sand consists of material which has been washed on shore by the waves and blown by the wind so as to have a broken, bumpy topography. Much of it is shifting sand dunes, and it is of little value.

Rough stony land comprises steep, rocky slopes or rock outcrops where the land is too broken or the soil too shallow and stony for cultivation.

The agriculture of Door County embraces fruit growing, dairying, and the production of general fruit, canning, and truck crops. The cherry is the fruit most extensively produced. The climate and soil are apparently ideal for this fruit, and over 3,500 acres have been set in orchards. The apple also thrives.

The climate of Door County is favorable for general farming dairying, and fruit growing. The mean annual temperature is about 43° F., the mean annual precipitation about 31 inches, and the average length of the growing season about 129 days. The waters of Green Bay and Lake Michigan stabilize frost occurrence and make conditions ideal, in this respect, for fruit growing.

The length of growing season as here indicated is based upon temperature records taken at the station on the Canal near the Lake Michigan shore, where the influence of Lake Michigan is very pronounced. The growing season on the Green Bay side of the peninsula is approximately two weeks longer than it is on the Lake Michigan side.

## 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 a map permanently. It the map is folded in such a way as to have the part you are interested in of a convenient size, and then have a simple frame with glass made to hold it, it can be kept indefinitely. Since some of the colors fade after being exposed to strong light for a long time, it would be a good plan to have a protecting flap of dark cloth over the map when not in use.