WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

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SOIL SURVEY

OF

BAYFIELD COUNTY

WISCONSIN

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TABLE OF CONTENTS

Part I

THE SOILS OF BAYFIELD COUNTY

	Page
ORIGIN OF SOILS	1
CLASSIFICATION OF SOILS	3
Texture	3
Topography	4
Stoniness	4
DESCRIPTION OF SOIL TYPES	7
Superior Clay Loam	7
Superior Loam	10
Superior Fine Sandy Loam	11
Sheboygan Clay Loam	12
Poygan Clay Loam	12
Poygan Fine Sandy Loam	13
Mason Sandy Loam	13
Orienta Sandy Loam	14
Sheboygan Sandy Loam	15
Kennan Loam	17
Kennan Sandy Loam	18
Antigo Fine Sandy Loam	19
Cable Loam	21
Plainfield Sand	21
Plainfield Fine Sandy Loam	23
Dunning Sand	23
Vilas Sand	24
Bibon Fine Sand	25
Saugatuck Sand	25
Peat	27
Yellow Fibrous Peat	27
Coarse Woody Peat	27
Fine Woody Peat	28
CLIMATE	28
Temperature	
Precipitation	
Frosts	
AGRICULTURE	36
Important Crops	37
Agricultural Statistics	38
Suggestions for Improvement	39
WATER SUPPLY	40
FRUIT GROWING	40

LIST OF ILLUSTRATIONS

CUTS

Figure 1. General Soil Map of Bayfield County.
Figure 2. Comparative Mean Summer Temperatures in Wisconsin.
Figure 3. Average Number of Days Without Killing Frost in Wisconsin.
Figure 4. Comparison of Temperature and Rainfall of Denmark and Bayfield County.
Figure 5. Average Date of Last Killing Frost in Spring.
Figure 6. Average Date of First Killing Frost in Fall.
Figure 7. Showing Relation of Subsoil to Drainage for Fruit Trees.

PLATES

Plate I–A—A New Clearing on Superior Clay Loam.
B—A Farm on Superior Clay Loam.
Plate II–A—A View Near Cornucopia.
B—A Characteristic Ravine in Superior Clay Loam.
Plate III–A—A View of the Gently Rolling Kennan Soils.
B—Another View of the Kennan Soil.
Plate IV–A—A New Farm on Antigo Fine Sandy Loam.
B—A View on Plainfield Sand.
Plate V–A—A View Showing the Topography of Vilas Sand.
B—A Typical Peat Bog.

Part I

THE SOILS OF BAYFIELD COUNTY*

A. R. WHITSON, W. J. GEIB and C. E. KELLOGG

Bayfield County, Wisconsin, lies in the extreme northwestern corner of the state, bordering the south shore of Lake Superior and Chequamegon Bay. It has an area of 1,497 square miles and is approximately sixty miles long and thirty-eight miles wide. Washburn, the county seat, is three hundred fifty miles from Madison and four hundred twenty-two miles from Milwaukee.

The southern part of the county is a portion of the highlands of the northern part of the state and has an average elevation of over 1,300 feet. From this highland area there is a broad ridge forming the axis of the peninsula between Lake Superior and Chequamegon Bay. This ridge varies from 1,000 to 1,200 feet in elevation. From the ridge the country slopes toward Lake Superior on the northwest and Chequamegon Bay on the southeast, producing a broad plain sloping gradually from the ridge to the lake on the north and to Chequamegon Bay and the broad valley extending from the latter southeastward.

ORIGIN OF SOILS

The accompanying sketch map (Fig. 1) gives a general idea of the soils of the county. The underlying rocks of the extreme southeastern corner of the county are the granites, gneisses and schists of the Archaean period. A belt of basaltic rocks, chiefly diabase and gabbro, extends along the northern side of the granitic rocks, forming high rough ridges frequently free of soil. The remainder of the county is underlaid by Lake Superior sandstone.

During the glacial period the ice flowing across the Lake Superior basin from the north formed a broad lobe down the narrowing end of Lake Superior and another down Chequamegon Bay. These lobes in meeting formed an intermediate moraine which extends from the northeastern to the southwestern corner of the county over the broad ridge mentioned above.

The glacial material which forms a mantle varying in thickness up to several hundred feet over the underlying rocks includes glacial till, formed from the weathered material previously formed by the surface weathering of these rocks together with material swept southward from the basin of the lake and bay by the ice. It falls naturally

* For soil maps, write A. R. Whitson, Soils Building, Madison, Wisconsin, indicating the location of the land if possible, giving the Town, Range and Section. The charge for maps is 10 cents per township.

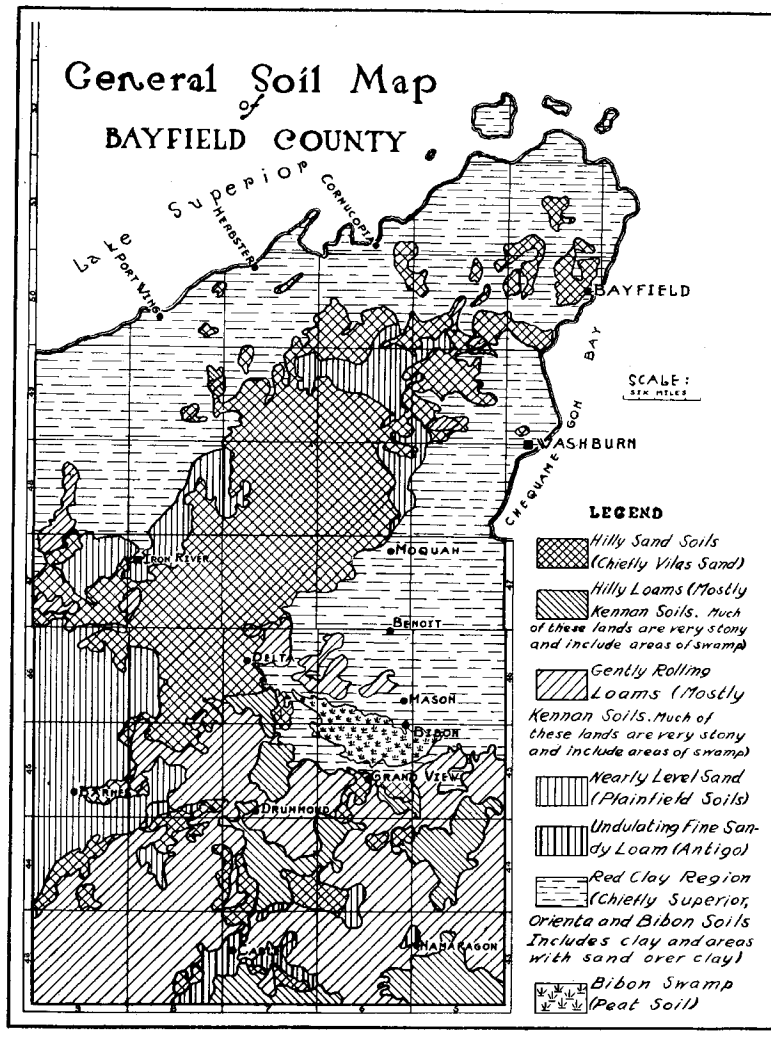


FIG. 1—General Soil Map of Bayfield County Showing the Distribution of the Principle Soil Types.

into three chief classes; first, that occurring on the granitic and basaltic rocks in the southern part of the county; second, the sandy drift forming the main axis of the broad northeast and southwest ridge, and third, the heavy red clay beds which form the broad plains bordering Lake Superior on the northwest and Chequamegon Bay and its valley extension on the southeast.

The soils of the southern part of the county, being mainly derived from granitic and basaltic rocks, are chiefly loams and silt loams in texture with many cobbles and boulders. These are the Kennan soils.

Over the main central broad ridge of the county, which is underlaid by sandstone rocks, the soils are largely of a sandy character, including the Vilas and Plainfield soils, while the flanking sides are chiefly of Superior clay. In each of these three areas, the bulk of the material occurs as it was left by the ice, while portions have been worked over and sorted by the water resulting from the melting of the ice. A considerable portion of the red clay beds were deposited in the quiet body of water, temporarily dammed between the high-land on the south and the solid ice of the retreating glacier. In other words, it is of lacustrine character (water laid) and shows the stratification and lamination of that method of formation. Portions of this clay, however, were worked over by readvances of the ice. In addition to all of these soils which were formed from stony or earthy material in various ways, there are numerous marshes in which organic matter has collected, forming a larger or smaller portion of the soil. In some areas the organic matter is a black humus forming 10% to 25% of the soil, the remainder of which is clay or other earthy material. In other cases the organic matter constitutes practically the entire soil, forming peat.

We have, therefore, a considerable variety of soils in the county, due to the different kinds of material from which they were formed and the different agencies which gave them their present character and condition.

CLASSIFICATION OF SOILS

The suitability of land for agriculture or other use is determined by a number of factors. Some of these factors, such as chemical composition and water holding capacity, affect the character of crops or tree growth to which they are adapted. Other characteristics such as lay of the land and stoniness affect the expense of clearing and operation as farm land. It is necessary, therefore, to classify the soils in such a way as to express all of these important features.

The chief factors which will determine the best use to be made of unimproved land are texture or fineness of grain, topography or lay of the land, and stoniness. Texture or fineness of grain largely determines the kind of crops a soil will produce best. Clay loams, silt loams and loams have good water holding capacity, so that fine, shallow rooted crops, such as small grains, pasture grasses, clover and other hay crops do well, while coarser or sandy soils will support the growth of trees which can go deeper for water. On the basis of texture, soils are classified into clays, clay loams, silt loams, loams, fine sandy loams, sandy loams and sands. But organic matter, chemical composition, character of subsoil and other matters are also important. Since these occur in various combinations, it is necessary to recognize groups or series, each series being a definite combination of factors. Just as the Jersey, Holstein, Short Horn, Percheron and other breeds of livestock each has its own well-known combination of characteristics, so we have the Kennan, Plainfield, and other groups or series

of soils. Each of these series is then subdivided into types on the basis of texture. So we have the Superior clay loam, the Kennan loam, etc.

Topography: The topography or lay of the land has a very important influence on the use of machinery in connection with the growing of crops and also on erosion of the soil. On the basis of topography or slope four classes are made: (A) land which is level or slightly sloping, (B) land having considerable slope but not enough to interfere with the use of any farm machinery or to cause serious erosion, (C) land which is quite steep but which can still be cultivated though it should be kept in grass for pasture as much of the time as possible to prevent erosion, and (D) land which is so steep or rough as to be untillable.

Stoniness: Stoniness is another very important factor in determining the expense involved in clearing new land and the efficiency with which the land can be operated after it is cleared. For this reason the degree of stoniness on each 40 acre tract is shown. Four grades are made: first, practically free of stones, second, having stones amounting to from 2 to 20 loads per acre, third, from 20 to 50 loads, and fourth, above 50. Thousands of acres in southern Wisconsin have been cleared for cultivated crops which originally had 20 to 30 loads of stone per acre. Land having the first two degrees of stoniness can be considered available for cultivated crops when other conditions are good and pieces of land having more than 20 loads of stone per acre can be utilized as pasture when it adjoins land more readily cleared. But large tracts uniformly covered with 20 or more loads of stone per acre cannot be considered suitable for agricultural development at present, and should be utilized for forest crops.

The Farm Unit: In studying the detailed maps by townships accompanying this report, it will be seen that several factors must be considered in determining what land can be developed for agricultural use to advantage. In addition to those already mentioned one of the most important considerations is that of what constitutes a suitable farm unit. Since dairying is now and probably will long remain the basal type of agriculture, the suitability of the farm unit for dairying must be considered. Pasturage is by all means the most economical feed during the summer months. A considerable portion of the farm, usually about ⅓, should be devoted to this use. For this purpose, the soil should have a sufficiently fine texture to carry a good grass sod which means that it should be a loam, silt loam or clay loam, since soils of lighter texture such as sandy loam and sands do not carry a good grass sod. On the other hand, stoniness and irregularity of surface or hilliness do not prevent land from being suitable for pasture use. When, on a tract of 80 to 160 acres, half or more of the area can be developed into good plow land suitable for producing winter feed and the remainder is of a character which can be used to advantage as pasture, the tract as a whole should be considered a satisfactory farm unit. The soil maps accompanying this report and indi-

cating the texture, stoniness and topography should be studied with reference to this principle when examining them with reference to their agricultural possibilities.

As an aid in the study of these soil maps with reference to the suitability for agricultural development, the different types of soil with the different degrees of stoniness and variations in topography or lay of the land have been classified into three groups. The first group includes soils and conditions of stoniness and topography which in general can be considered well adapted to agricultural use. The second group includes those which have a fair value for that purpose and a third, those which have relatively little value for agriculture.

Class I. Good (about 40%)

Superior Clay Loam
Superior Loam
Superior Fine Sandy Loam
Orienta Sandy Loam
Kennan Loam
Kennan Sandy Loam
Mason Sandy Loam
Antigo Fine Sandy Loam

Where topography is A or B and the stoniness not greater than S_1.

Class II. Fair (about 23%)

Plainfield Sand—Topography A or B.
Plainfield Light Sandy Loam—Topography A or B.
Bibon Fine Sand—Topography A or B.
Saugatuck Sand.
Poygan Clay Loam.
Poygan Fine Sandy Loam.
Sheboygan Clay Loam—Where not marshy.
Sheboygan Sandy Loam—Where not marshy.
Cable Loam—With stoniness not greater than S_1.

Kennan Loam
Kennan Sandy Loam
Mason Sandy Loam

Where topography is C or stoniness greater than S_1, except areas too large in extent to be utilized as pasture in a farm unit.

Also C topography or stoniness S_2 or S_3 of any other soil type that is in Class I, except where the areas are too large in extent to be utilized as pasture with the farm unit.

Class III. Poor (about 35%)

Kennan Loam
Kennan Sandy Loam
Mason Sandy Loam

Where topography is C or D or stoniness greater than S_1 and in areas too large to be utilized as pasture in the farm unit. Also where badly confused with rock outcrops.

Vilas Sand.

Sheboygan Clay Loam
Sheboygan Sandy Loam

Where marshy.

Dunning Sand.
Yellow Fibrous Peat.
Coarse Woody Peat.
Fine Woody Peat.

Plainfield Sand
Plainfield Light Sandy Loam

Where badly broken with pits and terraces.

Cable Loam—Where stoniness is greater than S_1.

Also D topography of any soil type and C topography or stoniness S_2 or S_3 of any soil type occurring in areas too large in extent to be utilized for pasture within the farm unit.

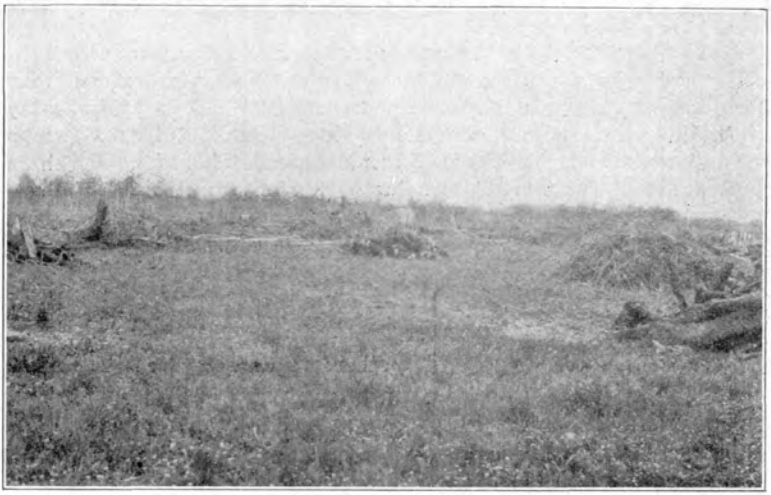


PLATE I—(A) A new clearing on Superior Clay Loam. This soil will grow good pasture and hay crops with the stumps still present and these may be removed to make plow land as the time becomes available.

(B) A farm on Superior Clay Loam. Note the characteristic level surface of this type.

DESCRIPTION OF SOIL TYPES

Superior Clay Loam

Extent and Distribution: Superior Clay Loam occurs within the Lake Superior Lowland and is the chief soil type of that province. That part of the old glacial lake deposit which has not been modified by surface deposits of soil, is largely this type.

Description: The surface of the virgin soil consists of an organic layer of leaf litter and forest mold two to three inches in thickness. This is underlain by a faintly pinkish, dull gray silty clay loam or silt loam. This layer varies greatly in thickness but is generally about four to six inches. On some of the slopes the gray horizon has been almost entirely lost by erosion. Below this layer the soil grades into red or brownish red heavy impervious clay. At about twenty-four inches a slightly lighter red clay layer is encountered. The clay is very impervious and difficult to penetrate; when wet it is very sticky and when dry it has a coarse blocky structure. The limit of weathering appears to be at about twenty-four to thirty inches for below this depth the clay is a fainter red and has appreciable amounts of lime, while above this depth the soil is generally acid according to the Soiltex test, particularly in the surface few inches.

Topography and Drainage: Superior clay loam is quite variable as to topography or lay of the land. Originally the material from which this soil has been developed was laid down by old glacial lakes as a nearly level deposit. Later a portion of this material was reworked by the ice and left with an irregular surface; sometimes the reworked material is but little different from the undisturbed except for its undulating surface and the presence of a few stones. Again in some places, particularly in the northern portion of the area, it is quite rolling and occasionally stony. Due to the large proportion of clay and the general uniformity of the soil mass this soil erodes quite readily. As a consequence there are a great many V-shaped valleys occupied by streams and intermittent drains. These V-shaped valleys are frequently very deep, especially near the shore of Lake Superior. In the more level areas, however, the inconvenience which these drainways cause to farming operations is more than compensated in their value as natural outlets for the surface run-off.

The more level areas are frequently quite poorly drained due to the impervious nature of the clay. The use of small ditches made with a plow are often very useful in caring for the surplus surface water. Tile drains give good results where their expense is justified. Low wet spots and swales are of frequent occurrence in this type. The surface soil in these spots is generally black due to the accumulation of organic matter. They vary in size from a few square feet up to two or three acres. Spots of this size are too small to be shown on the

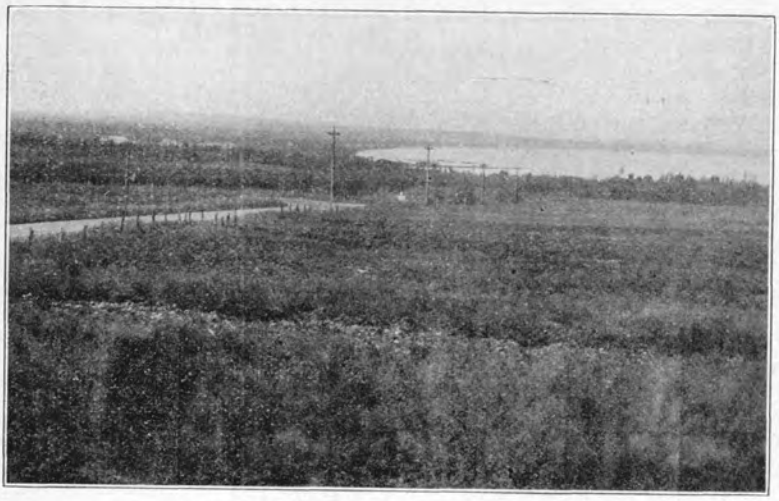
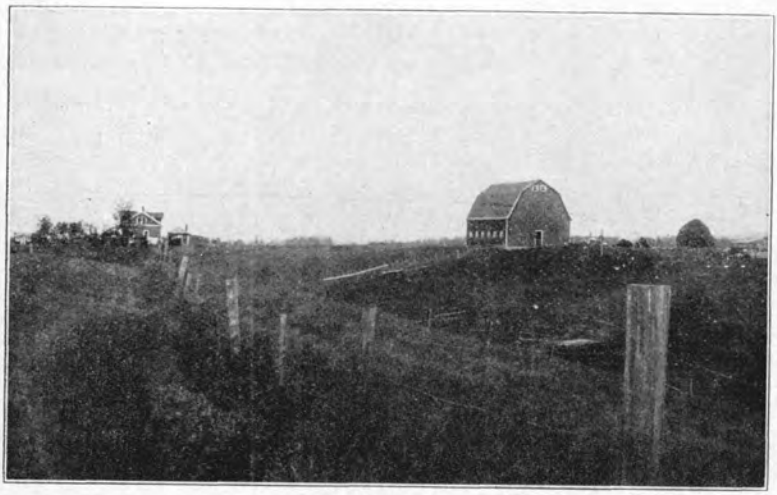


PLATE II—(A) A view near Cornucopia, looking north over Lake Superior. Superior soils predominate in this section.



(B) A characteristic ravine in Superior Clay Loam. The inconvenience which these V-shaped valleys cause to farming operations is usually more than compensated for in their use as natural outlets for surface water.

soil map. If better drainage can be supplied this land will easily work in with the other soil. If they are not too large, many farmers fill them with soil from the adjoining land. This is often practicable if drainage is difficult to accomplish and if the area is a menace to the use of machinery on the remainder of the field.

Native Vegetation: The original cover on this soil was largely white pine with some Norway pine on the better drained ridges or slopes. In the northern part, near Lake Superior, considerable hardwood, chiefly maple, yellow birch with some hemlock, made their appearance on this type. Practically all of the original stand has been removed, except some of the hardwood. The second growth consists of a rather dense stand of popple, white birch and balsam fir with some white pine and other species.

Agriculture: This soil is the most important type in the county. When properly managed, the soil is productive and gives profitable yields of hay, oats and other crops adapted to it. It is not so well adapted to corn as the lighter soils are, but the better drained fields will produce good corn when the soil is well prepared and kept fertile. The use of a phosphate fertilizer is especially helpful in this respect and it tends to make the crop mature earlier. Much of this soil is undeveloped due to the difficulty of land clearing. The average cost of clearing, including the cost of dynamite, burning the stumps and plowing varies from $50.00 to $75.00 per acre, depending upon the character and number of the stumps and the amount of second growth. The new settler clears and develops his land as his time and means permit. In order to establish a satisfactory farm unit it is only necessary that 1/4 or 1/3 of the farm be fully cleared. Clovers and grasses can be grown among the stumps very successfully. These crops afford excellent pasture and also considerable hay can be cut. The clearing can then be accomplished gradually as the time becomes available.

Dairying has been found to be the most profitable method of farming on this soil. Because of the high water holding capacity of the heavy clay, good pasture is maintained throughout the season. Alfalfa, clover, oats, some root crops and corn for ensilage can be grown for winter feeding. Root crops will probably be more successful on some of the lighter textured soils such as the Superior Loam or Fine Sandy Loam. Often small patches of these types occur associated with the Superior Clay Loam and can be utilized for that purpose. With the exception of some of the small flint varieties, ripe corn should not be expected. However, it can almost always be grown to a stage suitable for silage and will sometimes ripen. Due to its heavy texture, the soil is cold in the spring. Light applications of nitrogen and phosphorus fertilizer for spring crops, such as corn, will give the crop a good start. Sunflowers have been found useful by some in solving the problem of winter feeding.

Alfalfa is a profitable crop in situations where the land has fair or good drainage. An application of lime is generally very helpful in getting a good stand started as the surface two feet of the soil

is generally low in available lime. The deep subsoil is most always found to be neutral in reaction but this fact has little influence on the young alfalfa plants, as their roots do not penetrate to the depth of the limy material.

Stable manure and the sod of pasture and hay land plowed under greatly improve the physical character of this soil, making it much more friable and workable. Fall plowing results in better tilth than spring plowing. Moderate amounts of phosphate fertilizers will increase the yields of all crops, especially of clovers and alfalfa as they do on most all soils. The excellent pastures on this soil together with clover, alfalfa, oats and barley make it well adapted to dairying and with skim milk or whey some hogs especially of the bacon type can be grown to advantage, using barley in place of corn.

The crops to which this soil and climate are so well adapted are the same as those which make dairying and hog raising so successful in Denmark.

Superior Loam

Extent and Distribution: Superior Loam occurs in rather small areas grading between the Fine Sandy Loam and the Superior Clay. Other areas are also included which consist of a confusion of small patches, too small to be shown separately, of all the Superior types, the average condition being the Loam.

Description: The soil profile may be described as follows: Leaf mold and nearly black forest mold, about 2 inches, underlain by gray to brown fine sandy loam. This extends down to 14 or 24 inches below the surface and is underlain by heavy red clay with an angular nut structure. The deep material below 30 inches has sufficient calcium carbonate to give a neutral reaction, while the upper part of the soil is strongly acid.

Topography and Drainage: The land varies from undulating to gently rolling with some hilly areas near the streams and large drainways. The surface drainage is good except in some nearly level areas. Here plowed furrows will serve to carry off the excess water quite satisfactorily. Stones are absent except in a few areas.

Native Vegetation: The native cover was chiefly white pine with some mixed hardwoods in the northern part. The present second growth consists chiefly of popple, white birch, balsam fir, red maple and spruce with some white pine.

Agriculture: Agriculturally, this soil is very similar to the Clay Loam type except that there is more variation in the surface texture and that the soil is more easily worked, due to this lighter texture. Uniform areas of undulating or gently rolling Superior Loam may be considered nearly ideal for general purpose farming. The soil has a sufficiently high water-holding capacity to insure excellent hay and pasture crops. As with the other Superior types the surface soil is acid and applications of lime are necessary for the good growth of legume crops. In turn, the legume crops, such as clover, alfalfa and soy beans, are to be recommended as a source of nitrogen; this

element is generally deficient in Superior Loam. Good crops of potatoes and roots can be grown as well as the small grains—oats, barley and rye. The problem of land clearing is about the same as that for the Clay Loam type.

Superior Fine Sandy Loam

Extent and Distribution: The Superior Fine Sandy Loam occurs throughout the Superior Lowland region but more particularly that portion of the region bordering the Bayfield Ridge. It occurs on those areas where the original lake laid clay has received a shallow sandy covering; thus it occupies a position between the formations giving rise to the Superior Clay Loam on the one hand and those giving rise to the Orienta soils on the other.

Description: The unplowed soil has a surface layer of leaf litter about 1 to 3 inches thick. Beneath this covering is a dull gray, loamy fine sand about 6 to 10 inches in thickness. The gray layer is followed by a variable layer of yellowish brown fine sandy loam, mottled and streaked with gray and rusty brown. At depths from 15 to 30 inches is encountered the pinkish brown heavy clay. The depth and color of sandy material over the clay is extremely variable locally.

Topography and Drainage: The land is undulating to gently rolling with only occasional hilly areas near the larger drains and streams. The underlying clay of this type has been quite generally moved by minor advances of ice after its deposition. This movement has had the effect of producing more relief and also of mixing some sandy material with the clay. Some places have quite a quantity of boulders left by the ice, but in general, this soil is stone free. The soil is not uniform; plowed fields are patchy in appearance with sandy spots of various colors and red clay spots. Where there was found to be considerable confusion of small patches of Orienta and Superior soils that were too small to be shown as separate areas on the map they were necessarily combined and mapped as Superior Fine Sandy Loam in an attempt to give the average condition. Except in a few level areas surface drainage is good.

Native Vegetation: The original forest cover was chiefly white pine with some mixed hardwoods in the northern part of the county near Lake Superior. Most of this cover has been removed and the present second growth consists chiefly of popple, white birch, balsam and red maple with some white and Norway pine.

Agriculture: Superior Fine Sandy Loam is a good general purpose agricultural soil. It works easily and is well adapted to special trucking crops and to potatoes and root crops. Small grains—oats, barley and rye, can be grown successfully. Corn for ensilage is grown on this soil probably better than on the other Superior types. Good crops of hay and pasture may be depended upon. Small fruits as well as tree fruits are well adapted to this soil in regions of favorable climatic conditions.* The greatest undesirable feature of the cleared

* See discussion of fruit growing in this bulletin.

land is its lack of uniformity previously mentioned. The more sandy areas and the clay portions within the field react differently to similar farm management systems. By carefully laying out the fields in relation to the soil this difficulty may sometimes be partly overcome; that is, the fields should be arranged, as nearly as possible, so that the soil is uniform in each field.

The land clearing problems are about the same as for the other Superior types; except that in the Fine Sandy Loam stones are more often a problem.

Sheboygan Clay Loam

Extent and Distribution: Sheboygan Clay Loam is limited to the first bottom land along the water courses within the Superior Lowland.

Description: As the soil is at present in the process of formation there is practically no organic covering; yet some organic matter has been incorporated with the mineral soil during its deposition. To depths ranging from 12 to 36 inches the soil consists of chocolate-red silt loam or silty clay loam, underneath which lies the substratum of heavy red clay.

In many cases, where streams having wide valleys empty into Lake Superior, the waves have built a bar across the mouth and consequently at this point the water is dammed up and the stream spreads out during the period of the year when the flow is the greatest. In these situations the soil is more wet than typical and contains numerous water holes and old stream channels. Ordinarily all of this soil is inundated every year and a fresh deposit of sediment added.

Natural Vegetation: The forest growth is chiefly elm, oak, spruce and balsam, with some other species, such as alder and willow.

Agriculture: This type has no importance for agriculture except as it can be used for pasture.

Poygan Clay Loam

Extent and Distribution: Poygan Clay Loam is found entirely within the Superior Lowland Region. It may be considered as the poorly drained phase of the Superior Clay Loam type with which it is associated.

Description: The surface consists of 5 to 10 inches of nearly black, well decomposed organic matter, containing sufficient fine mineral material to give it the appearance of a silty muck. This surface layer immediately overlies a dark gray silt loam, grading into heavy dark gray clay. Below 12 to 16 inches the soil consists of heavy, impervious, pinkish clay, mottled with gray in the upper part. Some areas have been included which have a loam texture in the upper part of the mineral soil and a silt loam or loam texture down to 20 or 24 inches. The surface is nearly level and the poor drainage is responsible for the high content of organic matter.

Native Vegetation: The forest cover consists chiefly of ash, elm, red maple, and balsam fir, with popple, white birch, alder and willow

forming a large part of the second growth. White pine was often a small element in the original forest, as well as spruce and cedar in the more poorly drained areas.

Agriculture: At present, not much of this soil is developed agriculturally except portions which are used for hay and pasture crops. These crops do quite well on this land without drainage. The high clay content insures an adequate supply of moisture. In order to use the land for cultivated or grain crops drainage is necessary. Fields may be plowed in narrow lands, allowing the dead furrow to act as a shallow ditch leading to larger open ditches at the margin of the field. In most cases this system is inadequate for field crops other than hay and tile drains must be relied upon where their installation is practicable. This soil is typically very heavy at the surface and care must be taken to maintain good tilth. As with the Superior Clay Loam, fall plowing is to be advised. It is generally true that muck soils are greatly benefited by potash fertilizers. This fertilizer may be applied as a top dressing for pasture or hay crops or be worked in for cultivated crops.

Poygan Fine Sandy Loam

Extent and Distribution: Poygan Fine Sandy Loam is confined to the Superior Lowland and is associated with the soils of that region having a deposit of sand over heavy clay. Thus, as the Poygan Clay Loam, it is associated with the Superior soils, and is limited in occurrence to depressed areas having poor drainage.

Description: The soil consists essentially of a surface layer of nearly black, fairly well decomposed organic matter, containing considerable fine material. This layer varies from 5 to 10 inches in thickness and is underlain by fine sand. This sandy material is generally grayish yellow in color and is wet most of the year. At depths varying from 2 to 4 feet heavy, impervious clay is encountered. This clay is of the same general nature as that underlying all the soils of the Superior Lowland area. Like Poygan Clay Loam the land is nearly level and poorly drained.

Natural Vegetation: The original forest cover consisted of elm, ash, red maple, spruce and balsam, with some white pine. The second growth contains considerable popple, white birch, alder and willow as well.

Agriculture: Most of this land is undeveloped. The most important step in the improvement of this soil is drainage. As pointed cut in the discussion of the Poygan Clay Loam, tile drains are to be preferred where the expense is justified. Plowed field ditches help a great deal, especially for hay crops. Good crops of hay and oats are grown on fields drained in this way.

Mason Sandy Loam

Extent and Distribution: Mason Sandy Loam comprises about 6 or 7 square miles lying almost entirely within the Lake Superior Lowland region. The largest single areas are just west of the village of Mason.

Description: The virgin soil has about 2 inches of leaf litter on the surface. Beneath this organic covering is about 5 or 6 inches of gray light sandy loam. This layer is underlain by a variable brown sandy loam which extends down to about 20 inches. This brown layer often has cemented lumps of a coffee-brown color. The soil grades through a rusty brown layer of loamy sand and at about 25 inches is encountered a pinkish gray horizon of very compact and cemented loamy sand. This grades into a pink heavy sandy loam in the lower part. When the soil is dry this horizon is extremely hard. Underneath this cemented layer at about 35 inches, lies the parent material of pinkish sandy loam.

Topography and Drainage: This soil is developed almost entirely on knolls of ice laid material which were probably low islands during the period of the old glacial lakes. Apparently these low islands were subject to considerable washing by wave action as is evidenced by their very stony character. The land is undulating to gently rolling. The surface drainage is good but due to the development of the peculiar cemented horizon in the subsoil, the soil remains wet beneath the surface until late in the spring and relatively moist throughout the summer.

Native Vegetation: The original forest of white pine and mixed hardwoods has nearly all been removed. At present the natural cover is chiefly a second growth of popple, white birch, balsam fir, maple, and so forth.

Agriculture: Agricultural development has been somewhat restricted by the numerous stones. Excellent crops are obtained, however, where these have been removed. The friable nature of the surface makes this soil well adapted for potatoes, while its good moisture supply makes it suited for oats, hay and pasture. For good stands of clover and alfalfa lime will undoubtedly be necessary as the soil is acid.

Orienta Sandy Loam

Orienta Sandy Loam is associated with the Superior soils in the red clay region and occurs in areas where deep sand was deposited over the clay.

Description: The unplowed soil has the following profile character: (1) Surface leaf litter, forest mold and sandy humus soil, about 2 inches in thickness. When dry, this organic matter appears as dry, peaty material. (2) Light gray or whitish fine sand. The lower limit of this layer is very irregular; generally it is about 6 inches in thickness, but long tongues may extend down deeper. This white sand gives way abruptly to the lower layer: (3) brown loamy fine sand, irregularly cemented into a coffee brown sandy "hardpan". This layer is roughly parallel to the surface, and long tongues frequently extend down considerable distances. (4) Yellowish fine sand. The upper part is stained with brown, while the lower part is gray. This lower part is saturated with water during most of the year. At depths ranging from 36 to 72 inches this is underlain by: (5) a heavy red clay substratum.

Freshly plowed land has a spotted appearance and consists of gray, black and brown patches. The longer cultivated land, however, has a more uniform yellowish color.

Topography and Drainage: In a few places and especially near the ravines common to this region, the land is rolling but usually it is nearly level or undulating in surface feature. Stones are quite uncommon but a few areas have some surface stones. Elevated areas are dry while depressed areas are subject to waterlogging. Of great importance also is the surface configuration of the clay floor beneath the sand. Even though the land surface may appear to be nearly level and having a uniform gradient to provide drainage, for growing vegetation, fruit trees and shrubs particularly, may suffer because of water-logging in spots. The sandy nature of the surface soil permits a large quantity of water to permeate the soil, while in soils with a heavy clay surface a larger portion of the rainfall is lost as surface run-off. In the Orienta (and related types) there is an accumulation of water above the clay. If this water does not have an adequate outlet it may develop a relatively high water table in the soil above for a time sufficiently long to kill lower roots. In this case the supporting roots of the plant are confined to the upper part of the soil. During the drier portion of the season this water table subsides leaving the live roots in the dry sandy surface soil. Under the discussion of fruit growing this condition will be more fully considered.

Native Vegetation: The original forest cover was chiefly white pine with hardwoods in a few areas near Lake Superior. The present second growth is a variable mixture of popple, white birch, balsam and red maple with mixed hardwoods in areas near the Lake.

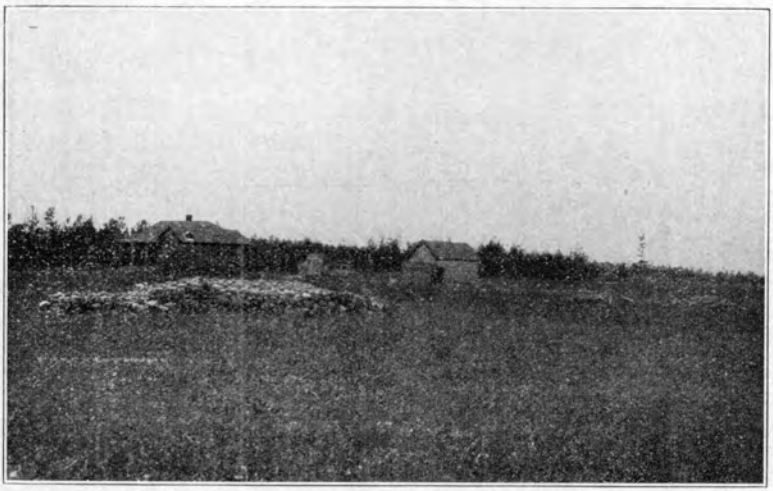
Agriculture: Agriculture has not been greatly developed on the Orienta Sandy Loam. Near the lake some areas have been used for fruit, especially the small fruits. Also throughout its occurrence areas have been cleared, particularly where adjacent to areas of Superior soils and have produced good crops of hay, oats and especially of potatoes. The hay and pasture are not as well adapted to the Orienta, however, as to the heavier soils.

Although the clay below this soil is frequently alkaline the upper soil is acid and applications of lime are necessary in order to insure stands of alfalfa and clover.

Sheboygan Sandy Loam

Description: Sheboygan Sandy Loam includes the sandy alluvial deposits along streams and also the deltas of sandy material frequently found at the mouth of these streams, in the region of the Superior Lowland. The soil is still in the process of formation so that only a thin covering of organic matter lies on the surface. The mineral soil consists of a dark brown yellow sandy loam extending down to twelve or fourteen inches; this grades into light colored wet sandy or gravelly material. In the Superior Lowland region heavy

PLATE III—(A) A characteristic view of the gently rolling Kennan soils. Such soils, when comparatively free of stones, have excellent agricultural possibilities.



(B) Another view of the Kennan soil, showing the rock piles characteristic of the cleared land in the Kennan area. Where these soils are too stony, the work of land clearing is not justifiable.

red clay may be encountered at three feet or deeper. The land generally overflows annually and drainage is poor so that wet and mucky spots are common.

Native Vegetation: The forest cover is chiefly elm with mixtures of willow, alder, red maple, balsam firs, etc.

Agriculture: Most of the Sheboygan Sandy Loam is uncleared at present. A few acres were observed which had developed sufficient drainage so that hay, oats and potatoes were grown successfully. The uncertainty of crops is too great to justify clearing the land in most cases but pasture of a fair sort can be depended upon throughout the year.

Kennan Loam

Extent and Distribution: The Kennan Loam occurs quite extensively in the southern part of the county and comprises the larger portion of the gently rolling uplands as well as a portion of the hilly uplands in the southeastern part.

Description: The unplowed surface 1 to 3 inches is composed of leaf litter and forest mold. Underneath this organic matter is a thin layer of gray, very fine sandy loam about 2 to 3 inches in thickness. This is underlain by a mellow light brown loam grading at about 16 inches into a fine sandy loam. At 24 to 36 inches the subsoil is a pinkish sandy clay. This material was left by the ice during the glacial period and is often very stony. It has a high content of fine earth which makes it fairly retentive of water. The rocks from which it has been derived were mostly granitic. The soil is acid throughout. A few areas have a silt loam surface and are somewhat heavier in the subsoil than the typical Kennan Loam. The greater part of this silt loam is found in township 43 North, range 5 West.

Topography and Drainage: This soil has a wide range of topographic features, ranging from only gently undulating to very hilly; for the most part, however, it is gently rolling. The surface drainage is generally good although wet spots and swampy areas are commonly associated with this soil. The internal drainage is nearly ideal, being rapid enough to make the land workable in the spring and allow excess water to drain away, but yet sufficiently retentive of moisture to supply the ordinary agricultural crops and insure good pasture throughout the season.

Native Vegetation: The forest cover was originally mixed hardwoods with some white pine. Most of the original stand has been removed and the present second growth includes mixed hardwoods, as well as popple, white birch, white pine and oak.

Agriculture: The agricultural development of this type has been greatly dependent upon its topography, and ease of clearing. Considerable portions of this soil are very well adapted to farming as far as topography is concerned. In these lands the ease of clearing becomes the important factor. Some of this soil originally had considerable white pine; the remaining stumps always present a difficulty. But more important is the amount of stones. This amount varies greatly from area to area and each parcel of land must be

considered individually. Where the stones are only scattering or few, land clearing may be accomplished at a reasonable cost while other areas are too stony to justify more than brushing for pasture lands. Frequently a good farm unit may be worked out by using the less stony portions for cultivated crops and leaving the remainder in pasture land. But many tracts are much too stony to justify clearing and should be devoted to forestry. The maps on the backs of the soil maps show the degree of stoniness by forties.

The crops most commonly grown on the Kennan Loam are hay, oats with some barley and rye. Potatoes are well adapted to this soil and good yields are obtained. Due to the fact that good pasture may be secured by brushing and seeding on this soil, it is well adapted to dairying. Corn for silage can be grown successfully and alfalfa is adapted to the soil; for the latter an application of lime is generally necessary for a uniform stand and maximum yield. These two crops, supplemented with root crops will largely solve the winter feeding problem for the dairy farmer. As the farm is more fully cleared, grain and potatoes may be added to advantage.

Kennan Sandy Loam

Extent and Distribution: The Kennan Sandy Loam occurs throughout the area of gently rolling uplands and in the southern portion of the hilly uplands. Small areas may also be found within the large body of sandy moraine, known as the Bayfield Ridge.

Description: The virgin profile is as follows: (1) Leaf litter, surface organic matter and black fine sandy humus soil, about 2 inches in thickness; (2) gray loamy fine sand about 3 inches thick. This sand is rather loose and incoherent. (3) Brown sandy loam. The soil is mellow in the upper part, but somewhat compact in the lower parts. A slight cementation is usually noticeable in the central portion. The soil has a fair water-holding capacity, but not as much as Kennan Loam. At 2 to 3 feet this layer gives way to: (4) a deep subsoil of pinkish sandy till. The till has enough clay to make it stick together but water moves through it readily. This soil frequently is quite stony but usually is not as stony as the Kennan Loam.

Topography and Drainage: Kennan Sandy Loam has a wide range of topographic features. It is developed from the lighter portion of the ice laid ground moraine and also from a portion of the terminal moraine. Some of the land is only undulating to gently rolling, while other areas are strongly rolling to hilly. Drainage is not a problem with this soil. Those areas with A or B topography and with but few stones are suitable for farms.

One noticeable variation occurs in the Kennan Sandy Loam. In the region north of Cable and extending east towards Grand View much of this soil contains a large percentage of pebbles and gravelly material. Agriculturally this variation seems not to be of great importance. The gravelly areas are indicated by gravel symbols on the map, where they occur.

Native Vegetation: The original cover consisted of mixed hardwoods and white pine, most of which has been removed, and at present popple and white birch with some jack pine and oak form the tree growth where the original forest is gone. Areas not badly burned have good hardwood reproduction, particularly hard maple.

Agriculture: The factors most commonly limiting agricultural development in this type are topography and stoniness. Those areas developed within the hilly uplands, or morainic sections, frequently have such a hilly surface that they do not lend themselves to agriculture. Although this type is usually not as stony as the Kennan Loam, stones are present and frequently become so numerous as to make clearing unprofitable. The water holding capacity of this soil is not as great as that of the loam types. As a consequence the land is not as well adapted to hay and pasture crops, although these crops are successful except during the drier years. Potatoes are better adapted to the Sandy Loam than to the heavier types. Oats do well on this soil; corn will approach maturity earlier than on the heavier soil, although not quite as large a growth can be expected. The soil is very acid and an application of about 2 tons to the acre of ground limestone is to be advised for the good growth of alfalfa and similar crops.

Antigo Fine Sandy Loam

Extent and Distribution: The area of Antigo Fine Sandy Loam is restricted to about 11 square miles in the vicinity of Cable and a few other small areas scattered throughout the lower part of the county, especially in the vicinity of Pigeon Lake.

Description: In the virgin condition the soil has an organic covering of leaf litter and humus, about 2 inches in thickness. This is underlain by a brownish gray sandy loam or fine sandy loam 2 to 3 inches thick. Underneath the grayish layer the soil becomes a light brown fine sandy loam or loam. This layer is quite retentive of water. At about 30 inches the soil is underlain by loose yellow sand and gravel.

This soil is developed on high bench lands. The rocks from which the deposits were formed are largely granitic and the resulting soil has been found to be acid throughout. The surface of this type is generally level or only gently undulating. Drainage is good but not excessive.

A gravelly phase of the Antigo is indicated on the map by gravel symbols. In a few areas, particularly the one near Pigeon Lake, the soil has a great many well-rounded cobbles about 4 to 6 inches in diameter. All of the areas designated by gravel symbols may have some of these cobbles. Frequently these areas have good deposits of road material; in fact all of the Antigo has good possibilities of gravel deposits. With the exception just noted, the surface soil of the Antigo Fine Sandy Loam is particularly free from stones.

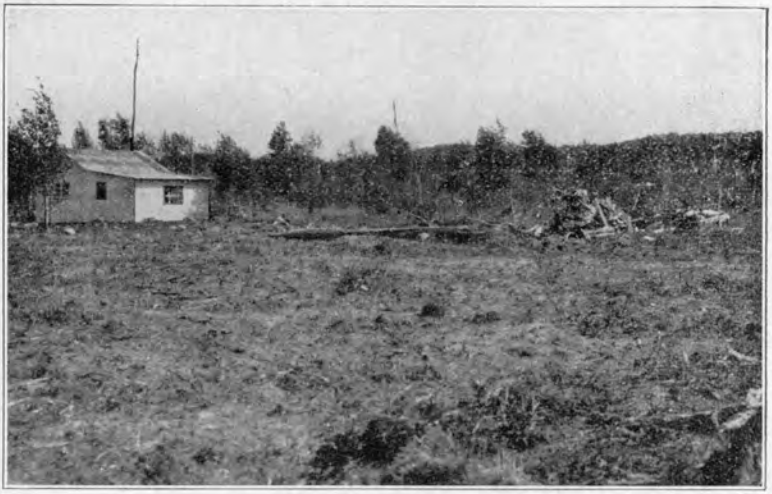


PLATE IV—(A) A new farm on Antigo Fine Sandy Loam. This soil is characteristically level or gently undulating and is well adapted to potatoes and other cultivated crops. Pasture is not as successful on this type as on the Kennan and Superior soils.

(B) A view on Plainfield Sand showing the level nature of the surface. Potatoes and other crops give fair yields when the soil is properly managed.

Natural Vegetation: The native cover on this type is largely jack, Norway, and white pine, with occasional areas of mixed hardwoods, popple and white birch. The Norway and white pine have been almost entirely removed.

Agriculture: A considerable portion of the Antigo Fine Sandy Loam is cultivated. Good crops of oats and clover are grown; particularly are potatoes well adapted to this soil. Alfalfa may be grown profitably but an application of lime is almost always essential for a good stand. Clover may also be expected to respond profitably to lime.

Cable Loam

Description: The Cable Loam is found in the poorly drained areas within the region of Kennan soils. The surface consists of nearly black quite well decomposed organic matter, containing sufficient fine material to give it a mucky character. This mucky material varies in thickness from a few inches to nearly a foot in depth; as the organic matter becomes thicker the soil is classified as one of the peat types, depending upon the nature of this organic matter. The upper mineral soil is a dull gray loam, or sandy loam. At about four inches, this grades into dull brown light sandy loam. The substratum is a sandy, stony till. The land is usually level, and most commonly occurs as small spots or strips in hilly country. Stones are so very numerous that in most cases clearing is impracticable.

Native Vegetation: The forest cover consists chiefly of popple, white birch, balsam fir, white spruce, red maple, alder, willow, with some ash and elm. In the original forest there was considerable white pine.

Agriculture: There is very little of this land utilized for farm purposes. In areas where this soil is associated with land suitable for cultivated crops it may be used as pasture but the excessive stoniness prohibits clearing for plowable land.

Plainfield Sand

Extent and Distribution: The area of Plainfield Sand includes the high benchlands in the western part of the county in the vicinity of Barnes, and also the benchlands west and northeast of Iron River. Other small areas occur throughout the county.

Description: The surface has a shallow layer of leaf litter about 1 to 2 inches in thickness. Underneath this is 1 to 3 inches in thickness of a light bleached gray layer of loamy sand. This gives way almost abruptly to a dull yellowish brown loamy sand. The soil is somewhat compact, especially in the central part of the horizon. At about 28 to 36 inches, the soil grades into loose yellow sand. A few pebbles and well-rounded cobbles are present, especially in the lower part of the soil, but large boulders are absent. Stones are never a problem on this type.

Topography and Drainage: In general this soil is level or only gently undulating; however, in many places large pits or depressions occur. Some of these depressions are occupied by lakes or bogs, while others of them are dry. The drainage is free to excessive. There are hardly any streams within the Plainfield area. Due to its rapid drainage this soil can be tilled earlier in the spring than the heavier types; and where the growing season is short, this is a distinct advantage. Yet for this same reason, this soil also becomes dry during the summer and crops and pastures on it are subject to severe drought during a season of scanty rainfall.

Southwest of Iron River and in a few other locations, the soil is quite fine throughout. In these places the original water laid material has evidently been re-worked by the wind. The land is generally somewhat rolling or "billowy" in surface configuration. By reason of the slightly finer texture the soil has a somewhat greater water holding capacity.

Native Vegetation: The forest cover on the Plainfield Sand is largely jack pine with occasional spots of Norway pine, although a few areas of white pine, popple, white birch, and other species have been observed. Practically all of the white and Norway pine have been removed, and considerable of the jack pine. Large areas of scrub oak are also found on this type of soil, especially where the land has been repeatedly burned by forest fires. Sweet fern grows quite generally and in those areas which are only scantily timbered, almost completely covers the surface. A great portion of this soil can be cleared at a very low cost.

Agriculture: Only a small portion of the Plainfield Sand in the county is under cultivation. The crops usually grown are: corn, potatoes, oats, rye, buckwheat and clover. The chief trouble in getting a catch of clover or alfalfa is that when seeded with a grain crop this crop dries the ground so much that the clover or alfalfa suffers from lack of moisture. Better results are secured by seeding alone or with a very light nurse crop which may either be clipped when less than a foot high and allowed to lie as a mulch if the soil is dry, or be cut later for hay. The first crop of clover may be used for hay while the late summer growth can be plowed under to increase the organic matter. The use of lime and potash will also help greatly to secure good yields of clover and alfalfa.

Many of the farms once started on this soil have been abandoned. In most cases the poor success may be largely attributed to three factors: (1) Continuous growing of grain and cultivated crops resulting in the depletion of the organic matter. With a sandy soil having a low water-holding capacity the presence of organic matter is especially necessary. (2) Lack of lime. Plainfield sand is low in lime; but one ton of ground limestone per acre every 5 or 6 years should be applied. For alfalfa, two tons should be used. (3) Lack of potash. Light sandy soils in Wisconsin are generally low in potassium and applications of potash fertilizers are always beneficial.

Plainfield Light Sandy Loam

Extent and Distribution: The largest area of Plainfield Light Sandy Loam is found in the high benchlands in the northern part of the Bayfield peninsula. Other smaller areas are distributed throughout the county.

Description: The virgin soil has a surface layer of organic matter about one to two inches in thickness. This is underlain by 4 to 9 inches of dull gray loamy sand. Beneath the gray layer is a dull brown or grayish brown light sandy loam. This material is fairly retentive of water and gives the soil a higher water-holding capacity than that of the Plainfield Sand. At about 30 inches the soil grades into porous yellow gravelly sand. Although large stones are absent on this soil, a few well-rounded cobbles occur. The drainage is free but not as rapid as in the case of the Vilas or Plainfield Sand. The land is generally level or gently undulating with occasional benches or pits.

Native Vegetation: The forest cover was like that on the Plainfield sand but with some more Norway and white pine. The pine has all been removed except for some jack pine. In badly burned areas scrub oak has made its appearance. Land clearing is not difficult on this soil in most areas.

Agriculture: There has been but very little agricultural development on this soil. This soil is adapted to the same crops and calls for the same treatment as the Plainfield sand.

These two soil types are of course relatively low in fertility and water-holding capacity. But their ease of clearing and working; the fact that they can be worked much earlier in the spring than heavier soils and their low first cost are advantages. When the farmer understands the treatment they require and uses good management, he can expect reasonable success in farming them. However, it is probably not desirable that new farms be started on these soils except in communities already started. The remainder should be used for such kinds of wood growing as they are adapted to until more farm lands are needed.

Dunning Sand

Description: This soil consists essentially of four to twelve inches of nearly black, fairly well decomposed, organic matter over wet gray or yellow sand. The organic matter usually has sufficient fine material to give it the appearance of a silty muck. This type occurs associated with the Plainfield and Vilas soils. It occupies the shallow depressed areas and includes strips of wet soil between the sandy upland and the peat. The land is flat and is naturally poorly drained.

Agriculture: Very little of the Dunning is used for agricultural purposes. Most of the areas are small. Its low natural fertility would not seem to justify the expense of drainage in order to grow

field crops. In its present state marsh hay and rather coarse pasture may be produced. The use of moderate amounts of lime, phosphate and potash will improve its pasture value.

Vilas Sand

Extent and Distribution: Vilas Sand is one of the most widely occuring types within the county. It forms the sandy glacial drift, particularly the moraines. Of these deposits the largest and most prominent is the Bayfield Ridge, a large interlobate moraine, occupying the central portion of the peninsula. Other areas are distributed quite extensively in the southern portion of the hilly upland.

Description: The virgin soil consists of: (1) A surface layer of peaty organic matter and sandy humus soil, about 1 to 2 inches in thickness: (2) Dark gray loose sand, about 2 or 3 inches in thickness: (3) Brown loamy sand fading at about 16 inches to a light brown sand. The sand is more loose than in the case of Plainfield although a slight coherence generally is noticeable at about 8 to 16 inches. At about 3 feet from the surface this material grades into: (4) a substratum of pale pinkish yellow sand. Some boulders are usually present but the soil is not usually stony. Some stony areas have been indicated on the map. Toward the northern end of the Bayfield ridge horizon 3 is often cemented into lumps or irregular layers. A few stony eskers were included as Vilas and the stoniness indicated by symbols. In the vicinity of Iron River and east some of the material consists largely of fine sand, rather than sand, but the profile character and adaptation of the soil to growing plants seems to be nearly identical to the typical Vilas sand.

Topography and Drainage: The topographic feature is quite variable. The majority of the Vilas is strongly rolling to very hilly with some areas of gently rolling land. Both the surface and internal drainage is excessive.

Native Vegetation: The original forest was largely Norway pine with some white and jack pine. The more northern areas described above also contain some hardwood, particularly maple, in the mixture. A large part of the prominent moraine in the center of the peninsula has been known as the "Barrens" for a great many years. Repeated fires had destroyed the young trees so that since white men have known the country large areas have supported practically no forest growth. At present jack pine and scrub oak form the chief tree growth, with a few Norway pine. On the more southern areas popple, white birch and red maple form a large part of the forest. In many places these species do not make good growth, however.

Agriculture: Agriculture has not been developed on this soil, nor can it be encouraged. The hilly nature of most of the land makes it undesirable from that standpoint. The water-holding capacity of the soil is too low for either pasture or ordinary farm crops. There is no prospect that the hilly areas will be needed for agricultural

purposes for a long time, if ever, and the best use for this land would seem to be for purposes of reforestation, through the prevention of fires and possibly planting. As mentioned above, the more northern area has a higher water-holding capacity, but clearing can be accomplished only at considerable expense and pasture cannot be depended upon during the summer season. Areas near the shore of Lake Superior may be utilized for horticultural crops, to some extent. The waterholding capacity of the soil is too low, however, to expect maximum yields.

Bibon Fine Sand

Description: Bibon Fine Sand is chiefly confined to the Superior Lowland. The soil is essentially yellowish sand over impervious clay at about five to seven feet. The type includes recent beach deposits of sand along the shore of Lake Superior. The land is nearly level to gently rolling and drainage is free.

Natural Vegetation: The original vegetation was white pine as the dominant species while the present second growth consists of popple, white birch, red maple and similar species.

Agriculture: Agricultural development is not to be encouraged at present on the Bibon Fine Sand. Most of the areas are small and occur associated with the Orienta soils and Superior Fine Sandy Loam. Although the water relations are quite similar to Orienta, most of the Bibon occurs outside of the region climatically adapted to fruit growing. The droughty nature of the soil during the dry seasons of the year make it an undependable soil for either pasture or cultivated crops.

Saugatuck Sand

Extent and Distribution: The Saugatuck Sand is limited to a few small areas scattered throughout the area but is principally confined to the Superior lowland region.

Description: The surface layer consists of a layer of forest mold, 2 to 4 inches thick. Below this is a layer of gray medium sand or fine sand from 7 to 10 inches thick, below which it changes to a dark brown loamy sand. Frequently this layer is indurated into a sandy hardpan. Gradually this induration disappears and the soil becomes lighter in color. Below about 36 inches the soil is water saturated most of the year. The newly plowed land has a spotted appearance of gray, black and brown, depending upon which portions of the soil were plowed up.

Topography and Drainage: The land is nearly level or undulating; however, the surface is characterized by numerous "cradle-knolls" probably caused by over-turned trees. In drainage condition the soil lies between Plainfield Sand on the one hand and Dunning sand on the other.

Native Vegetation: The original forest was chiefly white pine with some spruce and other species. At present balsam fir, popple, white birch, spruce with some Norway and white pine form the second growth. There is a ground cover of sweet fern.

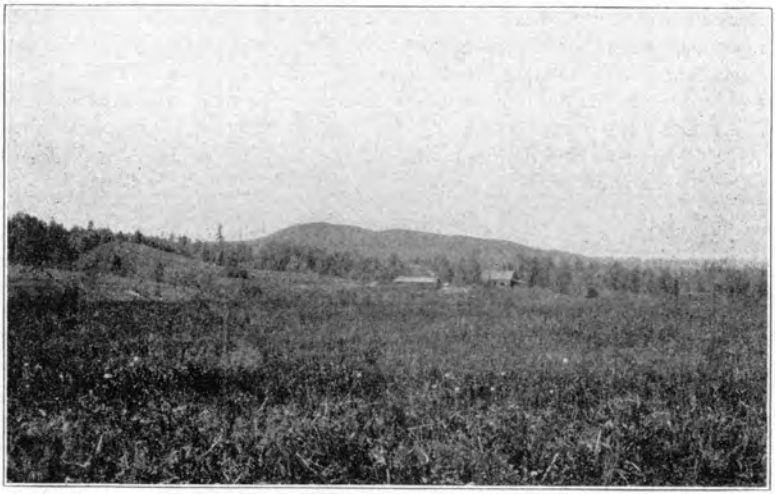


PLATE V—(A) A view showing the characteristic topography of Vilas sand. The more level soil in the fore-ground is Superior Fine Sandy Loam. Over 200 square miles of Vilas Sand are located in the central part of the Bayfield Ridge.

(B) A typical peat bog of the type mapped as Yellow Fibrous Peat. In the fore-ground the vegative cover is leather leaf, with a rim of stunted black spruce in the background.

Agriculture: This soil is not very suitable for agricultural use although such crops as cucumbers, strawberries, etc. may be grown when the fertility is maintained. It should probably be used for forestry.

Peat

Three classes of peat were recognized in the county on the basis of the organic material and its formation.

Yellow Fibrous Peat

Extent and Distribution: This type of peat is found in all portions of the area, except within the red clay region. It usually occurs as small areas although a few large bodies were found.

Description: Yellowish brown or reddish brown coarse, felty, fibrous peat, formed largely from small xerophytic shrubs and coarse reeds. The surface is spongy while the lower part is firmer. The material is very raw; decomposition has been but slight. The reaction is very strongly acid. The bog waters are usually brownish or yellowish. The natural drainage has been poor with no adequate outlet. The water table fluctuates several feet during the season so that in the spring the bogs are very wet while in the late summer they are extremely dry in the surface.

Native Vegetation: This type is mostly open marsh. The natural cover is largely xerophytic shrubs, leather leaf, Labrador tea, etc. Cranberries are often found. Clumps of stunted black spruce are common.

Coarse Woody Peat

Extent and Distribution: This peat is found throughout the county; the largest areas are in the southern part in the region of the gently rolling uplands.

Description: Brown, woody (with some fibrous) peat. The surface is coarse, slightly decomposed, woody material with more fibrous peat beneath. The woody material has mostly come from coniferous swamp species. This fibrous material is generally coarse and felty. Dark grayish-brown pulpy peat may be encountered at three feet or more. The reaction is strongly to very strongly acid. This peat is found under natural conditions in relatively wet swamps. The drainage water is usually brown.

Native Vegetation: The natural cover is largely spruce and tamarack. Some cedar and other swamp species may be present, but no hardwoods. There is usually a ground cover of heath plants and sphagnum moss.

Agricultural Use: On account of the expense of drainage, clearing and fertilization, the agricultural use of the yellow fibrous peat and the coarse woody peat cannot be wisely undertaken under present conditions.

Fine Woody Peat

Extent and Distribution: The largest area of this peat soil is the large body south of Mason, known locally as the "Bibon Marsh". Other areas are found throughout the area of red clay and in the gently rolling upland region.

Description: Dark brown (often nearly black) woody peat. This material has been derived from coniferous and hardwood forest accumulation. The surface fifteen inches is medium to fairly well decomposed and has a rather fine texture. The lower part is more raw and a lighter brown color. At about 2½ to 4 feet yellowish brown fibrous peat is usually found. This fibrous material is frequently somewhat matted. The reaction is usually slightly acid to neutral. The original drainage was moderately good; not as poor as in the case of the Coarse Woody Peat. The water table has been relatively stable. The drainage water is clear.

Native Vegetation: The native forest growth is mixed cedar, elm, ash, soft maple, white spruce, tamarack, alder, willow, etc.

Agricultural Development of Peat Soils: While this type of peat when adequately drained and properly fertilized would undoubtedly produce good yields of hay, root and other crops, the expense of drainage is likely to prevent it from being so used for some time.

CLIMATE

Since climate is of equal importance with the soil in determining the crops to which any region is adapted, a brief description of the climate of Bayfield County is first given. Figure 2, giving the mean summer temperature of the state, shows the conditions in this county. It brings out the fact that while the extreme northern part of the county near the lake and bay are kept much cooler, due to the influence of the water, the larger part of the county has summer temperatures as high as those found through a number of the western counties of the state, extending as far south as St. Croix and higher than that found in the northern part of the eastern portion of the state. It is this relatively high mean summer temperature which is the chief factor in determining the growth of crops.

The length of the growing season or the period between the last killing frost in the spring and the first in the fall is also important since that is the length of time which tender crops have for growth. Figure 3, showing the average number of days without killing frost, indicates that in the northern part of Bayfield County the modifying effect of the water of the lakes is to lengthen this period in that section. In other words, while the central and southern portion of the county has a higher average summer temperature, it has a shorter growing season, while the northern portion, having a cooler

summer, has a longer growing season. This difference is further expressed in the accompanying tables.

The northern cooler section, with the longer period between frosts, is better adapted to certain crops such as fruit and potatoes, while in the central and southern portions crops such as corn which require

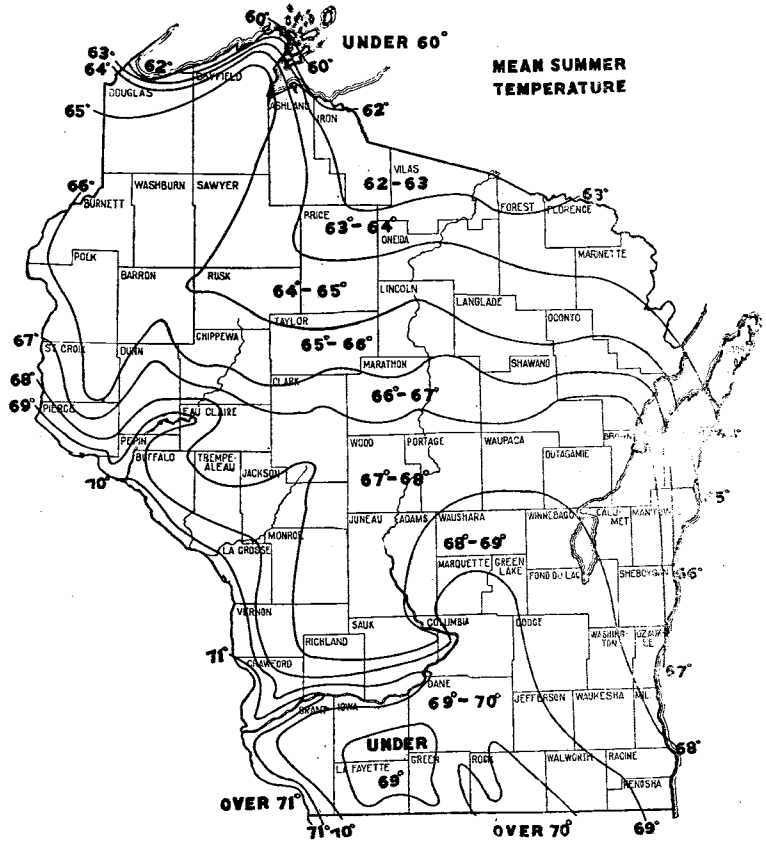


FIG. 2—Comparative Mean Summer Temperatures in Wisconsin. The Influence of Lake Superior is Very Noticeable in Bayfield County.

higher temperature for growth, will do better than in the northern part even though the length of the growing period is less. The farmer planting corn on land having good air drainage May 25 can expect 115 days before killing frost eight out of ten years. For the major crops, including hay, small grain and such special crops as roots, peas and others, the temperature conditions are favorable throughout the county.

Since dairying is the most important line of farming in this as in most other counties of the state, a comparison of the climatic conditions in Bayfield County with other leading dairy regions is worthwhile. Denmark is recognized as one of the most successful intensive dairy regions of the world and a comparison of the climatic conditions

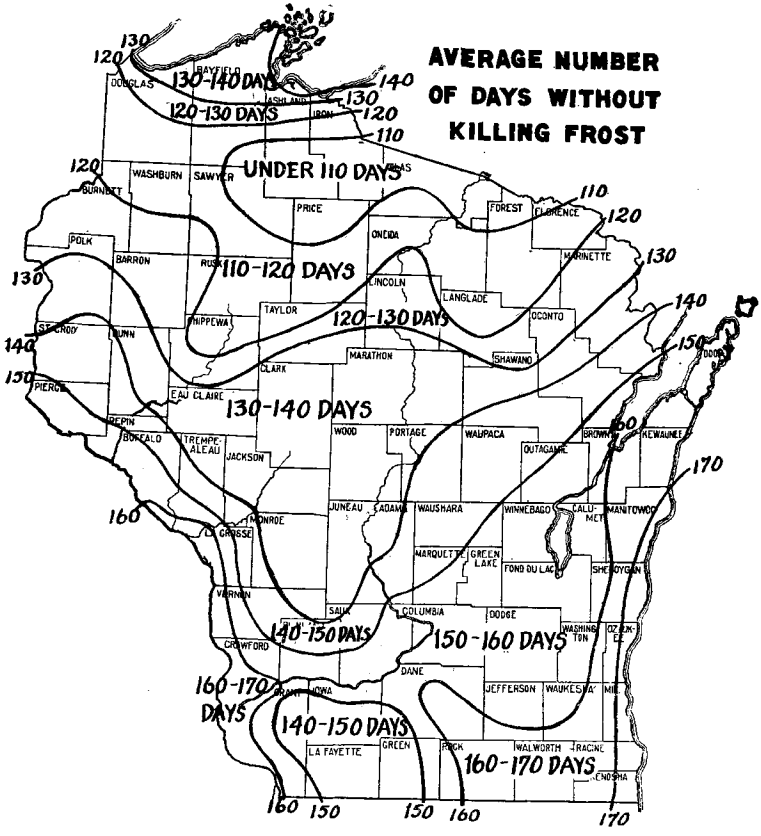


FIG. 3—Average Number of Days Without Killing Frost in Wisconsin. This Map Shows That the Growing Season in Much of Bayfield County Is As Long As In the Central Part of the State.

of Bayfield County with those of that country is expressed in Figure 4. This shows that both temperature and rainfall conditions of northern Wisconsin are more favorable to crop growth including pasturage than those of Denmark. The winters of the latter country are less severe but the feeding season is practically as long as that of Bayfield County. The heavy snow lasting well through the winter is very beneficial in protecting clover and alfalfa and in insuring

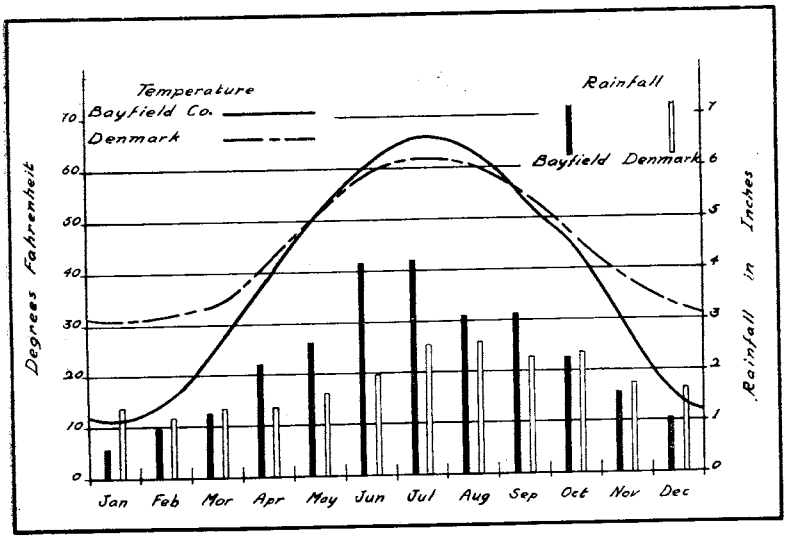


FIG. 4—Comparison of Average Monthly Temperature and Rainfall at Copenhagen, Denmark and Bayfield County, Wisconsin. Both Temperature and Rainfall Conditions of Northwestern Wisconsin are More Favorable to Crop Growth Than Those of Denmark, a Country Well Known for Its Successful Intensive **Dairying.**

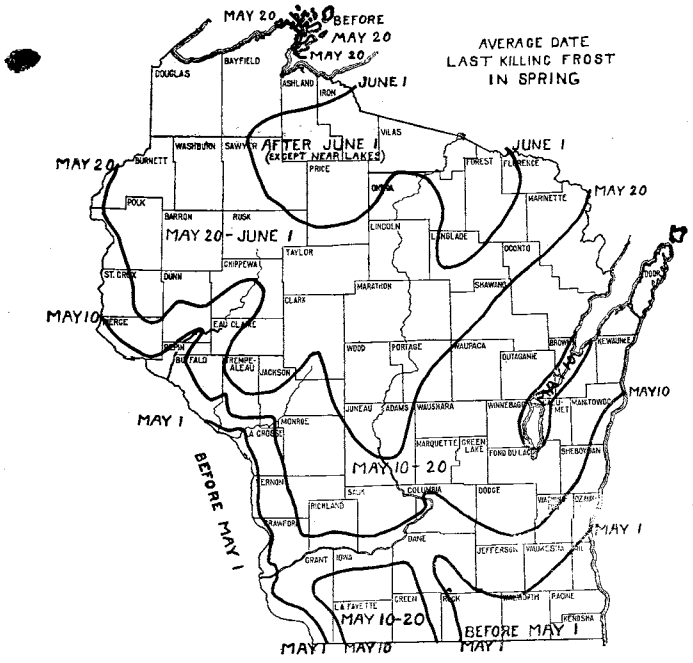


FIG. 5—Average Date of Last Killing Frost in Spring.

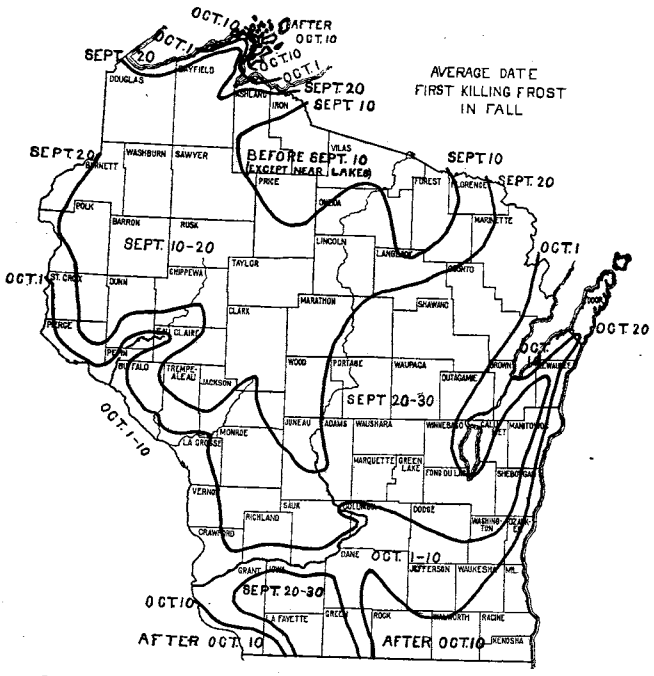


FIG. 6—Average Date of First Killing Frost in Fall.

good moisture conditions at planting time. Droughts during the later summer are much rarer than throughout the United States further south.

Figs. 5 and 6 show the average date of the last killing frost in the spring and the first in the fall.

The most important facts regarding rainfall, average temperature and frost are given in the following tables:

MEAN ANNUAL TEMPERATURE AND PRECIPITATION

Month	Cornucopia		Bayfield		Iron River	
	Precipitation	9 yrs. Temperature	Precipitation	15 yrs. Temperature	Precepitation	11 yrs. Temperature
December	1.21	17.2	1.28	21.4	1.46	17.4
January	1.49	10.1	1.37	13.3	1.14	5.8
February	.60	13.7	1.49	13.7	0.90	9.1
March	1.33	26.0	1.53	22.4	1.49	25.7
April	1.62	38.8	2.12	40.2	2.26	41.1
May	2.91	49.1	3.23	50.9	3.52	51.7
June	4.29	57.1	3.02	61.3	3.75	62.2
July	2.28	64.5	2.87	67.2	3.65	67.2
August	3.16	63.6	2.64	65.2	2.40	64.7
September	2.50	56.5	2.75	59.5	3.15	57.1
October	2.45	46.4	1.53	47.7	2.62	46.0
November	1.68	33.1	1.28	31.6	2.00	29.9
Year	25.52	39.7	27.26	41.3	28.40	39.8

PRECIPITATION AT POINTS IN OR NEAR BAYFIELD COUNTY

	Length of Record	Mean Annual Rainfall	Annual Snow Fall
Cornucopia	9 yrs.	25.52 in.	58.2 in.
Bayfield	14	27.26	51.6
Iron River	11	28.40	63.5
Hayward	32	29.12	50.2
Ashland	30	27.68	42.6
Solon Springs	15	28.75	49.8

FROST DATA AT HAYWARD, WISCONSIN

Elevation of Station—1,197 feet

Year	Last killing frost in spring	First killing frost in fall	Length of growing season
1910	May 14	Oct. 6	145
1911	June 28	Aug. 29	62
1912	June 7	Sept. 26	111
1914	May 15	Sept. 25	132
1915	May 19	Aug. 25	97
1916	June 5	Sept. 16	102
1917	June 15	Aug. 25	70
1918	June 25	Sept. 4	70
1919	May 19	Sept. 27	130
1920	May 14	Oct. 1	139
1921	May 16	Oct. 2	139
1922	May 28	Sept. 12	107
1923	May 20	Sept. 12	115

Average length of growing season at Hayward for 13 years—108 days.

FROST DATA AT IRON RIVER, WISCONSIN

Elevation of Station—1,096 feet

Year	Last killing frost in spring	First killing frost in fall	Length of growing season
1909		Sept. 1	
1910	June 3	Sept. 12	100
1911	May 12	Sept. 28	138
1912	May 29	Sept. 27	120
1913	May 25	Sept. 22	119
1915	May 27		
1916	May 2	Sept. 16	136
1917	May 28		
1918	May 13	Sept. 10	119
1919	May 11	Oct. 7	148
1920	May 14	Sept. 20	138
1921	May 16	Oct. 4	141
1922	April 30	Oct. 12	165
1923	May 17	Sept. 14	120
1924	May 21	Sept. 29	131
1925	May 25	Sept. 21	119
1926	May 14	Sept. 25	134
1927	May 20	Oct. 3	136

Average length of growing season for the above 15 years is 131 days at Iron River, Wisconsin.

FROST DATA AT CORNUCOPIA, WISCONSIN

Elevation of Station—640 feet

Year	Last killing frost in spring	First killing frost in fall	Length of growing season
1912	May 12	Oct. 15	155
1913	May 25	Sept. 23	120
1914	May 14	Oct. 14	152
1915	May 27	Oct. 9	134
1916	May 12	Oct. 9	149
1917	May 28	Oct. 6	130
1918	May 13	Sept. 26	135
1919	May 20	Oct. 7	139
1920	May 15	Oct. 1	138
1921	June 4	Oct. 4	122
1922	April 28	Sept. 25	151
1923	May 23	Sept. 30	130
1924	June 3	Sept. 10	99
1925	June 27	Sept. 21	87
1926	June 19	Sept. 12	85
1927	June 1	Oct. 7	132

Average length of growing season for 16 years—128 days at Cornucopia.

FROST DATA AT BAYFIELD, WISCONSIN

Elevation of Station—635 feet

Year	Last killing frost in spring	First killing frost in fall	Length of growing season
1891	May 16	Oct. 22	159
1892	May 27	Oct. 30	156
1893	May 23		
1894	May 11	Nov. 4	177
1895	June 1		
1896	April 8	Oct. 8	183
1897	April 30	Sept. 20	143
1898	April 26	Oct. 6	163
1899	April 22	Sept. 29	160
1900	April 19	Nov. 7	202
1901	April 24		
1902		Nov. 4	
1911	May 2	Oct. 22	173
1912	May 5	Oct. 23	171
1913	May 26	Oct. 18	144
1914	May 1	Oct. 14	165

Average length of growing season for 12 years—166 days.

AGRICULTURE*

Agricultural operations in Bayfield County date from about 1900, when farming began to assume proportions worthy of note. At that date there were 465 farms in the county and several communities were starting to develop. In 1910 there were 1080 farms in the county and by 1920 the number had increased to 1791. In 1925 there were 2275 farms. There seems to have been a reduction after 1925 for in 1927 there were 1809 farms. In a general way, farming operations followed the lumbering industry but at a much slower rate, for the amount of cut-over land increased much more rapidly than did the amount of farm land. In 1925 there was only 6 per cent of the land in the county in farm crops, while by far the greater part of the county had been cut-over, and the timber removed. In 1920 there was 17.9 per cent of the land in the county in farms, and that year the average size of farms was given by the census as 96.3 acres.

Agricultural development is not equally distributed over the county. There are a number of communities which are highly developed and there are extensive tracts of land where there is no development at all. The towns which are most highly developed together with the number of farms is given below:

Oulu	215	Port Wing	100	Washburn	126
Kelly	101	Mason	115	Barksdale	116
Eileen	140				

The towns in which there is the least development together with the number of farms in each is given herewith:

Namakagon	4	Delta	18	Iron River	11
Barnes	16				

In considering these figures, it should be kept in mind that the political towns are not all the same size. They range in area from 36 to 144 square miles. It also happens that parts of some towns are well improved while other parts are made up entirely of wild land. A glance at the soil map will readily show where houses, roads, etc. are most plentiful. These are the areas of highest development.

The town most highly developed is Oulu. This town of 36 square miles has 215 farms or approximately 6 farms per square mile. Eileen Town with approximately 36 square miles has 140 farms or about 4 farms per square mile. Mason Town has 36 square miles and 115 farms or about 3 per square mile. Washburn town has 90 square miles and 126 farms or 1.4 per square mile. In this Town most of the settlement is in the eastern part of the area while the western portion is taken up with wild cut-over land. Going to the other extreme, we find the town of Namakagon with 72 square miles with only 4 farms, while the Town of Barnes has 108 square miles and 16 farms. Delta has 72 square miles with 18 farms.

Note: For a discussion of the forestry possibilities of Bayfield County see part II of this report published by the Department of Agriculture.

Bayfield County presents a great variety of conditions which influence agricultural development. Some of these conditions are variations in the soil, the forest cover, climate and economic conditions such as markets, transportation facilities, roads, etc.

The most important of these factors is the soil. These variations in the soil are very marked and have largely determined the areas in which agriculture can be successfully practiced.

Some of the soils in the county have such a low producing power as to make certain areas entirely unfit for the cultivation of crops. Then there are other regions with soils of high productivity where highly developed farm communities have been established. Between these two extremes are various soils on which the advisability of attempting to farm is questionable. Between 30%–40% of the county is considered suitable for agricultural development at present including that already developed.

In Bayfield County agriculture has been developed most extensively on the Superior series of soils. These soils range in texture from a fine sandy loam to a clay loam. The clay loam is by far the most extensive. There are several places where agricultural communities have been developed. One of these is in the Town of Oulu and adjoining towns, covering considerable country between Iron River and Port Wing. Another good agricultural section is in Mason, Eileen and Kelly townships. Smaller agricultural communities are found in the vicinity of Washburn, Bayfield, south of Cornucopia and near Herbster. These communities mentioned have grown up chiefly on Superior clay loam, and other soils of the same or related series.

In the vicinity of Cable in the southern part of the county and extending northward towards Drummond, is a farming region that has grown up on the Antigo and Kennan soils. In the vicinity of Barnes, in the southwestern portion of the county, is an old community on Plainfield sand. The success of the agricultural communities already started will be made more secure by the development of more farms in these communities so as to secure better support for schools, roads, etc.

Important Crops

The chief crops grown in Bayfield County in about the order of importance from the acreage standpoint are hay, oats, barley, potatoes, corn and wheat, with such crops as buckwheat, peas, sugar beets, flax and beans of lesser importance. Alfalfa is grown to a limited extent.

Agriculture in Bayfield County has been developed chiefly along the line of dairying. While it is not generally considered a corn country, it is possible to grow corn for silage. As shown by the table of agricultural statistics given herewith, the number of silos is gradually increasing, which indicates also that the dairying industry is growing. In 1927 there were 300 silos in the county. In 1925 there were 161 and in 1920 there were only 30. The towns that lead

AGRICULTURAL STATISTICS

1928 Report of Assessors (corrected)

Bayfield Co.

	No. of Farms	Silos	A. in Corn	A. in Potatoes	Oats	Barley	Clover & Timothy	Alfalfa
Barksdale	116	30	118	60	264	176	1,331	60
Barnes	16	2	46	21	42		468	
Bayfield	43	18	101	26	136	26	265	79
Bayview	76	23	62	39	181	82	763	18
Bell	34	6	27	29	97	34	305	1
Cable	66	13	31	133	500	11	1,100	7
Clover	63	4	43	23	238	111	774	16
Delta	18	0	9	12	44	28	268	
Drummond	62	6	49	74	123	3	463	15
Eileen	140	18	83	88	753	322	2,745	3
Hughes	48	3	80	63	87	7	440	5
Iron River	11	2	18	14	61	3	170	2
Kelly	101	29	110	199	437	328	2,067	
Keystone	80	7	73	79	216	161	1,182	
Lincoln	74	5	162	156	310	166	1,293	9
Mason	115	14	75	56	275	309	2,313	2
Namakagon	4	1	1	7	6	2	75	
Orienta	56	8	44	16	144	189	1,226	46
Oulu	215	7	29	103	570	187	2,569	
Pilsen	71	10	27	50	257	132	1,171	
Port Wing	100	7	39	60	411	285	1,070	29
Pratt	51	9	41	72	207	60	800	14
Russell	42	12	66	67	109	35	421	18
Tripp	44	17	120	7	265	51	802	18
Washburn	126	25	72	75	313	106	1,291	55
Cable Village	4		65	9	8			
Mason Village	3						67	
Washburn Village	8			6			161	
Bayfield City	5			3				

Showing Number of Farms by Towns

1928 Report of Assessors (corrected)

Town	No. of Farms	Town	No. of Farms	Town	No. of Farms
Barksdale	116	Drummond	62	Namakagon	4
Barnes	16	Eileen	140	Orienta	56
Bayfield	43	Hughes	48	Oulu	215
Bayview	76	Iron River	11	Pilsen	71
Bell	34	Kelly	101	Port Wing	100
Cable	66	Keystone	80	Pratt	51
Clover	63	Lincoln	74	Russell	42
Delta	18	Mason	115	Tripp	44
				Washburn	126

in the number of silos are Barksdale with 30, Kelly with 29, Washburn with 25, Bayview with 23, Bayfield with 18, Eileen with 18, Mason with 14 and Cable with 13. Dairying is by far the most important branch of farming in the county. Butter and cheese are the chief products put on the market. In 1927 there were produced in the county 1,421,143 pounds of butter and 329,503 pounds of cheese. The amount of milk produced in 1927 was 576,800 cwt. There has been a gradual increase in the output of dairy products since 1900. In 1925 there were 8 creameries and 3 cheese factories in the county. In 1927, 892 farmers in the county supplied milk to creameries and 157 took their milk to cheese factories.

In making a study of the acreage of crops grown in the county as shown by the accompanying tables, it will be observed that for the past ten years there has been a gradual increase in the acreage of the most important farm crops. This increase has been general in practically all of the towns where agricultural communities have been developed. The number of farms in the county has increased from 463 in 1900 to 1809 farms in 1927.

During the past ten years the acreage of hay has increased in all of the agricultural communities. The total acreage of oats in the county has increased although there are a few towns in which there has been a decrease in acreage. Barley acreage shows a high percentage increase. Corn, produced chiefly for the silo, has increased in acreage, and the number of silos has increased until in 1928 there were 300 silos. The acreage of alfalfa, while small, is increasing and nearly all agricultural communities have made a start in growing this crop.

During the past few years since the War, while agriculture has been more or less depressed and the farmer handicapped by low prices, agriculture in the various farming communities in this county shows a healthy growth.

SUGGESTIONS FOR THE IMPROVEMENT OF AGRICULTURE IN BAYFIELD COUNTY

Agricultural Suggestions for Bayfield County

Expansion of farming operations in Bayfield County for at least the next few years, should be confined to soils which have unquestionable agricultural possibilities. These soils include the Superior types, the soils of the Orienta series, the Poygan series, Antigo series, the Kennan series where not too stony and to parts of the Plainfield series where level and most favorably located.

Under present economic conditions it does not appear advisable to attempt to reclaim the large marsh areas within the county. Potholes, depressed areas, and small marshes within operating farms can and should be drained to insure more economic operation and production on the farm unit.

The acreage of alfalfa should be increased. Lime will be helpful in starting alfalfa on many places on the Superior soils, and necessary on most of the other upland soils of the county.

The dairy industry appears to be the best branch of farming for extensive development in this region.

The raising of sheep could well be extended since there is so much land suitable for pasture, and also sufficient land available for the production of winter feed.

The production of hay could well be extended.

The commercial growing of potatoes offers possibilities on the Plainfield sand, light sandy loam and other fine sandy loams.

The fruit industry offers possibilities for extension, but those interested should be sufficiently financed to care for pruning, spraying, etc. Strawberries and raspberries do especially well, and the area devoted to them could well be extended.

GEOLOGY AND WATER SUPPLY DATA

The geological formations of Bayfield County are the pre-Cambrian granitic formations, the Keweenawan trap, the Lake Superior sandstone, the glacial drift and the lacustrine red clays. The northern part of the county is underlain with Superior red sandstone, over which is a thick mantle of clay and gravel forming an artesian slope, and producing an excellent source of underground water supply. The southern part of the county is underlain with crystalline rock over which is a variable thickness of glacial drift.

The principal water-bearing formations are the surface deposits of sand and gravel associated with the glacial drift and the red clay. The coarse sandstone beds carry an abundant supply but the fine grained beds of shaly sandstone are low in water. Usually, however, a considerable increase in the supply over that obtained in the drift can be obtained by drilling twenty to forty feet into the underlying sandstone.

The Keweenawan trap rock and the Huronian granitic formations are impervious, the supply being confined to the open fractures and joints.

A well defined artesian slope is developed in the surface deposits of stratified clays and sand adjacent to Lake Superior, with head of twenty to forty feet above the lake.

It may be said that there is a good supply of water available for household purposes and stock in all parts of the county.

FRUIT GROWING*

Climatic conditions must be the first consideration in considering the adaptability of any area for fruit growing. Except for that portion which has its climate ameliorated by the influence of large

*For information regarding orchard management, varieties of various fruits and similar information, the Department of Horticulture, University of Wisconsin, should be consulted.

bodies of water, northern Wisconsin is not adapted to fruit. Lake Superior has an influence upon the climatic conditions of land adjacent to its shores; so that a small strip bordering Chequamegon Bay and Lake Superior can produce fruit successfully.** This area is approximately three miles in width; although in situations where the prevailing wind is off the lake, in valleys extending back from the shore and in the direction of the prevailing wind, fruit may be grown at greater distances. On the slopes of these valleys air drainage is usually sufficient.

After climate, soil conditions must be next considered in orchard planning. Within the area climatically adapted to fruit growing there are four general soil conditions:

(1) *Heavy red clay.* This condition is represented by the Superior Clay Loam and Superior Loam. In the case of the latter, sufficient fine sandy material was deposited on the heavy clay to give the surface soil a loamy texture, but the heavy clay is encountered at one to two feet. Part of this land is gently rolling and numerous drainways provide good surface drainage; other areas, particularly of the Clay Loam type are nearly level and drainage is slow. Air drainage conditions must also be noted and only those areas considered that are suitable in this respect.

The red clay subsoil of the Superior soils is too impervious to be ideal for tree roots. Impervious subsoil and poor drainage are factors which check vegetative growth, reduce yields and lead to physiological troubles that are difficult to overcome. With these soils the first consideration must be drainage and every effort should be made to maintain the soil in good tilth by carefully plowing and by the incorporation of organic matter. But at best it is questionable if success with fruit trees may be assured. The well drained, more rolling areas are to be much preferred to the level land. In the use of the Superior Loam strawberries may be grown very well provided the surface two feet can be well drained and the soil maintained in a good, mellow condition.

(2) *Rolling stony sandy loam soils.* A few small areas of Kennan soils occur within this area and are usually well suited to tree fruits. Most of the areas are very stony and expensive to clear; but once cleared they are good orchard sites. These soils usually are found on knolls or hillsides so that air drainage is good. Unfortunately nearly all of the Kennan soils lie outside the fruit belt.

(3) *Hilly sandy soils.* Several areas of Vilas sand are adapted to fruit growing from the standpoint of climatic conditions and air drainage. These soils are frequently quite hilly and occasionally very stony. Both the surface soil and substratum is very sandy so that the water holding capacity is low, either for tree or small fruits The introduction of permanent orchards of tree fruits on these soils

** See page 29 of this report and Wisconsin Agricultural Experiment Station Bulletin 223; "The Climate of Wisconsin and its Relation to Agriculture."

can hardly be encouraged under present conditions. By the incorporation of organic matter in the surface soil and by maintaining a good supply of organic matter small fruits, particularly strawberries, may be successful; but the other soils should be considered first.

(4) *Soils consisting of a sandy surface and a clay substratum including Orienta Sandy Loam and Superior Fine Sandy Loam.* The

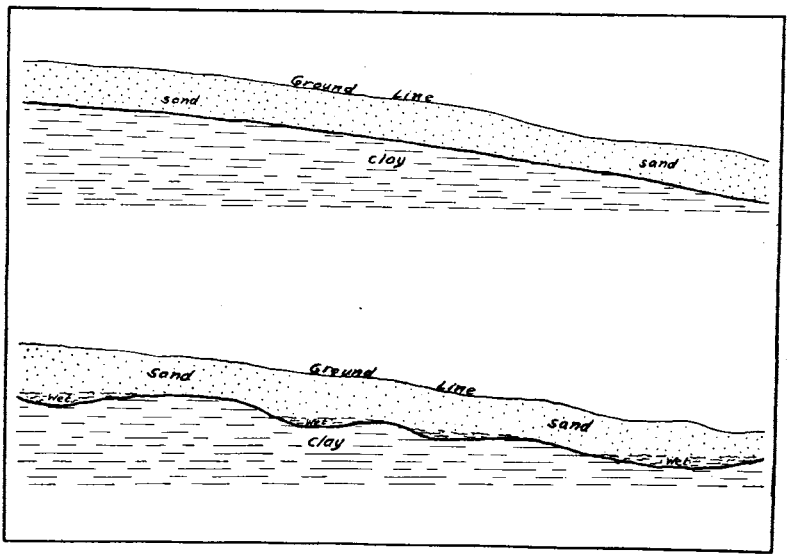


FIG. 7—Showing Relation of Subsoil to Drainage for Fruit Trees. In the upper sketch the uniform gradient of the clay floor insures good drainage. The lower sketch illustrates how water may accumulate in pockets above the clay. Water often will remain in these pockets sufficiently long to kill the lower roots of growing plants.

latter type has the clay at 18 to 35 inches while in the Orienta soils the heavy substratum varies from 30 to 80 inches, below the surface. Under the discussion of the Orienta Sandy Loam the importance of this clay substratum was emphasized. Elevated areas will be well drained while lower lying areas may be waterlogged. Of great importance is the configuration of the clay floor beneath the sand as well as the depth of sandy material over the clay. Even though the land surface appears to have a uniform gradient sufficient to provide drainage, the surface of the clay floor may be irregular. The sandy nature of the surface soil permits a large portion of the water to penetrate the soil rather than draining away as surface runoff. This water will accumulate above the heavy clay substratum; and if there is no adequate outlet it will accumulate and develop a relatively high water table in the soil above for a time sufficiently long to kill the lower roots. In this case the remaining live roots of the plant are confined to the upper soil which becomes very dry after

the water table subsides in midsummer and the plants will suffer from drought. Figure 7 illustrates the conditions described above. It is regretted that this important matter cannot be considered on the soil map. Each proposed orchard site should be carefully examined before trees or small fruits are set out in order to determine the nature of the water relations. Under good drainage conditions these soils are suited to all fruits, particularly are they well adapted to bush fruits.

Most of the fruits grown are apples, bush fruits and strawberries. Of the apples most commonly grown commercially are the: Duchess, Wealthy and Patten's Greening. The McIntosh has met with varied success. A great many other varieties are found in this section but their merits cannot be discussed here.

The strawberries, as well as raspberries, grown in this section find favor in the late markets after those from the southern sections are gone. The apples are too late to compete on the Chicago market and must depend on the local markets at Duluth and other neighboring cities.

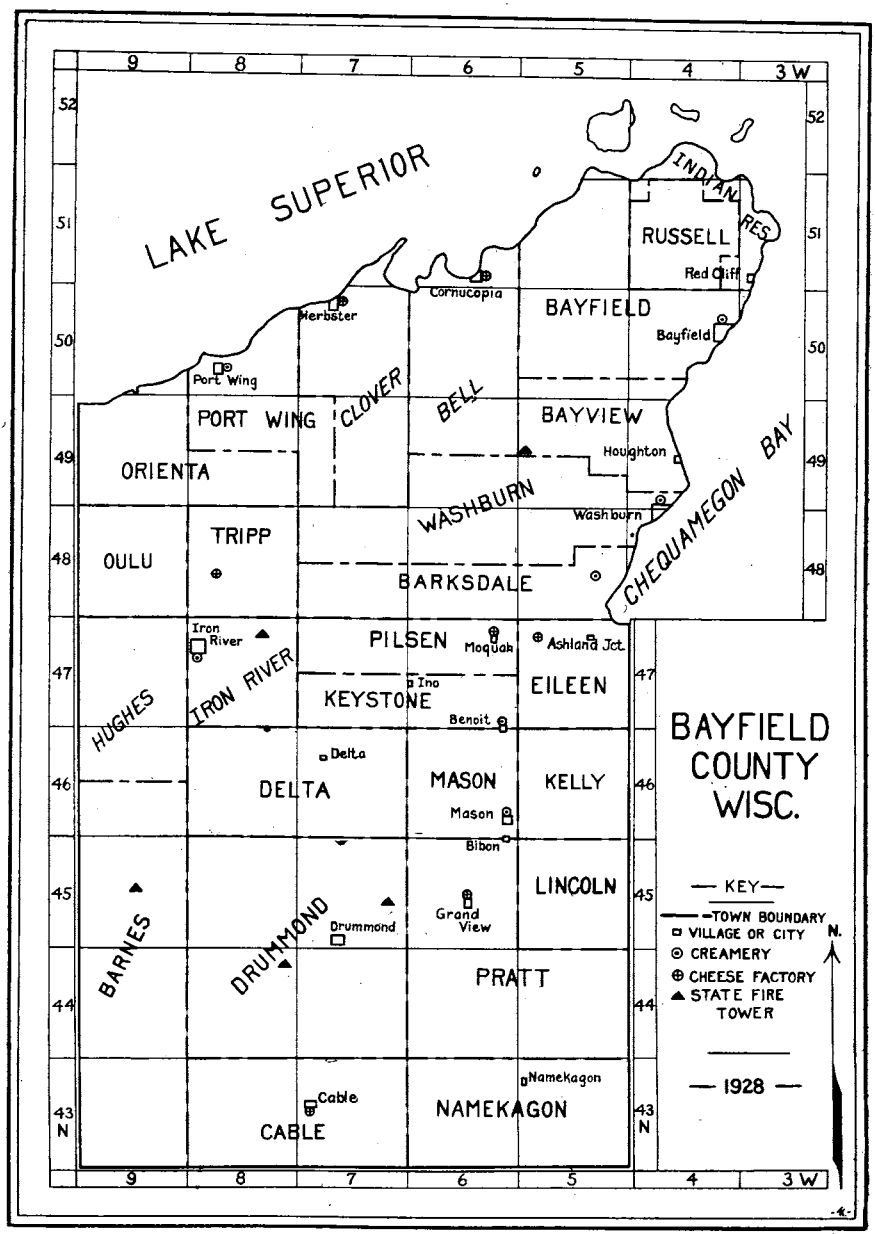


FIG. No. 8.—County Map.