WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

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SOIL SURVEY IN COOPERATION WITH THE COLLEGE OF AGRICULTURE,
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SOIL SURVEY

OF THE

BAYFIELD AREA

WISCONSIN

BY
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OF THE
WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY
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UNITED STATES DEPARTMENT OF AGRICULTURE

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TABLE OF CONTENTS.

ILLUSTRATIONS.

PLATES AND FIGURES.

MAP.

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

SOIL CLASSES

SOILS CONTAINING LESS THAN 20% SILT AND CLAY

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

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

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

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

SOILS CONTAINING BETWEEN 20–50% OF SILT AND CLAY

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

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

Sandy clay.—Less than 20% silt.

SOILS CONTAINING OVER 50% OF SILT AND CLAY

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

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

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

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

Clay.—Over 30% clay.

Soils may be grouped in another way. Where soils are closely related through similar sources of the material from which derived, mode of origin, topographic position, etc., so that the different soils constitute merely a 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, 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 name of the *soil class,* which refers to texture, with the name of the *soil series,* which refers chiefly to origin, we get the *soil type,* which is the basis or unit of classifying and mapping soils. A *soil type,* thus, is a soil which is uniform throughout its entire extent in texture, color, topographic position, and other physical properties, and having a distinct agricultural unity, that is, being adapted to the same crops, and requiring the same treatment. It is also uniform in the source of material from which it is derived, and the mode of origin which, taken together, determine the chemical composition. Since the soil type is the unit in classifying and mapping soils, and the basis upon which experimental work should be conducted, every farmer should be familiar with the soil types on his farm, and their leading characteristics.

SOIL SURVEY OF THE BAYFIELD AREA, WISCONSIN

CHAPTER I.

GENERAL DESCRIPTION OF THE AREA.

The Bayfield area, covering 329 square miles, or 210,560 acres, includes portions of Bayfield and Ashland Counties, Wisconsin. It covers that part of Bayfield County lying east of the ninety-first meridian of longitude and north of 46° 30′ north latitude, together with that part of Ashland County included in Tps. 47 and 48, R. 4 W. on the mainland and the entire group of the Apostle Islands. This area is situated in the extreme northern part of the State, close to the western extremity of Lake Superior; and the surveyed portion of the Bayfield Peninsula, together with the adjacent islands, constitutes the most northerly land in Wisconsin.

In the region comprising this area and the adjacent country were the earliest white settlements in this section, exploration parties under Radisson and Groseilliers having visited it as early as 1661. Trading posts were early established to facilitate intercourse with the Indians at various points in this region, one of which, on the shores of Chequamegon Bay, was called La Pointe. This post, subsequently removed from te mainland to Madeline Island and familiarly known as the Old Mission, has become famous by its association with the memories of Allouez and Marquette. The agricultural development of this country until very recently has, however, been slow, notwithstanding the fact of its early exploration. The great wealth of its forests, which first attracted attention, and the subsequent discovery of the mineral resources of northern

Wisconsin were the inducements that brought about most of the development which has taken place. This whole region was originally peopled by the various branches of the Chippewa Indian Nations, which are now represented by but few individuals.

The earliest white immigration was from other portions of the then Northwest Territory, of which this region was a part, and from Canada, the latter settlers being mainly of French extraction. More recently the immigrants have been largely Scandinavians and Germans.

That portion of the Bayfield Peninsula included within this area is of a rolling and almost rugged character, possessing but a few level areas, none of which are of any great extent. It is a region of hills and valleys. The slopes of the former, however, are seldom steep enough to prevent cultivation, though in some of the latter the drainage is inadequate. The elevations rise at once from the shore line on the east in a sharp, terracelike ascent, while on the north the shore line is characterized by a continuous line of precipitous bluffs of red sandstone or red clay from 10 to 50 feet in height, from which the rise is very sharp, elevations of 200 and even 300 feet being found at distances of from a few hundred feet to about a mile from the shore line in the northern portion of the peninsula. Proceeding southward the shore line loses much of its ruggedness, and the land along the shore assumes a more gently rolling character, that bordering on Chequamegon Bay on the south being low and level for a considerable distance inland. That part of Ashland County located on the mainland and included in this area lies mainly to the south of the city of Ashland. It extends from the lake front in a series of gentle rises and level stretches, reaching its maximum elevation in the southeastern part of the area, and forming a gently rolling plain somewhat dissected by depressed streams and gullies.

The surface features of the Apostle Islands are somewhat varied. The shore line of practically all of them consists of bluffs from 20 to 100 feet high, with here and there a few sand beaches, from which there is a gradual rise toward the cen-

ter. Stockton, Ironwood, Michigan, Cat, and Sand Islands are somewhat saucer shaped, their interiors being slightly depressed or at least nearly flat. The topography is usually gently rolling, or has a gradual slope from the bluffs along the lake to the interior. Oak Island is the highest and most rugged, reaching an elevation of 420 feet above the lake. This is higher than any part of the mainland within a few miles of the lake shore. The elevation of the other islands ranges from 20 to 150 feet above the lake.

In the northern part of the Bayfield Peninsula, numbers of small streams, together with Sand and Raspberry Rivers, afford an excellent system of surface drainage for much of this country. In areas of Superior clay considerable erosion has taken place along these stream courses. The sandy loam, however, permitting the passage of the water downward, rather than tending to create surface flow, is not so greatly affected. By reason of the rolling character of the surface, there are many depressions in this section in which the drainage from the adjoining hillsides collects, and from which it can escape but slowly, resulting in the formation of swampy spots. These are of frequent occurrence, but are usually of small individual extent. At present but little attempt has been made to drain the greater number of these areas, though as agricultural development progresses, they will doubtless all be reclaimed.

South of Ashland the slope is generally northeastward, the drainage being effected through the White River and other streams, into which many small streams find their way. Owing to its nearly level topography and to the impervious character of the soil and subsoil, much of the land lying south of the city is but poorly drained. The soil in this region is so retentive of moisture, and storm waters run off so slowly, that, as agriculture develops, it will be necessary to install drainage systems.

Until quite recently a large part of the area was a pinery of great value. White pine was the most valuable species found in the original forest, as well as one of the most abundant. Norway pine, hemlock, white and black spruces, balsam fir, white ce-

dar, and tamarack were also abundant. Deciduous and hardwood species were represented by birch, elm, oak, maple, basswood, aspen, hickory, and ash. Most of the available timber has been removed, and the areas of stump land are now overgrown with a dense seedling growth, consisting chiefly of birch and aspen. When the original growth of the valuable white pine was removed, no adult seed-producing trees were left standing; consequently there has been no reseeding. Had a sufficient number of trees been left for this purpose, there would now be a thrifty stand of young pines that in time would overcome the intruding birches and poplars and reclothe these lands with a forest as valuable as that which has been so destructively removed. Moreover, the conditions provided by the undergrowth of birch, poplar, and other deciduous species are admirably adapted to the protection of the tender evergreen seedlings.

A very small proportion of this area is cleared, the greater part being covered with the dense growth that sprang up when the timber was removed, and is still occupied by the stumps that mark the location of the former extensive forests. The cost of clearing and preparing these lands is considerable, yet the development that has taken place up to the present time indicates that satisfactory returns may be expected from capital judiciously invested in farming in this region.

Convenient transportation by rail and water puts all sections of this area in close communication with outside points as well as those places located within its limits. The Northern Pacific, Minneapolis, St. Paul & Sault Ste. Marie (Wisconsin Central), and Chicago & Northwestern Railway systems all enter this area, giving rapid transportation facilities to Duluth, St. Paul, Minneapolis, Milwaukee, and Chicago, as well as to the many smaller towns of the State and to the rapidly growing places in the iron and copper country. Besides the trains, daily boats ply between Ashland, Bayfield, and Washburn, and a ship-line connects Bayfield with Duluth, running three boats weekly each way.

The chief city of the area is Ashland, a place of about 12,000 population. It is the shipping point for large quantities of iron

ore and has ore and coal docks of great capacity. Here also are extensive lumber mills, a blast furnace, and a wood-alcohol works. It is supplied with electric lights and a street railway, and has waterworks and a sewerage system. There are churches of various denominations and many graded schools. The high school is an imposing building, said to be equal in both equipment and structure to any in the State. The city has wide streets, on which are located many good business blocks, banks, hotels, and residences.

Washburn, the next town in point of size, has a population of about 4,000. It is the county seat of Bayfield County, and is a brisk and thriving town, possessing good graded and high school buildings, numerous churches, a newspaper, banks, and retail business houses. Large sawmills and extensive lumber docks are located here. It is connected by rail and ferry with Ashland.

Bayfield has long been known as a resort for hay-fever sufferers, being one of the few places where victims of that malady are said to obtain immunity from their sufferings. It is a picturesquely located hillside town of about 2,000 population, situated near the northern end of the peninsula, directly overlooking the Apostle Islands. It has extensive lumber interests and sawmills. Many hundreds of tons of Lake Superior whitefish, trout, herring, etc., are shipped from this point annually. It is connected with points outside of the area by the Chicago & Northwestern Railway system, and by that route and by ferry with Ashland. Frequent communication is kept up with Madeline Island, 2 miles off the mainland, and others of the Apostle Islands. It has numerous graded schools, a fine high school, a public library, and churches of many denominations, as well as good retail stores, and banking and hotel facilities. Bayfield is the center of a highly promising fruit-raising section, and a large area of small fruits, apples, and cherries is being developed, the direct result of the highly satisfactory yields and quality of the products obtained in this vicinity.

SOILS.

The soils of the Bayfield area are of glacial and lacustrine origin. The glacial material consists of a heterogeneous mass of stones, sand, silt, and clay, and belongs to the Late Wisconsin stage of glaciation. This mass of material, forming the local soils of the present day, was brought into the area from the northeast over the country now occupied by Lake Superior. The depth of the loose material over the underlying rock varies greatly, ranging from a few feet to several hundred feet. The hills in the vicinity of Bayfield, as well as the Kettle Range, are largely derived from this drift. Since its deposition some erosion has taken place, serving to accentuate the rough topography prevailing over part of the area.

Coming from Canadian shores, as the glacier did, a part of the deposit, and especially the coarser particles, is very different from the rock on which it rests, and covers quite a wide range of mineralogical material. A considerable percentage of the drift, however, is of local origin and consists of the ground-up particles derived from the underlying red Potsdam sandstone. Many of the stones and bowlders of foreign origin are striated or scratched with deep grooves.

The lacustrine material, or what might be more properly classed as glacio-lacustrine, was probably deposited prior to the advent and retreat of the Late Wisconsin glacier when the lake stood at a much higher level than at present. The beds of heavy red clay which were thus formed were later modified somewhat by the advance of the ice sheet. In places the clay was picked up by the ice or pushed along and mixed with the material already carried by the glacier. It is this modification by glacial action which accounts in part at least, for the presence of pebbles and some bowlders in the clay on the Bayfield Peninsula and in the vicinity of Washburn, for the more uneven topography in these localities, and also for the mixture of clay and sand which is found in some places as the subsoil of the Superior sandy loam. The level topography and the almost entire lack of pebbles and bowlders south of Ashland

indicates that the clay beds there were not influenced to so great an extent by glacial action.

As only a small proportion of the area is improved, and as most of the region is cut-over land covered with a dense second growth, fallen trees, brush and stumps, it is much more difficult to map than well settled regions. On account of these conditions it was found impracticable to separate and indicate all of the minor variations in the soil. The map is, therefore, somewhat more general than the detailed areas in the southern portion of the State.

The names of the several types of soil mapped in the area, together with their actual and relative extent, are given in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Superior clay	112,576	53.4	Beach sand	1,792	0.9
Superior sandy loam	81,344	38.6	Superior silt loam	1,472	.7
Coloma gravelly sand	8,128	3.9	Genesee loam	320	.2
Marsh (containing areas of swamp)	4,928	2.3	Total	210,560	.....

CHAPTER II.

GROUP OF CLAY AND SILT LOAM SOILS.

SUPERIOR CLAY.

Description.—This type of soil, one of the most extensive in the area, is a heavy, compact clay of pinkish-red to light chocolate red color, with no apparent difference in color or texture between the soil and subsoil. After being properly cultivated for a few years, the soil appears to become lighter in texture and looser in structure, and to approach a brown color. This is due to mellowing effect of cultivation and to the incorporation of organic matter. When wet it is very adhesive and plastic; in drying it cracks on the surface, and both soil and subsoil have a tendency to break into cubical blocks or grains.

The surface frequently has a covering of from 1 inch to 3 inches of grayish silty material, from which the clay particles have doubtless been removed, and with which are incorporated varying quantities of organic matter. In many places, however, this covering has been entirely eroded. Small areas of sand, forming a thin layer over the clay, are sometimes found, but areas of this character are usually of too limited extent to be indicted on the map. Small depressions or flat areas of poor drainage, locally known as swamps, are found. Most of these patches may be readily drained when cleared, and as the soil differs from the better-drained areas chiefly by having a higher organic matter content, and as the patches are of small extent, they have not been separated.

In both soil and subsoil are sometimes found fragments of rocks and rounded pebbles, with an occasional bowlder. These are most common in that portion of the type lying near Washburn and farther north on the Bayfield Peninsula, where the

clay is more closely associated with the moraine, and where it has been somewhat modified by glacial action. This modification doubtless accounts for the texture being slightly lighter in these localities than it is in the southern part of the area.

Extent and distribution.—This is the most extensive type in the area and occupies 53.4 percent of the region surveyed. Extending south from Ashland, and northward along the west shore of Chequamegon to a point about 6 miles north of Washburn, its extent is broken only by a few small patches of Superior sandy loam. The type is extensively found in the northern part of the Bayfield Peninsula also, and it occurs on some of the Apostle Islands. On Madeline and Sand Islands it is the predominating type.

Topography and drainage.—The surface of this type varies from level to gently rolling and even rolling in a few places. The level tracts are found chiefly in the region west and south of Ashland. As found on the Bayfield Peninsula the surface is frequently more rolling. The rolling phase is not as extensive nor as important as the level portion of the type. Superior clay is very retentive of moisture, and the impervious character of the subsoil, together with its generally level topography, makes the problem of drainage a highly important one. Much of the type in this area, in its natural condition, is very deficient in this respect, and its surroundings are such as to present difficulties in establishing an adequate drainage system. Tiles are found to work well, notwithstanding the seemingly impervious nature of the subsoil. Reliance is at present chiefly put in open ditches, so arranged as to remove quickly the surface water, and but little tile draining has been done in this area. Experience has shown the system of shallow surface drains to be very effective, and since such drains can be readily and cheaply constructed, they are recommended for general use at the present time. On the level tracts tile drains are necessary, and on some of the gently rolling or sloping land, though not absolutely essential, they are beneficial. Where the farms are more highly developed and the financial condition of the

landowners will permit, tile drains should be installed where drainage is the most deficient.

Origin.—The type is a lacustrine deposit laid down probably prior to the Lake Wisconsin stage of glaciation and later influenced in varying degrees by the ice sheet. In this area it occurs chiefly on the nearly level plains in the southern part and as a more rolling bench along a portion of the northern and eastern shore line. On some of the islands and in the northern portion of the area, its position on the slopes seems to indicate that it was at one time overlain by a covering of the sandy material now found on the higher elevations, but which has since been removed. This type is highly susceptible to stream erosion, and when found occupying even slightly rolling plains, it has frequently become deeply gullied along the stream courses.

Native vegetation.—The original growth of white pine and other conifers in the south half of the area has been entirely removed, and on the uncultivated portions of the type in this region there has sprung up a thrifty growth of aspen and poplar. In the northern part of the area on the Bayfield Peninsula there is considerable hardwood, chiefly maple, birch, and hemlock, and some of this is still in virgin forest.

Present agricultural development.—Where favorably located, Superior clay is a strong soil and is eminently suited to the production of grasses and clover for mowing as well as for pasturage. Potatoes, mangels, turnips, and corn are being grown with success. Early varieties of corn for silage can be grown on all of the type. Some corn has been matured, and very satisfactory yields secured. Peas do very well, and yields of 33 bushels per acre have been secured. Wheat has yielded from 25 to 32 bushels per acre on the Experiment Station farm, and potatoes average 150 bushels, with a maximum yield of 320 bushels per acre. While good yields of potatoes are secured, the soil is heavy and rather difficult to handle for this crop. Clover does very well, and some alfalfa has been successfully grown on well-drained areas of small extent.

After a few years of proper cultivation, especially when clover is grown, this soil becomes much more loamy and more

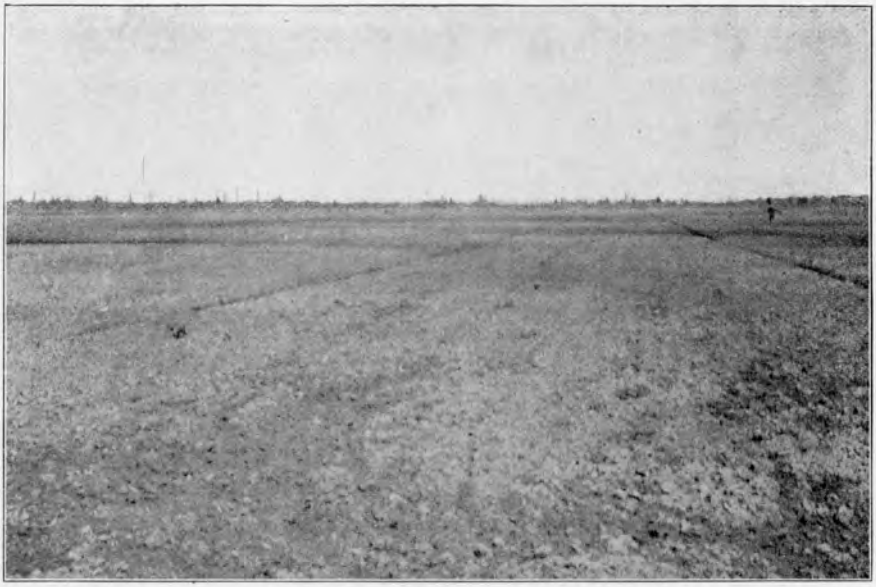

FIG. 1. VIEW OF SUPERIOR CLAY SOUTH OF ASHLAND, SHOWING CHARACTERISTIC TOPOGRAPHY.

The natural drainage of the Superior clay is deficient. This field has been seeded, and shallow open ditches have been constructed to assist in carrying off the surface water.

WISCONSIN GEOL. AND NAT. HIST. SURVEY. PLATE I.

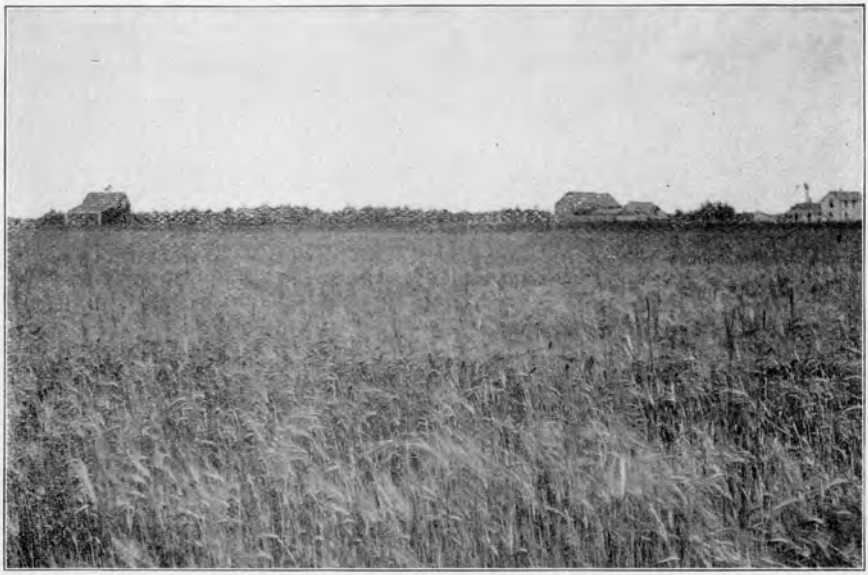

FIG. 2. VIEW OF SUPERIOR CLAY WHERE THE LAND HAS BEEN TILED.

The drainage of the Superior clay improves the physical character of the soil, and insures larger yields. This field of barley shows a thrifty, vigorous growth, and the stand is uniform.

easily worked. The type is well adapted to general farming and dairying, and development is now well under way along these lines, especially in the vicinity of Ashland and southwest of Washburn.

*Methods of improvement.**—The chemical composition of Superior clay shows it to have considerable amounts of most of the essential elements of soil fertility. It is only moderately well supplied with phosphorus, however, and where heavy crops are produced and especially where grain or hay is sold from the farm and comparatively little concentrated feed stuff purchased, it will be found profitable to use commercial fertilizers containing this element. The total amount of potassium is large, as is the case with all members of the Superior series of soils. The total amounts of organic matter and nitrogen are only fair and should be increased. The surface soil is often more or less acid, but the subsoil is well supplied with lime, so that while moderate applications of some form of lime may be necessary on much of this type of soil to permit clover and alfalfa to make their best growth, it is very probable that when alfalfa is well established and drawing on the subsoil, much less lime will be needed than on the more acid sandy soils.

In order to render this type more open and porous, and better to effect the ventilation and aeration of it, the use of coarse stable manure or the plowing under of green manuring crops is to be recommended. Wherever such a course has been followed a marked improvement has resulted in every instance. Good crops of wheat, peas, turnips, rutabagas, and potatoes have been obtained in the second year following such treatment. The question of drainage† should be given careful consideration. While tile drainage is not essential, except in a few instances, it is very desirable, even where there is a gentle slope.

From the results obtained on the Experiment Station farm near Ashland, it appears that the best way to subdue and improve this type is to practice thorough cultivation and to follow

* See Wisconsin Bulletin 202, The Management of Heavy Clay Soils.
† See Wisconsin Bulletin 329—The Right Drain for the Right Place.

a definite crop rotation, plowing under a crop of clover occasionally. A rotation which has given good results consists of small grain—wheat, rye, oats, or barley—the first year, seeded with clover and a little timothy; the second year clover, the first cutting being for hay and the second left for seed; the third year, mixed clover and timothy. The sod is manured either before plowing in the fall, or on the plowed field during the winter. The fourth year a cultivated crop should be grown.

Uncleared, cut-over land of this type can be bought for $12 to $25 an acre. Farms of similar soil, cultivated and improved, in Fond du Lac County can not be bought for less than $100 an acre.

The following table shows the average results of mechanical analyses of the Superior clay, both soil and subsoil:

Mechanical analyses of Superior clay.

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.....	0.6	2.8	4.7	11.6	12.6	31.3	36.4
Subsoil.....	.9	3.9	6.0	13.9	14.2	29.8	31.3

SUPERIOR SILT LOAM.

Description.—Superior silt loam, to a depth of about 12 inches, consists of a reddish or chocolate colored, very fine sandy or silt loam, underlain by silt or very fine sandy loam. But little difference in color exists between soil and subsoil, which latter merges at an increasing depth into stiff red or brown clay. This type is recognized solely by the percentage of silt present in both soil and subsoil, and by the absence of rock fragments and gravel so commonly met with in Superior clay.

Extent and distribution.—The type is of limited extent, occupying only .7 per cent. of the area, or approximately 1,472

acres. It is confined to a few small scattered acreas in the northern part of the Bayfield Peninsula.

Topography and drainage.—The surface of the type varies from nearly level over small tracts to gently rolling and rolling. Over the more level portions the natural drainage is deficient, and tile drains should be installed before the best results can be expected.

Origin.—This type is a lacustrine deposit of glacial material, but has been considerably reworked. It occupies an intermediate elevation between Superior clay and Superior sandy loam. The depth to which its surface and intermediate layers have been laid down over the red clay is extremely variable.

Native vegetation.—The original timber growth of hemlock, spruce, and pine has been nearly all removed and is now succeeded by gray birch and popular.

Present agricultural development.—Only a small proportion of Superior silt loam is under cultivation but from results thus far obtained the type has proven to be a good general farming soil, and when improved will be adapted to the same crops as Superior clay. It is a lighter soil, however, and can be cultivated with less difficulty. It may also be adapted to a wider range of crops.

Methods of Improvement.—The chemical composition of Superior silt loam does not vary largely from that of the Superior clay as given on page 21. In most cases it has a somewhat higher amount of organic matter and also has a somewhat larger amount of lime in the subsoil, though the surface soil is in many cases slightly acid. Its improvement in fertility should be along the lines suggested for the management of Superior clay as stated on page 21.

Like Superior clay, its most profitabe use would probably be in connection with dairying as pasture or mowing lands for the production of hay, both grass and clover doing well on it. By applying stable manure or by having green crops plowed under to supply organic matter so much needed by this type, marked increases in these crops will be obtained. Such treatment also is necessary if root crops of any kind are

to be grown on it. On one farm in the area it has been recently planted to strawberries, but it is too soon to determine its fitness for their production.

The following table gives the results of mechanical analyses of soil and subsoil of Superior silt loam:

Mechanical analysis of Superior silt 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.....	0.4	0.9	0.8	2.0	1.6	82.1	12.2
Subsoil.....	.0	.0	.0	1.0	4.6	67.1	27.4

CHAPTER III.

GROUP OF SANDY SOILS.*

SUPERIOR SANDY LOAM

Description.—Where typically developed the surface soil of Superior sandy loam, to a depth of 12 to 18 inches, consists of a gray to brownish sand or light sandy loam of fine to medium texture, usually becoming somewhat loamy with increased depth. At 18 to 24 inches it passes into a stiff, tenacious red clay. Occasionally at the lower depths the clay subsoil is interstratified with layers of fine sand and pockets of sand are sometimes found. The subsoil is the same material as the Superior clay, and where exposed in road cuts or by stream erosion, it exhibits the same tendency to break up into cubical particles and to crack and check. A characteristic of the type is the presence on the surface of rounded stones and bowlders, the latter in places in such quantities as to interfere with cultivation.

Areas of this type, as described, occur in the vicinity of Bayfield and along the north shore of the Bayfield Peninsula. The greater proportion of the soil on the Apostle Islands is also typical. There are, however, areas of considerable extent on the mainland, where the soil varies considerably from the description given above. The most important difference is that the clay subsoil is not always within 3 feet of the surface, and in a number of places it undoubtedly lies more than 6 feet below the surface. The surface soil in such places consists of a medium to fine loamy sand, which usualy grades into a loose, incoherent yellow or brownish sand of medium texture. A small quantity of gravel is sometimes found upon

* See Wisconsin Bulletin 204—"The Improvement of Sandy Soils."

the surface and also in the lower subsoil. On account of the irregularity of these variations, the fact that the clay may be found coming to the surface in places throughout the deep sand areas, and considering that the country is largely undeveloped cut-over land, thickly grown up with brush which makes it very difficult to get over, separation of the several types could not be satisfactorily made.

Superior sandy loam is confined chiefly to the north half of the area and to the Apostle Islands, though there are a few scattered areas in the southern part of the survey.

It is the second type in the survey from the standpoint of acreage and comprises 38.6 per cent. of the area surveyed.

In topography this type is gently rolling to hilly. On some of the islands and also on a portion of the mainland it occupies gentle slopes, but much of it is steep, though never too steep to be cultivated or put in orchards.

On account of its topography and texture, the natural drainage is good. Where the clay subsoil lies at considerable depth below the surface, crops may suffer from lack of moisture during extended dry spells.

In origin the material composing Superior sandy loam is derived from two sources. The sand, gravel, and bowlders are all of glacial origin, while the underlying clay is lacustrine material which has been influenced more or less by glacial action.

The original timber growth consisted of pine, hemlock, maple, birch, and spruce. All of the pine and the best of the other timber has been removed. The second growth consists chiefly of birch and poplar. The clearing of the underbrush and the removal of the stumps is a difficult task and requires a great deal of labor. The cost of clearing and getting the land ready for the plow varies from $30 to $75 an acre.

Present agricultural development.—Only a comparatively small percentage of Superior sandy loam is under cultivation. As a rule it possesses good surface and internal drainage, is easily tilled, and is warm, responsive soil. It is the predominance of this type in the vicinity of Bayfield that has earned for that place its reputation as a fruit-producing center.

VIEW OF SUPERIOR SANDY LOAM, FOUR MILES WEST OF WASHBURN, SHOWING CHARACTERISTIC SURFACE FEATURES.

Fruit growing has developed to a greater extent on this type of soil than on any other in the Bayfield area. This cherry orchard was planted on new ground, and while the trees are young, other profitable crops are being grown on the same field.

Superior sandy loam is especially adapted to the production of small fruit and truck crops. Apples and cherries also do well when the location is suitable. Good crops of clover, timothy, potatoes, peas, and root crops are obtained. Corn for silage can be readily grown and some has been matured. Alfalfa has been successfully grown. The greatest returns from this type are secured from strawberries and bush fruits which come on the market after berries from other sections are gone and when there is a good demand.

In view of its adaptation to a wide range of crops and the fact that it warms up more rapidly in the spring than the heavier soils, this type is probably the most valuable in the area.

Method of Improvement.—The chemical analysis of Superior sandy loam shows that the heavy subsoil is essentially the same in chemical character as that of Superior clay. In fact it has the same subsoil, but with a sandy surface soil. In chemical composition the sandy surface soil of this type is somewhat lower in total phosphorus than Superior clay; the average number of pounds of phosphorus for the surface 8 inches of an acre being approximately 600 pounds; of potassium approximately 25,000 pounds; and of nitrogen 1300 pounds. The organic matter, while somewhat larger in amount than in Superior clay, should still be increased to furnish an adequate supply for the development of available phosphorus, potassium, and other mineral elements. The surface sandy soil is rather low in lime,* but the subsoil is, in most cases, well supplied with this substance, so that while light liming of the

* As this type is frequently in an acid condition, and this and other soils in the area would be benefited by the application of lime, every farmer should know how to test his soil for acidity. "A very simple and reliable method to detect soil acidity is by the use of blue litmus paper, which can be secured of any good druggist. Take a handful of moist soil and form it into a ball. Break the ball into halves and place a piece of blue litmus paper in the center on one of the halves, and cover with the other half. After 5 minutes break the ball, and if the paper is pink in spots or over the whole end, the soil is acid." "Soil acidity is also usually indicated by the growth of certain weeds, such as sheep sorrel, horse-tail rush, corn spurry, and wood horse-tail." For more information on this subject, see Bulletin No. 230 of the Wisconsin Experiment Station on Soil Acidity and Liming.

surface will undoubtedly be helpful in promoting the growth of clover, it is not likely that as large amounts of this material will be needed on these soils as will be necessary on soils where the acidity is greater.

Land values are gradually increasing, as a result of the development of the fruit industry. Ten years ago most of the land in the vicinity of Bayfield could have been bought for $5 an acre, or less. At present the areas suitable for orchards sell for $25 to $50 an acre, and even more than this if especially well located.

The following table shows the average results of mechanical analyses of the soil and subsoil of Superior sandy loam:

Mechanical analyses of Superior sandy loam.

Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Soil	2.8	14.3	20.4	25.5	14.7	14.1	8.1
Subsoil	1.4	6.4	8.9	14.6	11.2	23.3	34.2

COLOMA GRAVELLY SAND

Description.—Coloma gravelly sand is a yellow to reddish or chocolate-colored, loose, incoherent sand, ranging from medium to coarse texture, underlain by light-red or brownish-red sand of much the same character and texture as the surface layer. Frequently the surface inch or two is of light to dark gray color, sometimes approaching black, as a result of the presence of organic matter and weathering. Both soil and subsoil carry a large percentage of rock fragments and gravel. These are of various materials among which have been recognized red, brown, and gray sandstone, granite, and other crystalline rocks, quartz, agate, and amorphous igneous rocks. Bowlders are of frequent occurrence both on the surface and in the soil and subsoil.

Scattered throughout the type are areas where the soil is somewhat heavier and better than typical. Such areas, however, could not be separated and mapped on account of their small size and the undeveloped condition of the country.

This type is of comparatively small extent and occupies only 3.9 per cent. of the area surveyed. It is confined chiefly to the west central portion of the area, northwest from Washburn from 4 to 8 miles. A small tract is found at Bayfield and another somewhat larger about six miles to the southwest, on Blueberry Ridge.

This type generally occupies the higher elevations, though occasionally it is found protruding into the valleys. As found in this area the type forms a series of rounded knolls or hills, forming a part of the Kettle Range.

The natural drainage is excessive and when brought under cultivation crops will doubtless suffer from lack of moisture during portions of the growing season.

The type is of glacial origin and is made up largely of unassorted morainic material.

The original growth was pine, which has been practically all removed, and in its place there has sprung up a somewhat sparse and unthrifty growth of birch, with an occasional poplar. The undergrowth is sumac and huckleberry, with a ground covering of wintergreen and other low growing or creeping species. In the low-lying, damp localities some hemlock, maple, and black alder are to be found growing upon it.

There are also tracts of maple and hemlock on soil of the higher areas, but such tracts are of comparatively small extent.

Present agricultural development.—Only a very small proportion of the type is under cultivation. Where typical it is less productive than any of the other soils with the exception of Beach sand. Where heavier than usual, and where the surface is not too broken, it will be a fair soil when brought under cultivation.

Method of improvement.—Coloma gravelly sand, as indicated by a single analysis which has so far been completed, has approximately 625 pounds of phosphorus, 33,000 pounds of potassium,

and 2,000 pounds of nitrogen in the surface 8 inches of an acre. It will be seen that in phosphorus it is nearly the same as that of the Superior sandy loam, and somewhat lower than that of the heavy Superior clay. It is rather low in phosphorus for soils which are to be heavily cropped, and the maintenance of a high degree of fertility will require the addition of some form of phosphorus as a fertilizer. The supply of potassium, while good in total amount, will require the presence of a larger amount of actively decomposing organic matter to render it available than these soils in their virgin conditions have on the average, so that the chief lines of improvement called for are organic matter and phosphorus. While only slightly acid at present these soils have relatively little calcium carbonate, either in the surface or subsoil, and the use of ground limestone or other form of lime will be of great benefit in the growing of clover or alfalfa—those crops which are most helpful in increasing the nitrogen and organic matter of the farm. In case of fruit lands, cover crops of some legume should be grown where an increase in the fertility is desired, though in many cases it is probable that a more mature and fruitful growth will be made without increasing the fertility of these soils to any considerable extent than would be the case if they were managed in such a way as to add largely to the organic matter, as would be desirable in raising staple agricultural crops.

CHAPTER IV.

GROUP OF MISCELLANEOUS SOILS.

GENESEE LOAM.

Genesee loam is very limited in extent and subject to considerable variation. It consists of alluvial material which has been washed down from the higher lands and deposited by the streams in times of overflow. The type consists of a brown loam or sandy loam 12 to 16 inches deep, underlain by a sand or sandy loam.

Pockets of silt and clay are found in places, and the variations are so numerous that it is impracticable to separate and indicate them on the soil map.

Only one area of this type was mapped. This lies along the Sioux River, north of Washburn. Here the type is under cultivation and produces good crops of hay, potatoes, and fodder corn. Part of it is subject to annual overflow, but the water does not cover the land long enough to prevent its being cultivated.

Small areas of this type occur along some of the other streams in the survey, but they were too small to be shown in the map.

BEACH SAND.

Comparatively little Beach sand occurs in the area. Areas are found only in sheltered bays along the main shore and chiefly along the south and west shores of the islands, which are somewhat protected from severe wave action. The north and east shore of the islands and most of the mainland consists of rocky walls.

Beach sand consists chiefly of quartz sand and some rounded gravel derived from the rocks that cover the lake bottom. Some of the material is carried down by the streams from the sandy regions and some is washed from bluffs by the

waves. Long Island consists entirely of Beach sand. The other areas are narrow strips along the shore. Where most extensively developed, the sand occurs as a low ridge from 2 to 3 feet high. At the mouth of Sand River there are two such ridges, between the Marsh and the lake front. The oldest portions of the Beach formation support a slight growth of sand cherries, a wild vetch, and some blueberries.

MARSH (INCLUDING AREAS OF SWAMP).

Marshy spots, in their present condition entirely unsuited for cultivation, are found in a number of places throughout the area. Those at the mouth of Sand, Raspberry, and Sioux Rivers, and the largest areas on Madeline Island, consist chiefly of Peat which is but slightly decomposed. These places are very wet throughout the year, and it would be difficult to drain them, as they are but little above the level of Lake Superior. The small area 2½ miles northwest of Bayfield is also Peat. The Marsh west of Ashland has a mucky peat covering for a few inches or a foot, and is underlain with clay. The higher portions of it can be useds for cutting hay, but most of it is too wet and low to be easily reclaimed.

There are a number of low-lying areas throughout the region of Superior clay where the drainage is poor and where water stands part of the year. While these places are sometimes referred to as Swampy, they should not be considered as swamp, for as soon as the land is cleared they will drain out sufficiently to be cultivated, and the soil itself does not differ materially from Superior clay. Areas of this kind are to be found on Sand, Stockton, Michigan, Cat, and Ironwood Islands, as well as on the mainland.

The areas mapped as Marsh include only those which are in a wet, soggy condition for the greater portion of the year. The inland areas can doubtless be profitably drained when the surrounding country is more extensively developed, as the streams passing through them have considerable fall. The Marsh areas at the mouth of streams, however, are all so low and so near the level of the lake that drainage would be impracticable.

CHAPTER V.

GENERAL AGRICULTURE OF THE BAYFIELD AREA.*

There are at present but few well-developed farms in that portion of the area lying to the north and northwest of Bayfield. The average size of such farms as do exist is from 10 to 30 acres. The type of farming followed on these has of necessity been general, no attempt having been made at specialization until recently.

In the last few years the tendency has been toward the raising of small fruits, together with apples and cherries. In this particular section, where sandy loam soil predominates, conditions all combine to make these endeavors successful. The adaptation of the soil can not be questioned, and the climatic conditions are highly favorable. The luxuriant growth of grasses and clover here has induced some to venture into dairy farming, mostly in a small way. No creameries or cheese factories have been established in this neighborhood, as the amount of milk produced is small and is easily disposed of as whole milk or dairy butter, in the cities of Bayfield and Washburn.

In the southern portion of the area, in the vicinity of Ashland, markedly different conditions exist, and the distribution of different types of farming with reference to soil types is admirably illustrated by the conditions existing in this area. Just as the adaptation of the sandy soils in the vicinity of Bayfield has resulted in the production of special crops, so the advancement of dairying and stock raising has gradually developed on Superior clay in the southern part of the area. In this section the greater portion of this soil type is devoted to

* See Wis. Bulletin 196—Opportunities for Profitable Farming in Northern Wisconsin.

grazing and the production of grass for hay, to which it is especially well fitted. The city of Ashland provides a good market for milk and butter, and many dairy herds are being established. The number of these headed by purebred sires and the fine class of buildings provided for their housing indicate the success of this branch of agricultural industry in this vicinity. Where not consumed on the farms, hay is the chief marketable crop, and while much of the land in its present state is well suited for its production, it is advisable to grow hay only in connection with a regular crop rotation such as is suggested under the discussion of Superior clay. Moreover, the ready market for dairy products in Ashland and the adaptation of soil to grass and clover combine to make this type of farming profitable without requiring the installation of extensive drainage systems. In many fields the efforts in this direction are confined to constructing broad, open ditches to remove the surface water that accumulates from the melting snows and heavy rains. Under proper methods of cultivation and rotation, excellent crops of wheat, peas, turnips, rutabagas, and potatoes are raised. Several large droves of fine hogs are to be seen on farms in this section, the breeds most prominent being Berkshire and Poland China, and some farmers were observed to be pasturing both sheep and steers. The varieties of stock kept and the thrifty appearance of the surroundings indicate that stock raising in this section need not be confined to any one branch and testify to the profitableness of the business as a whole. This is as it should be in a section where on much of the soil such magnificient crops of clover, timothy, alfalfa, and pasture grasses can be grown. While somewhat far north for corn to ripen, good silage crops can readily be produced, and efforts are being made to perfect some new varieties that can and do mature in this section. As much as 50 bushels per acre of one of these varieties was recently harvested on a farm in this section of the State.

Except on Sand and on Madeline Islands, no agricultural development has been undertaken on any of the islands of the Apostle group. Sand Island has recently become the

FIG. 3. VIEW SOUTH OF BAYFIELD, WISCONSIN, SHOWING A GOOD ORCHARD SITE, BORDERING LAKE SUPERIOR. MADELINE ISLAND IN THE DISTANCE.

While the apple trees are coming into bearing other crops are grown on the same land. In this orchard strawberries and currants are bringing in very profitable returns.

WISCONSIN GEOL. AND NAT. HIST. SURVEY. PLATE III.

FIG. 4. VIEW TAKEN WITHIN THE CITY LIMITS OF BAYFIELD, WISCONSIN, OVERLOOKING LAKE SUPERIOR AND MADELINE ISLAND.

The sloping land bordering Lake Superior and Chequamegon Bay affords many excellent orchard sites, and the fruit industry is rapidly developing. This View shows a field of currants.

scene of some activity in small fruit production, with every prospect of success. Some general farming is followed on Madeline Island, together with a number of small ventures in fruit growing, and an experimental orchard has been established on it by the State of Wisconsin. On the remainder of the islands much timber is still standing, although in most cases the more valuable portion has been removed.

The predominating type of soil on the Apostle Islands is Superior sandy loam, and this is more uniform in its development than on the mainland. It is the opinion of horticulturists that the islands are as well adapted to fruit growing as the mainland. Clover, peas, potatoes, oats, and wheat are being successfully raised on Madeline and Sand Islands, and general farming and dairying will no doubt be developed along with the fruit industry. The spring season is a little later on the islands, but the modifying influence of the lake makes the date of the first killing frost in the fall somewhat later than on the mainland. It is not probable that extensive development will take place upon the islands as a whole until values on the mainland reach a higher point. The only objection to the agricultural development of the islands is their inaccessibility.

FRUIT GROWING*

There are a number of factors which should be in accord to insure the greatest success in the fruit growing industry, as indicated in Bulletin No. 201, Wisconsin Experiment Station, from which data has been taken to supplement this chapter. Chief among these factors are climate, soil, elevation, and exposure, any one of which if not in the proper relation with the other factors may be the cause of failure. While apples, cherries, and a number of small fruits are successfully grown in this particular region, the fruit belt is commonly considered as occupying the entire territory suitable to apple culture.

The climatic conditions throughout northern Wisconsin are not favorable for the development of the fruit industry, ex-

* See Bulletin No. 201, Wisconsin Experiment Station on Planting the Commercial Orchard.

cept in localities which are subject to the modifying influence of large bodies of water. The portion of the Bayfield Peninsula within the present survey, and especially those portions of the peninsula immediately bordering Chequamegon Bay, are favored in this respect. The effect of the lake is to retard growth in the spring until danger of late frosts is past and to prolong the growing season in the fall. The greatest influence is immediately along the shore, and this gradually decreases as the distance from the lake becomes greater. The modifying influence of the lake, most pronounced and of greatest value for fruit growing, extends from the lake shore to the first hill top, a distance which usually ranges from 3 to 5 miles. In some places this belt is of greater width. Beyond this region there is a secondary influence from the lake extending back about 25 mies from the shore, beyond the limits of the present survey, but this is not sufficient to insure favorable conditions for fruit growing except in a few instances.

The soil conditions over most of the Peninsula and throughout a portion of the remainder of the area surveyed are well suited to the development of the fruit industry. In the vicinity of Bayfield, Superior sandy loam is the predominating type and probably better adapted to fruit growing than any of the other soils mapped. South of Washburn, and also to the west, there are extensive areas of Superior clay. Wherever there is good surface drainage, this soil is somewhat lighter in texture than typical, and it is also well adapted to fruit growing. The country to the south of Ashland is too level, and the soil too heavy, for profitable fruit growing on a commercial scale.

The elevation throughout most of the fruit belt varies from about 50 feet or over, immediately along the shore, to from 200 to 400 feet above the level of the lake several miles inland. Throughout this region there are a large number of excellent orchard sites. The orchard site should always be sufficiently elevated above the adjacent land, and the surface should have enough slope, to insure good surface drainage as well as good air drainage.

"The exposure of an orchard site refers to the general direction of the surface slope. As a rule, in Wisconsin, a northern or northeastern slope is preferable. The trees are slower

in coming into blossom in the spring than when the orchard has a southerly exposure, and therefore there is less danger from late spring frosts. Near large bodies of water best results are secured by having the exposure towards the water*."

On the Apostle Islands, practically the same conditions exist as are found throughout the fruit belt on the main land, and considerable areas on them will, when cleared, doubtless prove suitable locations for fruit culture.

Another factor of great importance in fruit growing is the selection of varieties to which both soil and climate are suitable. For best results selection should be confined to varieties which, although doing well elsewhere, seem to be best adapted to the soil and climate of the particular region under consideration. The following list is not a catalogue of all varieties of fruit adapted to the environment of this area, but it embraces most of the varieties which past experience has shown to be suited to this region and to localities similar to the Bayfield area.

APPLES.

Less than half a century ago the idea was prevalent that apples could not be made a commercial success in the Northwest. To-day, however, there are hundreds of bearing orchards throughout this territory yielding tremendous crops of magnificent fruit which brings the highest prices in the markets of the world.

The conclusion first reached was the result of trying to introduce into this region the old standard varieties of the East, so long grown on soils and under climatic conditions entirely different from those of the newer region. None of these varieties, however, found the environment provided by the new location sufficiently congenial to enable them to uphold their reputation, which had been established under such very different surroundings. It was hoped that the introduction by the United States Department of Agriculture of a large number of varieties imported from Russia would solve the prob-

* From Bulletin No. 201 of the Wisconsin Experiment Station.

lem, and that by this means the Northwest could be supplied with varieties that would prove entirely suitable. After careful test, however, it was found that while some valuable sorts were obtained from this source, as a rule the Russian varieties were to early and none proved to be entirely suitable for winter keeping. This brought to the front some of our horticulturists who had been experimenting by making crosses and raising seedling, in an endeavor to produce varieties which should combine hardiness and quality. This work has resulted in the production of some varieties in which are combined the best qualities of the old familiar varieties of the East with those of the introduced Russian sorts, and as a result of this achievement of American horticultural science, successful apple growing in the Northwest is now an accomplished fact.

The varieties most extensively grown in the Bayfield area are the Wealthy, Duchess, Okabena, and Patten's Greening. Among other varieties which appear to be adapted to this region are University, McIntosh, McMahon, and Yellow Transparent. More extensive trials will doubtless show that there are a number of other varieties suitable for the Bayfield area.

Martha, Transcendent, and Whitney are crab apples possessing many good qualities and suitable for this area. While, of course, there are many other varieties of apples and crabs that would perhaps do well in this area, those mentioned are believed to be peculiarly suited to the environment, and are varieties with established commercial reputation.

PLUMS.

While plum culture may acquire an important place in the horticulture of the Bayfield area, this fruit has been grown for so short a time that a specific statement concerning the varieties best adapted to this region would not be justifiable at present. It appears, however, from the experience acquired to date that the native varieties of plums will be the ones best suited to the conditions of soil and climate existing in the area surveyed. Some European varieties have been tried out, and while not entirely hardy, considerable success has been attained in their culture.

VIEW NEAR BAYFIELD, WISCONSIN, ON SUPERIOR SANDY LOAM, SHOWING FOUR YEAR OLD ORCHARD OF DUCHESS APPLE TREES.

Two rows of strawberries are growing between the rows of apple trees.

CHERRIES.

Cherries have been grown successfully in this area for years. On many of the Apostle Islands the "Mission" cherry, as it is called, has been known for a long time and has become quite fully naturalized. It is supposed to have been introduced by the early French settlers. As the cherry will grow only on a soil that is well drained and free from constant moisture, it is especially adapted to cultivation on the rolling areas of sandy loam in the Bayfield district, and should by no means be planted on the moist, heavy clay. By reason of their superior hardiness, Early Richmond and Montmorency are the cherries recommended for this area. The English Morrell has also been quite largely planted.

APRICOTS.

As far as could be ascertained, the growing of apricots has not been attempted in this section, the impression being that this fruit is not sufficiently hardy. While this is true of many sorts, it yet remains a fact that there are many varieties of Russian origin that succeed where the other varieties can not be grown. Among the desirable sorts of this class, many of which will withstand a temperature of 30° below zero, which are recommended for trial, are Alexis, the fruit of which is large and attractive, being a rich yellow with red cheek; Superb, a golden yellow variety of large size, excellent quality, and very hardy and productive; and Budd, a late variety with large white fruit having a blush or red cheek, and perhaps the best of the late varieties for this region.

SMALL FRUITS.

Small-fruit cultivation has been uniformly successful throughout this area wherever undertaken. A careful consideration of the merits of many varieties of this class of fruits, together with a study of the soil and other conditions under which they are to be produced, leads to the selection of the following list of varieties suitable for cultivation in this area:

Of the red raspberries, the Marlboro, Cuthbert, and Miller are all desirable varieties, especially the last named. Among the black raspberries or "black caps," none are better suited for this section than Gregg, Older, and Winona. Eldorado has proved a highly desirable blackberry on the more sandy soils of this region, producing fine crops of excellent fruit. Snyder is also one of the very best blackberries for the north, being second in hardiness only to Stone's Hardy, itself a very prolific sort, of good quality, although the fruit is somewhat smaller than the Snyder. Wachusett, or as sometimes called Wachusett Thornless, is a variety of somewhat doubtful hardiness for this section, nevertheless it is worthy of trial upon the clay soils to which it is equally adapted as to the sandy types. This fact alone is deemed sufficient to warrant its mention as a variety likely to prove valuable in portions of this area.

The English varieties of gooseberries, while possessing great merit, have been found to be very much subject to mildew in certain localities, and for this area it does not seem wise to recommend them. Varieties derived from native species, although bearing somewhat smaller fruit than many of the British sorts will be found preferable. Among the best sorts for this area are the Industry, which with good care rivals the English varieties in size, and the Downey, Pearl, and Red Jacket, which are vigorous growers, free from tendency to mildew, and perfectly hardy in this area.

Currants can be grown in this area without difficulty, and are to be seen in many gardens and dooryards. For commercial culture the Cherry, Red Dutch, Perfection, and Fay's Prolific, or Fay, are desirable red varieties, and White Imperial and White Grape are popular white varieties.

While soil suitable for strawberry culture is to be found in all portions of this area, the region immediately around Bayfield presents a combination of soil and climate resulting in more favorable general conditions than exist in large tracts in other parts of the area. The sandy loam, extensively developed in this neighborhood, is an ideal strawberry soil, and the protection accorded by the heavy mantle of snow that covers the ground during the winter months renders mulching unnecessary.

Moreover, this natural protective covering remains as long as its protection is needed and disappears when no longer required.

At present the varieties most extensively grown are Senator Dunlap and Warfield. So well are these suited to the conditions in this section that it seems almost unnecessary to mention any of the others, though doubtless some of them would, if tried, prove quite equal to these. Especially is this true of those parts of the area where the soil becomes more clayey, for in the development of varieties of this fruit many good sorts have been produced that thrive in a variety of soils. Besides the Senator Dunlap and Warfield, the Bederwood, Haverland, and Glen Mary are considered to be worthy of trial on the sandy loam soils of this area. On the denser phases of the sandy loam and on the moderately heavy clay, Bubach, Jessie, Marie and Sample will, no doubt, prove highly satisfactory. For this type of soil in more southern localities Gandy is unexcelled, and if not too late in its season would prove itself highly profitable. It is, without doubt, unsurpassed in keeping and shipping qualities.

CHAPTER VI.

CLIMATE*.

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

The distribution of the rainfall over Wisconsin is remarkably uniform, the average yearly precipitation having a range of from 28–34 inches, while the mean for the State as a whole is 31 inches. This is a slightly heavier rainfall than is received by Eastern England, northern France, most of Germany, Sweden, and the Dundee Valley. As compared with other portions of this country, Wisconisn, has a total rainfall equaling that of central Oklahoma and Kansas, northern Iowa, Michigan, northwestern New York, or the Puget Sound Basin of Washington. But owing to its northerly location, the lessened evaporation probably makes the precipitation as effective as that of Arkansas, Illinois, or Virginia.

The local distribution of rainfall varies, however, from year to year, some sections receiving more rainfall one year, and other sections more in other years. The variation is caused by the movement of cyclonic storms. The average rainfall for the entire State during the driest year since records have been kept was 21.4 inches and for the wettest year 37 inches.

Of equal importance in agriculture to the total rainfall, is its seasonal distribution, and in this respect Wisconsin is

* This Chapter has been taken largely from Wis. Bulletin 223 on The Climate of Wisconsin and Its Relation to Agriculture, which should be consulted for more information on climate.

unusually fortunate, since about half of the total rainfall comes in May, June, July, and August, and nearly 70% from April to September inclusive. June has the heaviest rainfall averaging 4.1 inches, while July averages 4 inches and May 3.9 inches. The precipitation during the winter, on the other hand, is slight; December, January, and February each averaging from 1 to 1.5 inches of rain and melted snow. The average rainfall for the State during winter as 3.9 inches, during spring 8.3 inches, during summer 11.4 inches and during autumn 7.4 inches. Most of the rainfall occurs just preceding and during the period of plant growth, thus being received by the crop at the most effective time. Wisconsin receives during the growing season, April to September inclusive, an average of 21 inches of precipitation, which is as much rain as is received during the same months by eastern Texas, Illinois, Ohio, or eastern New York. The small winter precipitation in Wisconsin, mostly in the form of snow, on the other hand, causes virtually no leaching of fertility from the soil, nor erosion.

Another phase of rainfall distribution, of great importance, is its variation within a period of a few weeks. Frequently periods of drought and periods of unusually heavy rainfall occur, continuing for one to four weeks, and occasionally longer. Observations taken at Madison over a period of 50 years, from 1882 to 1911, inclusive, show that there are, on the average, three ten-day periods during which each growing season when the amount of rainfall is so slight that crops on a reasonable heavy soil (Miami silt loam) actually suffer from the lack of moisture. It is probable that observations in any other portion of the State would show similar conditions.

The Bayfield Area lies within the "Superior Shore" division, which is one of eight climatic provinces in Wisconsin. This includes a narrow belt adjoining Lake Superior, of unknown width, though it is unlikely that the lake influence extends further inland than twenty-five miles, and as a factor of horticultural value, it is confined chiefly to the region between the lake shore and the first hill top, which is usually from 3 to 5 miles inland. There also appear to be great variations within this belt, the southeastern slope at Bayfield being warmer, and having a

growing season much longer than the northwestern slope at Herbster. The Herbster record is so short, however, as to be of little value. This Superior shore is characterized by cool summers, with frequent northeast winds off the lake and a mean temperature (64°) like that of the coast of Maine or the Puget Sound region; pleasant, prolonged autumns, (46°) similar to those of the Berkshire Hills of Massachusetts, or eastern Washington; cold, continuous winters, having about the same mean temperature (15°) as the central portion of Wisconsin, Aroostook county Maine, the Green Mountains of Vermont, southern Minnesota, or northern Montana; and cool, retarded springs (37°), resembling the Adirondacks and the Red River Valley.

Generally, on about four winter mornings, the temperature drops to 20° below zero or lower; while on an average of five days in summer it reaches 90° or more. Sudden changes in temperature occur in this section, due to shifts in the direction of the wind. In summer, a storm coming up the Mississippi Valley causes a hot, dry wind from the south, which descending 1000 feet from the highlands is further heated by the increased pressure, and often sweeps down upon the lake shore with marked severity. The temperature may rise to over 100°, and then with the passing of the storm center to the east, a reverse breeze off the lake sets in, reducing the temperature even below 50°, and usually accompanied by rain. In winter reverse effects follow this change in wind, the land breeze being cold and the lake breeze comparatively warm.

The average length of the growing season varies from probably 150 days on the Apostle Islands, Madeline being the warmest, to an average of 130 days on the mainland near the water, diminishing probably to 115 days, ten miles inland. However, the records in this region are so few and short that estimates of the length of the growing season are merely approximate. The islands, therefore, have a growing season similar to that of the St. Lawrence Valley, northern Iowa, or eastern Colorado, but a much colder summer temperature (about 60°); while a belt ten miles inland, though it has a shorter growing season, similar to that of Central Maine, the

Catskills, Central North Dakota, or Montana, has a mean summer temperature probably 5° warmer than the islands.

The rainfall on this northern slope, owing to the lessened evaporation, and the fact that a larger proportion comes in summer and fall, is probably more effective than in the southern part of the State; but the occasional cold, wet, windy northeasters, lasting sometimes a couple of days, are very disagreeable. On the whole, this region resembles the coast of Maine in both climate and scenery, though clear and free from fogs in summer, colder and drier in winter, and covered with a deep blanket of snow from December 1 to April 1.

By reference to Figures 5 and 6 it will be observed that the average date of the last killing frost in the spring falls between June 1 and May 20th, and that the average date of the first killing frost in the fall comes between September 20 and October 10th. From the data given on these two maps the length of growing season for any portion of the State may be readily determined.

The following table has been compiled from the Weather Bureau records taken at the station at Ashland, Wisconsin. The records of precipitation cover a period of 19 years and the temperature records 16 years.

Precipitation and temperature at Ashland, Wis.

	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Annual.
Precipitation:													
Mean for 19 years.....	1.14	1.23	1.53	2 11	3.30	3.43	4.07	3.14	3.13	2.84	1.53	1.21	28.66
Temperature:													
Mean for 16 years.....	14.8	13.6	2.37	39.6	50.5	61 4	68.0	67.1	60.4	47.8	31.7	20 4	41.6
Absolute maximum	58	55	60	83	89	98	104	97	99	94	6-	55	104
Absolute minimum	—31	—33	—20	6	21	25	42	37	28	13	—13	—22	—33

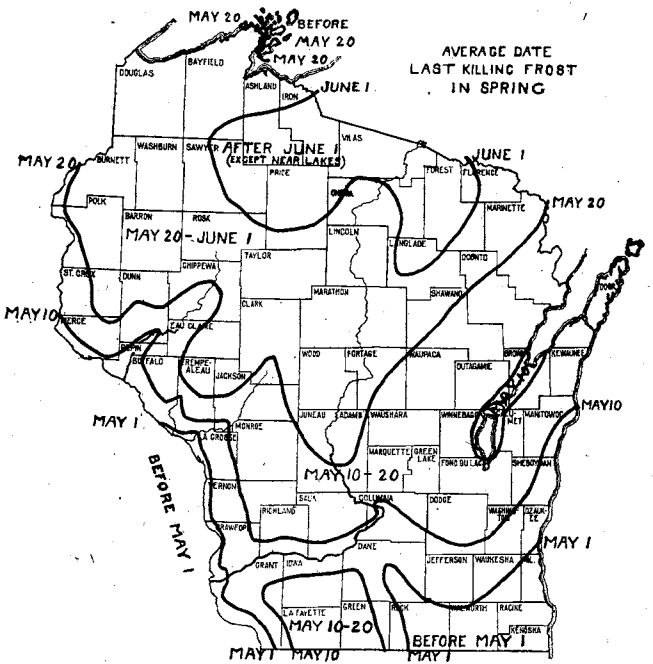

FIG. 5. LAST KILLING SPRING FROST.

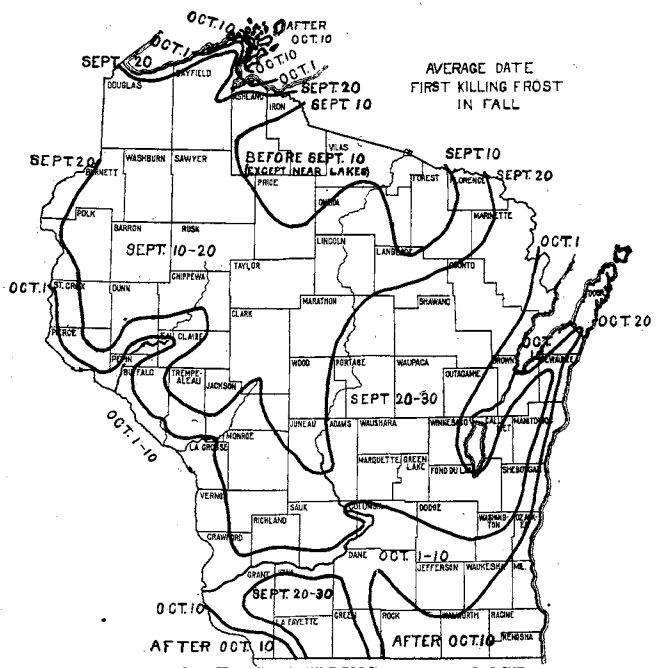

FIG. 6. FIRST KILLING FALL FROST.

These maps have been prepared from the original monthly reports of the observers of the U. S. Weather Bureau for the past 12 years, supplemented by private records.

The average date of the first killing frost in the fall at Ashland is September 21, and the average date of the last killing frost in the spring is May 14. This gives an average growing season of 130 days for Ashland and the immediate vicinity.

It will be observed from the table above that the mean annual precipitation is 28.66 inches, and that this is especially well distributed throughout the growing season, when it is most needed. The mean annual temperature at Ashland is 41.6°, the maximum 104° and the minimum—33°. The extremes of temperature are infrequent and of short duration.

Conditions on the Bayfield Peninsula differ somewhat from those at Ashland, though the Weather Bureau has no official station in the area except the one above mentioned. From the most reliable data obtainable, however, it is found that the average date of the last killing frost in the spring on the Bayfield Peninsula is May 10, and the average date of the first killing frost in the fall is October 1. This gives a period of about 140 to 145 days free from killing frosts.

SUMMARY.

The Bayfield area covers parts of Bayfield and Ashland Counties, Wisconsin, including the Apostle Islands. The survey comprises the most northerly land in Wisconsin. The northern part of the area is of a rolling, almost rugged, character, rising sharply from the lake shore with but few level areas, none of which are large.

The shore lines of both mainland and islands are bold and precipitous; very little beach formation has taken place. In the southern part of the area the land assumes a more level character, especially south of the city of Ashland. Owing to the rolling character of the land in the northern part of the area, the surface drainage is generally good; in the near-by level stretches in the southern part drainage is less efficient. Many wet spots occur throughout the whole area, owing either to the impervious nature of the subsoil, or to the topography of the surrounding country. The problem of drainage is, therefore, an important one.

The entire area was formerly covered with forests, but has been extensively cut over. It is now covered with a dense growth of birch, poplar, and other deciduous species, which, together with the pine stumps, makes clearing expensive.

Convenient transportation facilities by rail and water connect the various points within the area and afford access to the markets of Chicago, St. Paul, Minneapolis, and other large cities. Ashland is the largest city and principal local market in the area. Good local markets are also to be found in Washburn and Bayfield.

The soils of this area are all of glacial or lacustrine origin, being either deposits from the waters during interglacial periods or formed of the morainic material that marks the course of ice advance.

Superior clay, a red, dense, impervious clay of lascustrine origin, is an extensive type, especially adapted to grass and grain crops, dairying, and stock raising. When rendered less dense by cultivation and the introduction of organic matter, preferably in the form of coarse manure, it yields good crops of wheat, peas, turnips, rutabagas, potatoes, and other root crops. Lighter phases may be used for fruits.

Superior sandy loam is extensively developed in the vicinity of Bayfield, and is especially well adapted to small fruits, potatoes, and to such varieties of apples, cherries, etc., as are suited to the local climate. The sandy material form-in the surface layer is glacial material; the stiff red clay may be lacustrine or lacustrine modified by glacial reworking. Though strewn with small rocks and bowlders, it is generally a well-drained, easily tilled, warm, productive soil.

Superior silt loam is similar in many respects to the Superior clay and its crop adaptation is much the same, where sufficiently level to be cultivated. It is of lacustrine origin.

Coloma gravelly sand is the least important of the extensive types found in the area. It is a poor agricultural soil, being loose, incoherent, and highly susceptible to drought. Coloma gravelly sand as found in this area is an accumlation of true morainic material, and forms a series of rounded knolls or hills, locally known as the Kettle Range. The steep slopes should be reforested.

Genesee loam consists of alluvial material, is first bottom land, and is subject to annual overflow. Only a small area is mapped.

Beach sand occurs in narrow strips along the shore, in sheltered coves on the mainland, and around the Apostle Islands. It is of limited extent and of no agricultural value.

Marsh (containing areas of Swamp) is found at the mouth of some of the streams, on a few of the islands, and in depressed areas throughout various parts of the survey.

Agricultural development has just begun. At present general farming is the prevailing type of agriculture throughout the area, but local conditions are inducing specialization along certain lines. In the vicinity of Bayfield conditions especially

favorable for fruit production exist, and the acreage devoted to the production of apples, cherries, and small fruits is steadily increasing. South of Ashland, which affords a ready market for dairy products, the soil is especially well adapted to the production of grass and other forage crops, and in this section much attention is being paid to dairying and live stock.

The winters are long and severe and the snowfall heavy. The presence of snow throughout the cold period usually prevents the ground freezing to any great depth. This is especially true in the neighborhood of Bayfield, where strawberries and other small fruits are grown without mulching. Ashland, though situated somewhat south of Bayfield, does not receive the full benefits of the influence of Lake Superior, and is uniformly somewhat colder during the winter months than the latter place. Late frosts in spring are quite unknown throughout the area, and the growing period is rapid and uninterrupted throughout the season.

KEEP THE MAP.

The Experiment Station will publish bulletins from time to time dealing with the management of the different types mapped, so that some way should be found by each person receiving a copy of this report to keep the map permanently. If the map is folded in such a way as to have the part you are interested in of a convenient size, and then have a simple frame with glass 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.