WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

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

BULLETIN NO. XXXII SOIL SERIES NO. 6

RECONNOISSANCE

# SOIL SURVEY

OF

## NORTH PART OF NORTH WESTERN WISCONSIN

BY

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MADISON, WISCONSIN
PUBLISHED BY THE STATE
1914

# Wisconsin Geological and Natural History Survey

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MAP.

Soil Map of North Part of North Western Wisconsin .....*Attached to back cover*

# NOTE

The Soil Survey of Wisconsin is being made along two lines, first: a general survey of the northern and less well developed portions of the state, and second: a detailed survey of the southern and older portions.

The northern part of the state has been divided into five areas of each of which a map showing the general classes of soils is being prepared.

The first area included Portage, Wood, Clark, Taylor, Marathon, Lincoln, and portions of Price and Langlade Counties. The general survey of the soils of this area was made a number of years ago and maps and reports published. The classification followed in this early work differed somewhat from that at present in use and the maps do not show as much detail as the other maps of the northern part of the state.

The second area map, called the South Part of North Western Wisconsin, includes Polk, Barron, Rusk, Chippewa, Eau Claire, Dunn, Pepin, Pierce, and St. Croix Counties. Reports on this area are now available.

This report is on the third area, called the North Part of North Western Wisconsin, including Burnett, Washburn, Sawyer, Douglas, Bayfield, and most of Ashland Counties.

A special report has been prepared on the northeastern portion of Bayfield County along the bay and including the islands, in which considerable development of the fruit industry is taking place. This is now available for distribution.

The fourth area includes Forest, Florence, Marinette, Oconto, Langlade, and Shawano Counties. The field work on this area has been completed but much work remains to be done on the analysis of the soils and the preparation of the report, so that the map and report can probably not be ready for distribution before July 1st, 1915.

The fifth area including Oneida, Vilas, Iron, Price, and the eastern portion of Ashland Counties is being surveyed this year

(1914) and a report will probably be ready for distribution about January 1, 1916.

In the detailed survey in the southern part of the state the field work has been completed in Waushara, Waukesha, Iowa, Fond du Lac, Juneau, La Crosse, Jefferson, Kewaunee, Buffalo, Columbia, and Dane Counties. The reports on Waushara, Waukesha, and Iowa Counties are now available for distribution. Those on Fond du Lac, Juneau, and La Crosse and Kewaunee will be ready about December 1, 1915, and those on the remaining counties mentioned will be printed as rapidly after that time as the analytical work and the preparation of reports can be completed.

Reports on all of these areas when ready may be secured of the undersigned.

A. R. WHITSON,
In Charge of the Soil Survey.

# PREFACE.

An intelligent study of the soil is fundamental to all successful agricultural practice, for the soil is the basis upon which agriculture rests. The problems arising in the management of soils are among the most complex in the entire realm of agricultural science. In the solution of these the studious farmer can be of much assistance. Farmers, who have operated their farms for a decade or more, oftentimes without giving a thought to the principles of soil fertility, are awakening to the fact that soils are not inexhaustible, and that there exists a close relationship between yields and proper care and management of the soil. Too often, however, has the operator of a farm neglected to give heed to this relationship, and the result has been soil depletion and farm abandonment. There are few farms in the area under consideration that have been cropped for a long period; in fact, much of this section may be spoken of as virgin land. This is a distinct advantage to farmers now in the area, and others who contemplate locating here. The facts now known, relating to soils and soil fertility, as well as other phases of general agriculture, should be studied and applications made wherever possible in order to avoid some of the mistakes made by others, and to profit by the new and improved methods in farming.

Soils are found to differ in physical as well as in chemical composition, and the operator's success will be in direct proportion to the extent to which he realizes and learns these differences, and plans his methods of tillage, fertilizing, and cropping in accordance. To assist in the further study of the soils, as well as crops, and their adaptability to the soil, the state maintains two branch experiment stations, and one demonstration farm in the area, the work of which is directed by the College of Agriculture. The station at Spooner is located on sandy and sandy loam soil, and has for its main object the study of

this class of soils. At Ashland Junction the problems of the management of heavy clay soils are studied, while the farm at Superior, also on the clay soil, is purely of a demonstrational character. These institutions vary from 20 to 160 acres in extent, and are doing much to promote general agricultural development.

The survey of the soils of the state is under the supervision of the Wisconsin Geological and Natural History Survey, in cooperation with and under the direction of the College of Agriculture. One of the purposes of a soil survey is to acquaint farmers and others interested in agriculture with the different soil types in a given area. It is hoped that by means of the examinations made, both physically and chemically, together with the recommendations of the Experiment Station, that this work will become of real service to the farm operator. In this connection it should be stated that the Experiment Station will publish bulletins from time to time dealing with the management of the different types mapped, so that each person receiving a copy of this report, should make provision for preserving the map. It can be mounted on cloth for protection, and kept in this way for reference. Strong light will fade some of the colors, unless some means of preserving it is taken. The authors are fully aware of the incompleteness of this survey, but it is hoped that it will serve as a general guide to the soils of Northwestern Wisconsin, and form the basis of a detailed survey which will follow later.

T. Dunnewald assisted in the prosecution of the work in 1912, and C. Thompson in 1911 and 1912. Together they are responsible chiefly for the work in eastern Sawyer County, southern Ashland, and southwestern Douglas. Mr. Thompson also worked in the southeastern part of Burnett County, while Mr. Dunnewald did additional work in southeastern Washburn County. Mr. Bergh assisted during part of the season in 1910 in Bayfield County.

*Acknowledgments.* Acknowledgements are due the United States Bureau of Soils for use of part of the soil map of the Bayfield area, and also the Superior area. The mechanical analyses of most of the samples given in this report was done by the United States Bureau of Soils through the kindness of W. J. Geib, State Inspector for the Bureau.

Much assistance has been rendered the authors by lumber companies and others who furnished the party information, and assisted in furnishing means of transportation, etc. Thanks for such services are due the following:—Hines Lumber Co., at Hayward; Rust-Owen Lumber Co., at Drummond; Stearns Lumber Co., at Ashland; Theodore Okerstrom, Port Wing; Donaher Holton Co., St. Paul; Crex Carpet Co., St. Paul; Cordy Bros., Mellen; Wise Land Co., Stone Lake; Flieth-Thompson Co., Cornucopia D. M. Maxcy, Washburn; George Harmon, Spooner; W. Landraint, Supervisor of Assessments, Ashland; Good Land Co., Ashland; P. Savage, Iron River; J. W. Dady, Superintendent of Red Cliff Indian Reservation, Bayfield; and others who assisted our party in many ways. Acknowledgements are also due to F. T. Thwaites, Curator of the Geological Museum, who contributed valuable assistance in the preparation of the base map, as well as in correcting the proof maps; and to Dr. S. Weidman for suggestions and assistance with reference to the geology of the area.

The photographic views of Plate VI and figure 1 Plate IX, are from H. W. Geller, formerly Agricultural Agent for the Duluth and South Shore Railroad, and the views of Plate VIII, and Figure 2, Plate IX from H. H. Peavey of Washburn, Wis. The other views were taken for the authors by E. Ayres of Superior.

F. L. MUSBACH.

June 12, 1914.

# RECONNOISSANCE SOIL SURVEY OF THE NORTH PART OF NORTH WESTERN WISCONSIN.

## CHAPTER I.

### GENERAL DESCRIPTION OF THE AREA.

The area discussed in this report comprises about 6600 square miles, located in the north western part of the state, as indicated on the map of Wisconsin, figure 1. It is bordered on the west by Minnesota, and on the north by Lake Superior, and includes that portion of Wisconsin lying in the extreme north western part of the state. It lies approximately between the parallels 45° 45′ and 47° North latitude, and the meridians 90° 20′ and 93° West longitude, which corresponds to the latitude of north Maine and south Washington, and to the longitude of eastern Louisiana. The tract includes Sawyer, Washburn, Burnett, Douglas, Bayfield, and nearly all of Ashland county, embracing an area larger than the state of Connecticut and Rhode Island combined, or about half the size of the Netherlands.

*Early Exploration.* The counties bordering Lake Superior were among the first visited by white men; and long before settlements were made, French explorers and missionaries set foot on northern Wisconsin soil. Radisson, and Grosseilliers were the first to visit this region. From 1660 to 1662, they skirted the south shore of Lake Superior and built a stockade near the present site of Ashland. They spent the winter of 1661 exploring the interior of the country south to the head waters of the Chippewa River and west to the Mille lacs region in Minnesota. Claude Allouez followed in 1665 and opened a Jesuit Mission and trading post, named La Pointe, between the present cities of Ashland and Washburn. Marquette, famous

explorer and missionary, was the last Jesuit in charge of this mission, in 1671.

La Pointe was continued, however, at irregular intervals as a trading post, first on the mainland and later on Madeline Island, up to the time of the French and Indian War, when it

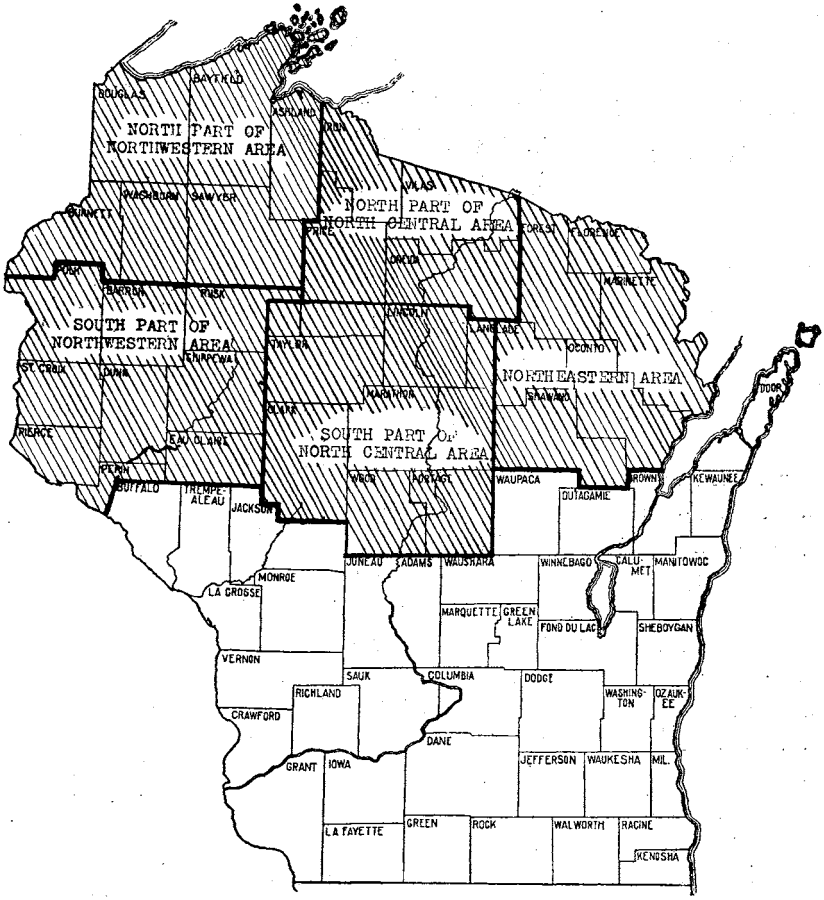



FIGURE 1. MAP SHOWING THE FIVE AREAS INTO WHICH THE NORTHERN PART OF THE STATE HAS BEEN DIVIDED FOR SOIL SURVEY PURPOSES.

was deserted for a short period, but was re-established in 1765. The post became an active bartering place for nearly a hundred years. The La Pointe mission house established by Catholics in 1840 on Madeline Island is still standing a short distance from the little village which bears that name. The name La

Pointe was later applied to a large portion of northwestern Wisconsin, out of which was carved Douglas county in 1854, Ashland in 1860, and Bayfield in 1866. The area, including counties to the south, was principally a part of Chippewa and Polk counties. Burnett County, including Washburn, was set off from Polk in 1865, and Washburn from Burnett in 1883. Sawyer remained part of Chippewa County until 1883.

*Early Settlements.* While exploring parties had traversed large portions of the area either on foot or by canoe, permanent settlements were not attempted until the early fifties of the last century. Stimulated by love of adventure, some of the pioneer builders followed the route of Daniel du Lhut, by way of the St. Croix and Brule Rivers to Lake Superior, and began the settlement of Superior, in Douglas County, in 1854. Aside from trading and hunting, little was attempted in agriculture for nearly 30 years, when the present Omaha railroad reached the head of the Great Lakes. The first setlement in Ashland County was made by eastern people—Asa Whittelsey and others—at Ashland, in the same year that Superior was started; while Bayfield was started in 1850, also by eastern people. The Omaha Railroad reached this point in 1883, and the Wisconsin Central came to Ashland in 1877. Burnett County was peopled by Norsemen from southern counties in the State. Grantsburg was founded by Knute Anderson in 1865, but had no railroad facilities until 20 years later. Washburn County was first settled by easterners in Bashaw Valley, in 1872. Shell Lake was founded in 1880, the year after the Ashland Division of the Omaha Railroad was built. Spooner was located at the present site in 1883. Early settlements in Sawyer County followed in the wake of the railroads in the early 80's, when Hayward and other towns were organized.

*Geology.* The district under consideration is underlain by rock formations which consist of very old crystalline rock, and sandstone of a more recent geological period.

*Crystalline Rocks.* The crystalline rocks are of Precambrian Age and include granite, quartzite, and trap rock. Granitic rock occurs in the southwestern portion of area as shown in the accompanying generalized map. See Plate II. These rocks are a part of the old Isle of Wisconsin, and represent the oldest known formation in existence. The rock is, as a rule, thickly

covered with glacial drift, so that exposures are found only in local areas, and usually of small extent. In the southeastern part of Sawyer County, a quartzite ridge, which is a continuation of the Rusk County Range, is a prominent topographic feature of that locality.

The Penokee Iron Ridge, which occupies a narrow belt overlying the granite, comprises not only iron bearing rock, but also quartzite, slate, and dolomite, which are quite complex in structure. From an agricultural standpoint, this latter product, consisting of a high grade of magnesium-lime rock, is of considerable economic importance. Especially is this true when it is understood that sources of limestone are unknown in this district, aside from this formation. In several locations in section 15, Township 44, Range 5 West, where exposures occur, a fine quality of material was observed occupying a nearly vertical fold 50 to 75 feet thick.

The Trap-rock (of Keweenawan Age) is an extensive underlying formation, which outcrops frequently in the form of escarpments above lower lying land. It is also known as the Copper Range, and such local names as Minong, Douglas and St. Croix Copper Range are used to designate local areas where outcrops occur prominently. In the vicinity of Mellen extensive ridges of solid rock are of frequent occurrence. Topographically, however, their influence is of relatively small importance, since the formation is covered, generally with a thick blanket of drift.

*Sandstone.* In western Burnett County, and southwestern Washburn County, the prevailing rock is sandstone, of later Cambrian period, which is known as Potsdam. No exposures of this rock have been found, as it is everywhere covered with a deep mantle of drift and alluvial material. This sandstone lies horizontally over the trap-rock and varies in thickness from 700 to 1000 feet. The material of the sandstone was deposited in shallow water of the sea, and the stone is, as a rule, quite soft and friable. This formation occupies also extensive areas in the central portion of the state.

The northern border of the area under consideration, including the entire Bayfield Peninsula, and continuing in a southwesterly direction into Douglas and Burnett Counties, is underlain by Keweenawan Sandstone. A portion of this formation, occupying a belt along the Superior shore, was formerly corre-

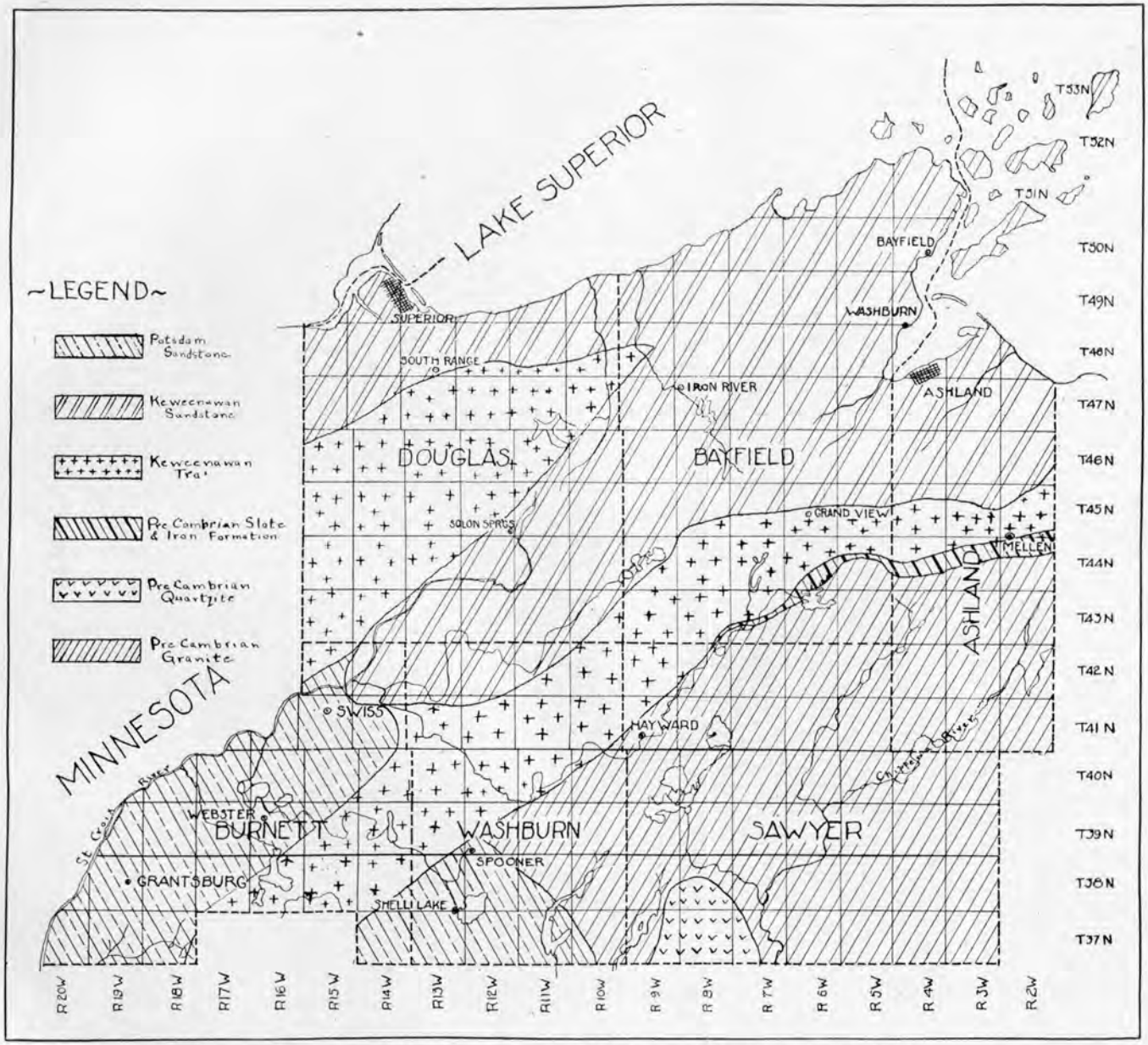



FIGURE 2. GEOLOGICAL MAP OF NORTH PART OF THE NORTH WESTERN AREA

lated with the Potsdam Sandstone found elsewhere in the State, but later studies* have shown that this belt may be grouped with the main body of Keweenawan Sandstone. The beds vary from nearly horizontal layers, along the shore, to more nearly vertical ones in areas some distance back from the shore line. In color the rock is predominantly reddish to chocolate brown, with local areas of a more whitish cast. This material has been used extensively for building purposes.

*Glacial Drift.* Deposits of glacial material form an almost complete covering of varying depth over the entire section, so that the underlying rocks are exposed in only a relatively small area. In the Bayfield Peninsula the glacial drift is very deep, exceeding 500 feet, possibly, in most cases. The material of the drift consists of sand, clay, and gravel, and is, predominantly reddish in color.

The history of ice sheets in this area presents some complex problems, a subject, which is now under investigation by geologists. It is quite generally believed that some of the material was carried in from long distances from Canadian regions, and that the area was under ice several different times before the final retreat of the last ice invasion.

In the area under consideration, the soil has been influenced to a large extent by the underlying rock, the decomposition of which furnished material that has been reworked and modified by the action of glaciers and other agencies. For example, the extensive area of Keweenawan Sandstone underlies more than 75 per cent of the sand soils described as Plainfield Sand. The granitic and trap rock, by their decomposition and disintegration, give rise to heavier textured loam and silt loam soils. The heavy red clay soils bordering Lake Superior bear no relation to the underlying rock (Keweenawan Sandstone), since this soil type represents material deposited by water at a stage in the glacial history, when the present Lake stood at a very much higher level than at present.

Repeated glaciation has been an important agent in modifying either directly or indirectly the soils which would otherwise have been formed. In some cases only a thin coating or veneer of glacial material has been deposited, while in areas, particu-

*F. T. Thwaites—Lake Superior Sandstone.

larly in the path of the moraine, the drift material may be several hundred feet in thickness, as in the case of so-called kettle moraine which occupies the Bayfield Peninsula. Again the material carried by the ice may be entirely foreign to the vicinity in which it now occurs, as in the case of the Miami loam soil in southwestern Burnett County. The underlying rock in this area is of Potsdam Sandstone formation, yet the surface soil is limey in character.

*Surface Features and Drainage.* The main topographic features of the area are: (1) the sloping plains bordering Lake Superior; (2) the morainic ridge occupied by the Bayfield Peninsula, and extending southwest nearly through the entire County; (3) the nearly level Jack Pine Plains in the southwestern part of the area, lying parallel to the St. Croix River, which also forms the northern boundary of the plain; and (4) the Range Country, which produces such prominent topographic features in Ashland County, and of lesser importance where it occurs elsewhere in the western part of area.

*Clay Plains.* The clay plains bordering the Lake are 10 to 15 miles in width, and follow the shore line continuously, except where interrupted by the morainic ridge in the Bayfield Peninsula. The slope lakeward varies from 10 to 50 feet per mile, being less near the Lake and more abrupt with the approach of high land to the south. The principal streams draining this area are the Bad, Flag, Iron, Brule, and Nemadji Rivers. These, together with their tributaries, are usually direct-flowing streams which have eroded deep and narrow V-shaped valleys throughout their entire course, except where the land near the Lake is comparatively low, where wide valleys occur, and streams meander in their course. This plain dissection has been carried on over considerable areas, and where it exists, makes farm operations tedious and inconvenient. There is also a tendency to further depredation, since the timber and brush are being removed, and no steps are taken toward checking the process.

*Bayfield Ridge.* The Bayfield Ridge of morainic material is a prominent feature of the Peninsula. The ridge is between 10 and 15 miles in width and occupies the heart of Bayfield County, and is essentially a region of hills and valleys. At the southwestern extremity it drops abruptly to the Jack Pine Plains,

and at the northeast it maintains its morainic character to the water's edge. This ridge rises rapidly from the water's edge to a height of nearly 650 feet in the vicinity of Bayfield, where also well marked beach lines may be observed, indicating the height at which the water of the Lake was held by the retreating ice sheet. The north shore of the Ridge is characterized by precipitous bluffs of red sandstone, varying from 10 to 50 feet in height, except where streams have produced wide valleys by erosion. This region is peculiar in that no streams occur within the area. Small lakes are of frequent occurrence. Many of the large streams have their headwaters near the foot of this upland. Rain waters falling on the upland sink until an impermeable strata is reached, which causes the water to seek an outlet. Springs are of frequent occurrence at the foot of this upland.

*Jack Pine Plains.* The Jack Pine Plains occupy a broad belt from 10 to 20 miles in width, extending diagonally across the district beginning in the southwestern part of Bayfield County and terminating in northwestern Polk County. The general slope is west and southwest. It is drained by the St. Croix and its tributaries, the principal ones of which are: Nemakagon, Yellow, Clam, and Wood rivers. In the southwestern part of the Plains occupied by a broad belt of 10 to 15 miles in width in the western part of Burnett County, almost a complete absence of lakes and streams is noted. Extensive peat beds are found developed here, which apparently mark the beds of former lakes.

*Range Country.* The Range Country stands out in bold relief above the Clay Plains in the eastern part of area and includes the Trap and also the Penokee Range. It rises to an elevation of 900 to 1200 feet above Lake Superior, and trends from a generally northeast to southwest course through Ashland and part of Bayfield Counties. In places the underlying rock is covered with drift and is comparatively low, while in the vicinity of Mellen, some of the crests reach an altitude of 1200 feet above the Lake, or 1800 feet above sea level. Outcrops are numerous, the principal ones of which are indicated on the map. These outcrops are usually sharp, precipitous ridges which give the country a rather rugged appearance. The

Range drops abruptly southward to a gently sloping upland, forming the principal water shed of this section of the state.

The Range country in the west is included in Douglas County, and consists entirely of separated ranges of the Trap formation. These are usually of less relief than the eastern section, averaging 500 to 600 feet above Lake level. A few of the local ranges are included in the Clay Plains. South of the Range, the country is generally level, gradually sloping southward. The watershed of this section of the state is within 8 to 10 miles of the Range.

The area included in the southeastern part of the district is of a rolling character, the slope of which is generally southwest. This region is drained by the Chippewa River and its tributaries. Areas, somewhat more hilly in character, occur in a tract of varying width beginning near Lake Owen and following a southwesterly course, leaving the area near Birchwood. This tract has a typical morainic topography, and represents material of recent Wisconsin glaciation.

# CHAPTER II.

## GROUP OF SANDY SOILS.

### PLAINFIELD SAND.

(Including Areas of Vilas Sand.)

*Area.* The area of the Plainfield Sand includes a broad belt of country 5 to 15 miles in width, that stretches from the southwestern townships of Burnett County in a northeasterly direction to a point about 10 or 12 miles from the extremity of the Bayfield Peninsula. A portion of the area in northern Bayfield County is separated from the main body by the undulating Vilas Sand. The slope of this belt or plain is toward the southwest in the direction of its length, with an average slope of 2 to 3 feet per mile. The St. Croix-Brule River channel, in a general way, marks the north and west boundary of the type in Douglas and Burnett Counties.

This area has been described at some length by Chamberlin in his "Geology of Wisconsin", as the "pine barrens". With respect to the origin, it is stated, that this formation is mainly the result of the sorting and stratifying action of water. At just what stage in the geological history this deposition took place, has not been definitely ascertained.

*Surface Features.* The topographic features are for the most part level to gently rolling, and viewed as a whole, may properly be spoken of as a plain. There are, however, areas in which the surface becomes of a rolling character, owing to glacial depressions, some of which are occupied by lakes, others by peat bogs, while some are dry. Often the otherwise level areas are marked by prominent ridges of wind blown material called "sand dunes". These are usually 25 to 50 feet in height.

In some areas it will be noticed by referring to the map, lakes are plentiful; while in others, few, if any, are found. In

the western part of Burnett County, a lakeless region occurs, and in the upper end of the Bayfield peninsula, and also in an area south of Brule River in Bayfield and Douglas Counties, a similar region is found. Through the central part of the so-called "plains," chiefly in Burnett County, lakes and streams abound. Many of the lakes are connected with one another by streams, of which the most important are the Clam River, the Yellow, and the Nemakagon.

Extensive peat marshes are frequently associated with this soil type in the western part of Burnett County. In some of the townships in this county, peat soil occupies two-thirds of the entire land area.

*Soil.* The soil of the Plainfield Sand is largely the result of material that has been sorted, reworked, and modified by water action, which has sifted out and carried off the finer earth particles. This process varied considerably, so that the soil resulting largely from this action, shows considerable variation. It is also very probable that in some sections, the soil has been modified by the action of ice movements over it.

In a general way, two soil types may be described, the separation of which involves the work of a detail survey. These variations are based primarily on the difference in the texture or size of grain of the soil mass, and the character and uniformity of the subsoil. By comparing the mechanical analyses of samples, this textural difference becomes apparent. No. I is taken from Barnes township in Bayfield County, and represents a loamy sand phase, while No. II, taken north of Grantsburg, is typical of the fine sand.

TABLE I.—*Mechanical Analyses of Plainfield Sand.*

No. I.

| Description | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|---|---|---|---|---|---|---|---|
| | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. |
| Surface soil, 0—8 inches..... | 1.3 | 24.9 | 30.0 | 21.8 | 3.2 | 13.1 | 5.6 |
| Subsoil, 8—24 inches.... | .4 | 18.7 | 32.1 | 29.9 | 4.5 | 9.8 | 4.8 |
| Subsoil, 24—36 inches... | .9 | 27.5 | 34.8 | 30.2 | 3.1 | 1.3 | 2.2 |

No. II.

| Description | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|---|---|---|---|---|---|---|---|
| | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. |
| Surface soil, 0—8 inches..... | .1 | 10.5 | 27.2 | 50.6 | 4.4 | 3.9 | 3.2 |
| Subsoil, 8—24 inches .... | .1 | 6.4 | 25.8 | 54.6 | 7.1 | 3.1 | 2.9 |
| Subsoil, 24—36 inches... | .0 | 2.7 | 21.4 | 66.4 | 6.2 | 1.8 | 1.4 |

In sample No. II, will be noted the preponderance of fine sand, and the small amounts of finer earth particles—silt and clay. No. I contains less than half the amount of fine sand, but larger amounts of clay and silt. No. I also contains more coarse gravel, and coarse sand. Some times a small amount of bowldery material is associated with this phase of the Plainfield Sand.

The soil of the predominant type is the fine sand, and to a depth of 8 inches, is generally a greyish to brown fine sand, carrying a small amount of organic matter in the surface 1 to 2 inches. The subsoil to a depth of 3 to 4 feet differs very little from the surface soil in texture. The color varies from reddish brown to pink or reddish, and is quite uniform.

The soil mass is an open incoherent mass of well rounded, angular soil grains, in which quartz grains predominate. On account of this water worn characteristic, the material lacks grit and sharpness so common in some sand. Besides quartz, hornblende and mica are found, these latter two often giving the soil a greyish cast.

In certain well defined sections of small extent, the surface 6 to 10 inches is nearly black in color, and contains a large amount of organic matter which has accummulated during periods of inadequate drainage. These are usually level or depressed areas, and are found principally in Burnett County north of Grantsburg. South of Webster, also several good sized areas of black sand occur. The agricultural value of this phase is increased considerably by the added amount of humus.

The loamy sand phase occurs in scattered tracts throughout the area. Portions of township 45, Range 9, afford a good illustration of this phase. The soil to a depth of 8 to 10 inches is greyish in color, and contains more of fine earth particles than the predominant type so that it resembles a loamy sand or even a sandy loam. The subsoil usually is of a lighter color, and grades into coarser sandy material to a depth of 36 to 40 inches. Frequently small amounts of gravelly material are associated with the subsoil. This phase of the Plainfield Sand, as a rule, is superior to the other agriculturally.

In some local areas, marked variations in the subsoil were found. Along a section adjacent to the St. Croix River, in Burnett County the subsoil was found to consist of fine gravelly material, which formed an exceedingly compact mass to a depth of several feet. Again red, lake deposited clays were observed along the St. Croix River underlying the sand. At Clayfield, a fine exposure about 20 feet thick underlies the sand at a depth of about 10 to 15 feet below the surface. This bed is composed of layers, varying in color and in degrees of hardness. Water flowing over this exposure, eroded the softer material first, leaving a rather jagged cross section. This material was used in the manufacture of brick at Clayfield, and also at Grantsburg. It is used also as a base in the manufacture of paint. A pulverizer and mixer were installed along the St. Croix River recently to utilize this raw material for paint purposes. Clay out-crops frequently in other local areas, but usually at such depths as to have no bearing on agriculture, either in contributing to the soil mass, or in influencing the moisture conditions of the subsoil. Fine spring water isues from the point of contact between sand and clay along the St. Croix River, and other places where conditions are favorable for water to escape.

*Native Vegetation.* The predominant timber growth de-

VIEW OF PLAINFIELD SAND SOUTH OF IRON RIVER, SHOWING CHARACTER OF TIMBER DEVELOPED OVER PORTIONS OF THIS SOIL TYPE.

Jack Pine is the predominant tree growth developed on this soil. Its value has increased rapidly since the Norway and White Pine have been so generally cut.

veloped on this soil type is jack pine, and on this account the area has been referred to as the "Jack Pine Plain". There is, however, considerable difference in the size of timber and the the density of growth. In some areas only small spindly trees are found, while in others, fine tall pine, scaling 1 million to 1¼ million board feet on 160 acres. See Plate I. Usually the ground water conditions are more favorable, or the soil is better in quality where these heavy tree growths develop. While jack pine is the prevailing tree growth, areas were found in which Norway, black oak, and occasionally poplar, and birch, developed almost to the exclusion of the prevalent jack pine. In the vicinity of Bass Lake and Big Sand Lake in Burnett County there are areas several square miles in extent, in which black oak form the predominant tree species. Hazel, willow bushes,* brake, and fern are often found associated with the forest, though in many instances these form practically the entire vegetation. Severe forest fires have been unusually destructive in this region, destroying not only the timber, but also the thin covering of vegetable matter. Until recent years the demand for jack pine lumber was limited. It, however, finds a ready market now, being used largely in the manufacture of boxes and crates, as well as dimension material.

*Agriculture.* A large portion of the Plainfield sand is under cultivation. The crops usually grown, and the yield are:—oats, 25 to 40 bushels, rye, 12 to 20 bushels, corn, 30 to 40 bushels, and potatoes, 100 to 150 bushels per acre. Navy beans are grown as special crops in several areas, and found to be a profitable crop. The hay crop is usually limited, and consists mainly of timothy; though where the soil has been managed properly, clover may be grown. Considerable difficulty, however, has been experienced in many localities in getting good stands of clover. The usual rotation followed consists of corn and potatoes, followed by oats, rye, or buckwheat the second year, and clover the third. See plate II. Too often, however, the hay stand is limited and the rotation resolves itself into alternating grain with cultivated crops. Dairying is carried on

*NOTE—The presence of willow appears to have no relation to depth of ground water. Willows were in abundant evidence in Sections 2 and 12, township 45, Range 10, where a flow of water was difficult to obtain at depths of 70 feet to 125.

to some extent over the area, and the tendency in that direction is well established. Truck crops are also important, and together with cream and butter, form the principal cash products sold from the farm.

## PLAINFIELD SANDY LOAM.

*Area.* The Plainfield Sandy Loam embraces an area of about 100 square miles, located mainly in Burnett County with several widely separated tracts in Washburn and Sawyer Counties.

*Surface Features.* The surface is generally level, becoming in places a trifle rolling. Practically the entire area is adapted for cultivation.

*Soil.* The soil to a depth ranging from 8 to 16 inches varies from a greyish sandy loam to loam, with which small pebbles and gravelly material are often associated. The subsoil is generally lighter in color, and carries a proportionately larger amount of gravel, and is frequently spoken of as gravelly subsoil. Strata of stony material are found at depths of 18 to 24 inches in local areas. The subsoil below 24 inches becomes more distinctly sandy, and at depths of 40 inches, sand is invariably found. In some localities, the subsoil was found to grade into fine sand at 12 to 18 inches; the gravelly material being entirely absent. Stoniness is of frequent occurrence, but seldom in sufficient quantities to interfere with agricultural operations.

*Native Vegetation.* The native forest growth is made up of a mixed stand consisting of black oak, birch, poplar, jack pine, and Norway pine. In certain sections of Burnett County around Doran, and in parts of Sawyer County, Norway pine with some jack pine are found; in others, jack pine is the predominant species. Practically all of the merchantable timber has been cut, the second growth forming dense thickets made up of poplar, birch, aspen, and hazel.

*Agriculture.* The soil is easily tilled, and well adapted to such crops as potatoes, corn, and other cultivated crops that require warm, mellow soil. Oats and rye are the principal grain crops. Barley is grown to less extent. Clovers and timothy are important crops, and grown generally. The type will maintain profitably a diversified system of farming.

VIEW OF PLAINFIELD SAND IN BAYFIELD COUNTY, SHOWING CHARACTER OF CROPS GROWN ON THIS SOIL.

This view illustrates a rotation well adapted to this type of soil. Oats stands in the foreground, cultivated crops—corn and potatoes back and at the left, and red clover in the background.

## PLAINFIELD SANDY LOAM. (BOTTOMS)

*Area.* The area of the Plainfield Sandy Loam (bottoms) occupies level bottom lands principally along the Nemakagon, and the Yellow River, and their tributaries. It is the location along stream bottoms, or former bottom lands that have been modified somewhat by ice or water action, that formed the basis for separating this type from the Plainfield sandy loam already described. The main body occurs along the Nemakagon river, beginning at a point a few miles west from where that river heads in a lake of the same name, widening gradually until in the vicinity of Earl in Washburn county, where it is nearly six miles wide, and includes practically an entire township. West from Trego, the bottom lands of the Nemakagon disappear, the river from this point apparently having cut a new channel, the banks of which are high and uneroded. South from Trego, there are indications that originally the river flowed in this direction, but was turned from its course by the accumulation of drift thrown across its course by moving ice. The same soil formation is continued, however, farther south along the Yellow river, and in the so-called Bashaw Valley in Washburn and Burnett counties. In the vicinity of Minong, another small area occurs.

*Surface Features.* The Plainfield sandy loam occupies valley bottoms which are generally level. The bluffs bordering the valleys are sometimes quite steep, and vary considerably in height, ranging from 50 feet to 200. Small depressions usually occupied by peat marshes are found here and there throughout the area. Portions of the area have been modified by the action of the Ice moving over it, and leaving the surface somewhat hummocky and uneven. Sags and depressions occur here more frequently. Part of the Yellow River valley in the vicinity of Spooner is modified in this way. The Nemakagon Valley slopes at the rate of about 8 feet per mile between Cable and Trego, the fall being nearly twice as great for the upper half of the valley as the lower.

*Native Vegetation.* The bottom lands were timbered mainly with a dense stand of jack pine, and Norway pine; the former occupying large areas almost exclusively, and constituting much

the greater extent of the timbered land. Scattering white pine are found occasionally, especially on the heavier soil phase. Black oak, poplar, and white birch, often occur locally, instead of the usual pine, or these appear as second growth after the pine has been removed. In the Bashaw Valley, forest growth was developed only locally, large areas originally being covered only with oak thickets, instead of pine found elsewhere.

*Soil.* The soil is of alluvial origin, and affords considerable variation both with reference to the soil and subsoil. In a general way, three rather distinct phases may be noted—sandy loam and loam, fine sand, and loamy sand.

The *sandy loam and loam* occur mainly in the Bashaw Valley, see Plate III, in the vicinity of Minong, portions of Yellow river valley in township 39, Range 12, and the larger part of the upper Nemakagon Valley, extending southward to the vicinity of Phipps. The soil to a depth of 6 to 10 inches is invariably a sandy loam to loam greyish to brownish in color. The subsoil usually grades into sandy material often carrying considerable amounts of gravelly material to a depth of 18 to 24 inches. Below 24 inches, the subsoil becomes quite sandy and continues to depths of 40 inches or more. Frequently clayey sand is associated with the coarse material under two feet, giving the subsoil a hardpan characteristic. This condition was found frequently in the Bashaw Valley.

A small amount of rock fragments occur throughout the soil mass, while over the surface small stones are found frequently, but not in sufficient amounts to interfere with cultivation. Slope wash from the hills adjacent to the valley bottoms often modifies the character of the soil along the bottoms near the approach of the upland, making the soil more loamy than it would otherwise be.

The *fine sandy phase* occupies a considerable tract north of the Nemakagon river between Trego and Spring Brook, and in portions of the bottom lands of the Yellow river in township 38 and 39, Range 13. The soil to a depth of 8 inches is a fine greyish to reddish sand, quite uniform in character. From 8 to 40 inches, the soil carries a trifle more coarse sand, and is lighter in color. At the lower depths the mass often contains considerable coarse material, pebbles and gravel. The line of separation between the fine sand and the loamy phase is not a sharp one,

VIEW OF PLAINFIELD SANDY LOAM SHOWING BOTTOM LANDS AND GENTLY SLOPING BLUFFS TO UPLAND. TAKEN FROM THE BASHAW VALLEY, WASHBURN COUNTY.

The separation of Plainfield sandy loam (bottoms) is based primarily on location. The type occupies bottom lands.

so that a mixture of both soils may be found in the vicinity where the one merges into the other.

In the greater portion of the Nemakagon Valley lying between Spring Brook and Phipps, and occupying approximately one-third of the entire valley, the soil is predominately *a loamy sand.* The surface 8-inches varies from a grey to brownish loamy sand to sand, carrying considerable amounts of coarse sand. From 8 to 16 inches, the subsoil becomes coarser and lighter in color, followed by coarser sand and gravelly material to a depth of 40 inches. At the latter depth, the formation is largely made up of coarse sand and gravel. The sand and gravel material comprising this soil is angular, smooth worn material, made up principally of quartz, hornblende, and mica. Small cobble stone, one half to two inches in size, are frequently found strewn over the surface.

The following table gives average results of mechanical analyses of soil and subsoil of two samples of the Plainfield sandy loam. The sample from the Nemakagon Valley represents the intermediate type, or loamy sand, while the sample taken from the Bashaw Valley is typical of the sandy loam and loam phase found in that valley, and also in the vicinity of Minong and elsewhere. No analyses were made of the fine sand the mechanical composition of which is similar to the Plainfield sand given under II on page 23.

TABLE 2.—*Mechanical Analyses of Plainfield Sandy Loam.*

| Locality | Description | Fine gravel | Coarse sand | Med. sand | Fine sand | Very fine sand | Silt | Clay |
|---|---|---|---|---|---|---|---|---|
| | | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. | Per ct. |
| Nemakagon Valley Twp. 41, Range 10. | Susface soil 0″—8″..... | 7.0 | 24.1 | 26.1 | 25.6 | 2.5 | 6.6 | 7.5 |
| | Subsoil 8″—24″..... | 17.6 | 23.4 | 23.9 | 24.3 | 1.8 | 3.9 | 5.1 |
| | Subsoil 24″—40″..... | 20.9 | 36.9 | 20.8 | 15.2 | .7 | 1.8 | 3.6 |
| Bashaw Valley. | Surface soil 0″—8″..... | 5.7 | 18.9 | 18.6 | 24.7 | 7.9 | 15.6 | 8.4 |
| | Subsoil 8″—24″..... | 8.9 | 13.0 | 14.5 | 26.3 | 14.2 | 14.7 | 8.1 |
| | Subsoil 24″—40″..... | 14.0 | 12.8 | 11.8 | 27.0 | 13.1 | 12.2 | 9.2 |

*Agriculture.* This soil type is devoted to general farming, and in part, to such specialized crops as potatoes, cucumbers, sweet corn, and beans. The Bashaw Valley is largely a dairy section, cream forming the main cash product. Potato growing is a very important industry along the entire Nemakagon Valley. The soil conditions are especially well suited for the tuber, and yields average during favorable seasons from 150 to 250 bushels per acre.

Small grains are oats, rye, and buckwheat. Corn is a crop that may be grown usually to maturity. The soil warms up early in the spring, permitting early planting. For ensilage the crop may be grown safely every year, as a rule. Clover is grown and yields well on all but the "lightest phase" of this soil. It can also be grown on this phase where proper precautions are observed, and the ground prepared properly. (See under Management of Sandy Soils.)

## VILAS SAND.

*Area.* The Vilas Sand comprises large areas chiefly in Bayfield and Sawyer counties. Smaller widely separated tracts occur also in most of the other counties of the area under consideration. The total area of this formation embraces upward of 600 square miles, or nearly one-tenth of the entire district. In a general way, the main bodies of this soil type are co-extensive with the area of terminal moraine of recent Wisconsin glaciation. The general trend of this moraine was from a northeasterly to southwesterly direction, occupying the extensive high ridged land of the Bayfield Peninsula, and continuing in a general southwesterly course following approximately the upper course of the Nemakagon river. South of Hayward, the formation becomes more irregular in outline, and its course is almost due south, leaving the area in the vicinity of Birchwood. In the northwestern part of Washburn county, a small area occurs which extends over into Burnett county. Several other smaller tracts are found throughout the area.

*Surface Features.* The surface of the Vilas Sand is essentially one of hills and valleys. The slopes of the hills may be steep and precipitous, barely sufficient to hold the material in

VIEW OF VILAS SAND SHOWING CHARACTERISTIC TOPOGRAPHIC FEATURES OF THIS SOIL FORMATION.
TAKEN NEAR TOPSIDE IN BAYFIELD COUNTY.

Considerable areas of Vilas sand are well adapted for grazing purposes—while others should be reforested.

place; or they may be long and gentle, rising in extreme cases to heights of 100 to 200 feet above the surrounding lower land. Over considerable portions of the area, the undulations are of less relief, varying in height from low knobs to abrupt hills 25 to 50 feet in height. Sags and depressions are common characteristics, which together with the rounded hills, have lead the term "kettles and pots" to be applied to regions of this character. The sags and depressions are frequently partially filled with decaying organic matter or peat, forming marshes, or they are occupied by water, forming ponds or small lakes few of which have any visible outlet in that portion of the formation in northern Bayfield County. See Plate IV. This part of the area is also a streamless area. South in Sawyer and adjoining counties, the lakes are large bodies of water, nearly all of which are connected with some outlet tributary to the Chippewa, or St. Croix rivers. In this portion, extensive areas of poorly drained swamp lands have developed. These are for the most part heavily wooded. Gravel ridges are of frequent occurrence.

Scattered here and there throughout this extensive assemblage of hills and valleys, there occur tracts ranging in area from a few acres to 100 acres or more, in which the surface is more gently rolling or moderately level, and on which the soil is of better quality than the type described.

*Native Vegetation.* The main body of the area in Bayfield county was timbered largely with Norway and white pine, which has been cut long since, leaving only stumps and lone dry tree tops remaining. Forest fires have frequently swept the cut-over land, adding to the desolateness of the country. Second growths of poplar, and birch frequently follow the cut-over pine. In isolated areas through the pinery, there frequently occurred hardwood ridges in which maple, basswood, birch, and oak make up the tree growth.

In the areas included in Sawyer, and Washburn counties, a mixed stand of timber developed; in places the pine predominated; in others hemlock, and mixed hardwood—maple, birch, and basswood, with scattering pine. The second growth is largely white birch, and poplar. Considerable areas of swamp land in northeastern Sawyer County and extending into Ashland, are wooded with spruce, ash, cedar, alder, and tamarack.

*Soil.* The soil is predominantly a brownish to reddish brown sand to sandy loam, to a depth of 8 to 10 inches, the surface of which is often greyish in color and carrying a small amount of organic matter. The subsoil invariably becomes sandy, lighter in color, and usually carries a small amount of gravelly material and small pebbles below 10 to 12 inches. As a rule, below 3 feet, the soil becomes quite coarse and generally contains more gravel and stony material.

While the prevailing soil is of this general character, wide local variations occur, both as to surface and subsoil. The surface soil was frequently found to be a fine loam or even silt loam with desirable subsoil characteristics, but in a survey of this character, it was impossible to separate out these areas, while others, if it were possible to map, would be too small to indicate on the map of the scale used. The better soil conditions are usually expressed by the character and stand of timber developed. In the exclusive pine section, isolated islands of mixed hardwoods are almost invariably associated with better soil or subsoil conditions. These areas are of variable extent. *The fact that this soil type includes tracts so widely different both in soil, and also in topographic features, cannot be too strongly emphasized.*

*Agriculture.* The agricultural possibilities of this soil type must necessarily be limited, and, as a rule, adapted to the conditions prevailing in the area. Much of the area is better adapted for grazing, which has been tried only in a limited way, but with apparent success. Unquestionably there are possibilities in this business. As stated, tracts less rugged in character are usually found within any considerable area, upon which the usual farm crops might be grown.

Again, there are areas which have been burnt over repeatedly leaving little of the rich vegetable matter in the soil. Such areas are capable of producing only a limited amount of grass under present conditions. There are also tracts which, on account of their ruggedness, and further because of the extremely light textured soil, are better adapted for forestry purposes. It is also quite probable that the original forest growth which developed here, started under more promising conditions, so that where forest fires have burnt over the ground so completely, considerable difficulty may be experienced at the present time in getting a growth started.

## MANAGEMENT OF SANDY SOILS.

There is no type of soil that may be cleared and brought under cultivation at less expense than the jack pine sandy soil. Much of the land in the area of the Plainfield Sand may be developed at a cost ranging from $4.00 to $7.00 per acre. Where heavily wooded areas occur, the expense, not including the cost of cutting timber and piling the brush, ranges from 12 to 15 dollars per acre.

The low cost with which this land may be brought under cultivation, as well as the ease of working it after it is once broken, have led many to practice excessive cropping without due regard to the limitations of soil of this character. Physically the sand soils are open and porous, and only contain a limited amount of organic matter, which in turn reduces their water holding capacity profoundly. Chemically, this class of soils are usually low in their nitrogen content, since this element is associated with the organic matter of the soil. The total supply of phosphorus is equal to about one-half to two-thirds that found in the heavier soil types, while the potassium condition is more satisfactory. The average of a considerable number of analyses shows the total content of the three essential plant food elements in the surface 8-inches, to be as follows:

| | |
|---|---|
| Phosphorus | 660 Pounds |
| Potassium | 34700 Pounds |
| Nitrogen | 1550 Pounds |

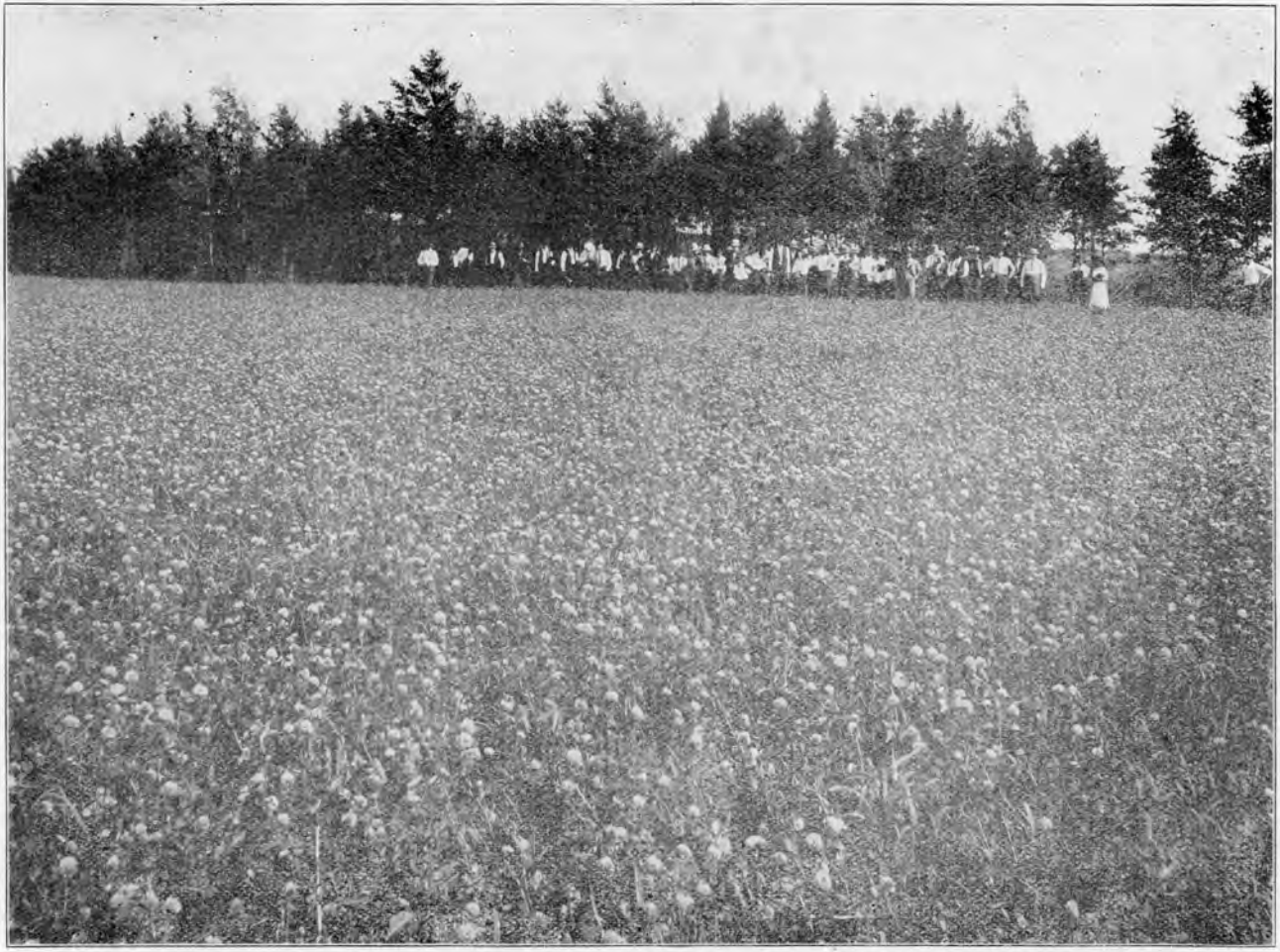
The rate at which any plant food element becomes available depends, however, in a measure upon the size of the soil particles, being proportionately less in coarse than in fine grained soils. The fact that these soils have a low water holding capacity, and are deficient in most of the essential plant food elements, should be taken fully into account by the owners of this type of soil immediately after the land has been cleared and broken, rather than after a number of years of cropping to grain and cultivated crops, without the use of legume crops, some of which should be plowed under frequently in the rotation period.

The starting point with soils which have been cropped for some time is the incorporation of organic matter, either by plowing under a green crop, preferably a legume, or by means of barnyard manure. Clover and alfalfa are splendid crops to utilize for this purpose, where these can be grown. See Plate V. The acid condition of the soil, and the lack of available plant food are, however, often causes for failure in getting a crop of either started. Annual legumes, as soy beans, cow peas, and winter vetch are acid-tolerant plants which may be grown until conditions favorable to clover and alfalfa are obtained. Rye and buckwheat are also valuable crops to turn under to increase the organic matter in the soil, but these do not add any nitrogen as the legumes do. There is, however, less difficulty in getting a fair stand of the grain crops, even though the soil has been depleted to a considerable extent. As a starter, then, they possess this important advantage over clover and other legumes.

The introduction of organic matter not only serves to increase the water holding capacity of the soil, but also through its decomposition, tends to liberate insoluble mineral plant food in the soil. This is especially true of potassium, fairly good supplies of which are contained in the soil, as shown by chemical analyses.

As the total amount of phosphorus is already low in virgin soils, the logical step is to increase the amount of this element in the soil. Where it is possible to utilize concentrated feed stuffs, high in protein, such as bran, the amount of phosphorus in the manure may be materially increased, since these feed stuffs carry considerable amounts of phosphorus. It will be found, perhaps, that the purchase of ground rock phosphate fertilizer will be the most practical method to increase the phosphorus content of the soil. This is the cheapest form in which phosphorus may be purchased, though it is not available for immediate crop use, unless it has been incorporated with organic matter—barn yard manure, or with some of the green manure crops mentioned above; the fermentation and decomposition of which serves to make the insoluble phosphate available.

Clover when once established should occupy a prominent place in the rotation. A three-year rotation, including clover one year, cultivated crop one year, and grain one year, has



VIEW SHOWING SECOND CROP OF MEDIUM RED CLOVER GROWING ON JACK PINE SANDY LOAM SOIL.

This legume should be included in every well-planned rotation. It supplies both plant food and organic matter which this soil is usually deficient in. Taken from the Spooner Branch Experiment Station.

proven very satisfactory. A four-year rotation in which clover occupies the land two years, a portion of which is pastured, has the advantage of adding more organic matter and nitrogen to the soil. The opportunity of introducing organic matter should never be lost sight of. For example, when the corn is "laid by", some green manure crop, soy beans, vetch, and clover, should be sown, the crop allowed to make maximum growth, and then turned under.

For a complete discussion of the management and improvement of sandy soils, reference should be made to Wisconsin Bulletin No. 204, sent free upon request, by addressing the College of Agriculture, Madison, Wisconsin.

## CHAPTER III.

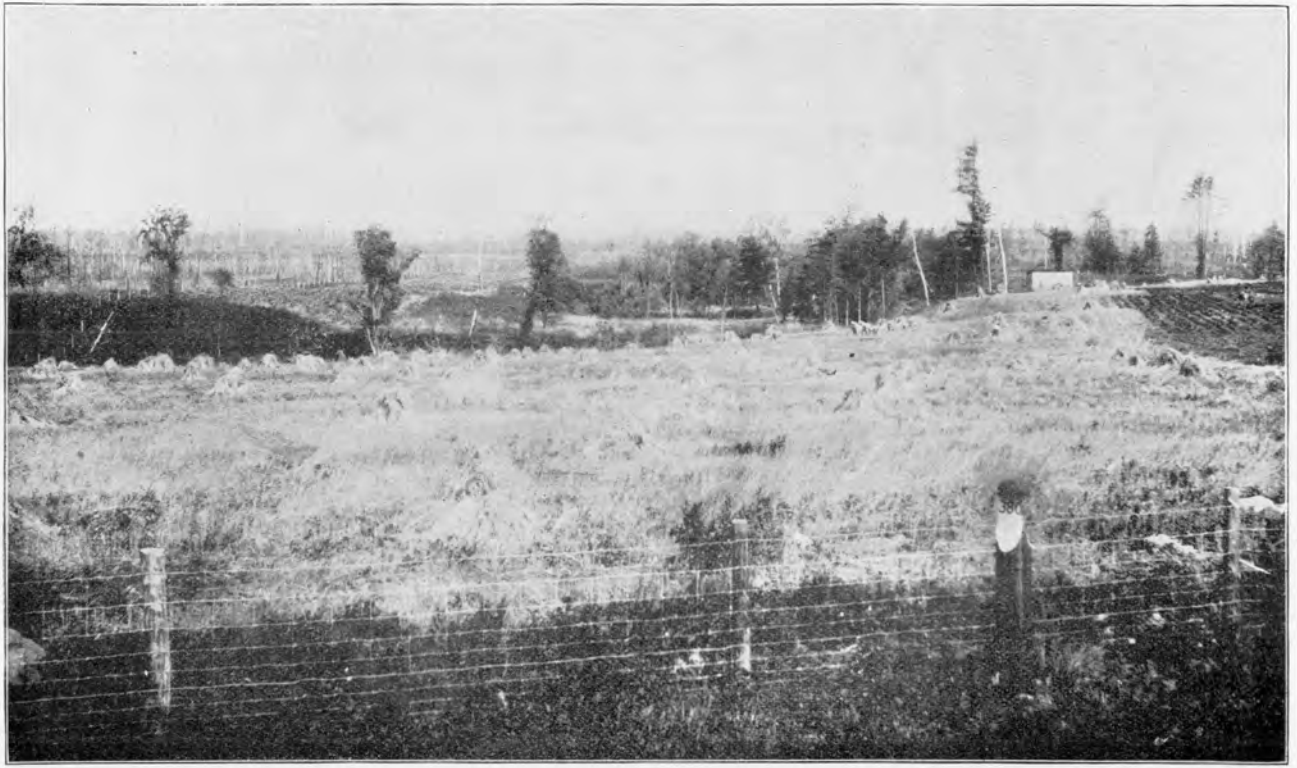
## GROUP OF LOAM AND SANDY LOAM SOILS.

### MELLEN LOAM.

*Area.* The area of Mellen Loam is included in a broad belt which extends in an east to westerly course nearly across the entire area under discussion. From the map it will be seen that the Plainfield Sand cutting across it in a diagonal manner separates the formation into two nearly equal areas. It occurs in every county, though only small areas are found in Burnett and Sawyer Counties. Nearly one-third of Douglas and large tracts in southern Bayfield, and in the south central part of Ashland are made up of this soil type. The entire area embraces approximately 1200 square miles or about one-fifth of the district under consideration.

*Surface Features.* The surface is generally of a rolling character, see Plate VI, with many depressions, lakes, and peat marshes. Frequently the surface becomes hummocky, the small hillocks varying from 10 to 30 feet in height, giving the country a somewhat billowy appearance. In the vicinity of streams the land often assumes a rather undulating and broken character. Another characteristic of the surface condition is the presence of many extensive areas of poorly drained land, most of which are covered with a deep peat soil, and densely wooded, as a rule, areas are especially prominent in the southern part of Ashland County, occurring mainly south of the water shed. Large tracts of similar areas occur in Douglas County. Streams tributary to Lake Superior drainage system flowing northward, and those flowing southward, tributary to the Mississippi River System have their headwaters in these swamps, the same swamp frequently being drained in both directions.

In regions where exposures of the Penokee Iron Range, and the Copper Range are prominent features of the country, the



VIEW OF MELLEN LOAM NEAR LAKE NEBAGAMON, DOUGLAS COUNTY, SHOWING SURFACE FEATURES AND CHARACTER OF CUT OVER LAND.

The cost of fitting this land for cultivation ranges from 20 to 50 dollars per acre. The Mellen loam is recognized as an excellent general purpose soil.

surface becomes rugged and rough. This broken area includes a belt varying in width from less than one-fourth of a mile to more than a mile.

The Copper Range rises to a height of 700 to 900 feet above Lake Superior in Ashland County, the outcrops of which become quite prominent north of Mellen, and trend in a general southwesterly course. South of Birch Lake Postoffice, a similar rugged area nearly two miles in width occurs.

South of the Copper Range, and in places closely associated with it, the Iron Range rises to an altitude of about 1000 feet above Lake Superior. On the crests of some ridges an altitude of 1200 feet is attained, making this range country with few local exceptions, the highest land in the state. The approach to this elevated region from the north is gradual and less steep than the south side, owing to a large amount of glacial material arrested by the advancing ice sheet. Rock outcrops are frequent, especially in townships 44 and 45, Ranges 2 and 3 West; township 45, Range 4, township 44 and 45, Range 5 West, and township 44, Range 6 West. Along the border of the Mellen Loam and Plainfield sand in township 44, Range 9, and township 43, Range 10, outcrops of Copper Range are also prominent. Throughout the area, outcrops of the two ranges and also of granite occur frequently. In some of the townships enumerated above, the surface features are dominated by the Range so that not more than one-third of the area is agricultural land. Stoniness is common over the entire area; in some places interfering with farm operations unless removed or collected in piles. The bowlders are mainly of local origin, and vary in size from small stone 2 inches in diameter to huge bowlders, difficult to remove.

*Native Vegetation.*—The area was heavily timbered with pine, hemlock, and mixed hardwoods—yellow birch, maple, bass, and oak. In certain localities, the white pine was the predominant species, while in others, hardwood, and hemlock formed the prevailing forest growth. In Douglas County, hemlock was of little importance commercially, and red oak replaced the birch. The southern portion of this county assumed the character of pinery, mainly white pine, with some Norway. In Bayfield and Ashland Counties, the Mellen Loam was timbered chiefly with a mixture of hardwoods—maple, yellow birch, and bass,—together with hemlock, and pine. In places the hard-

woods predominated, forming hardwood belts; while in others the predominance of pine characterized the area as pinery. The pine has practically all been cut, and since, hemlock, and hardwoods are being so extensively used for building purposes, the forests of Northern Wisconsin will soon become a matter of history.

*Soil.* The Mellen Loam to a depth of 8 to 10 inches is a brown to reddish brown loam or sandy loam, the surface 1 to 2 inches of which carries a fair amount of organic matter. Over considerable areas, the surface 2 to 3 inches is a greyish color, which changes abruptly to the typical reddish brown, characteristic of this formation. The subsoil grades into lighter colored sandy loam at about 24 to 30 inches. Below 30 inches the subsoil becomes heavier, carrying a larger proportion of fine earth particles, which gives it a greater capacity for moisture than the soil above. Over a considerable area in the vicinity of Mellen, this heavy subsoil varied in thickness from 12 to 18 inches, and is in turn followed by reddish sandy and gravelly material. In this area the so-called hard pan was found at depths of 18 to 24 inches.

The surface soil varies considerably within short distances. Frequently the hillocks are sandy and lighter in color, while the lower lying land may grade into a heavy loam or silt loam. These variations occur throughout the entire body of the Mellen Loam, and require a detail survey to indicate accurately. Stoniness is common over the soil area, but only locally in sufficient amounts to interfere seriously with agricultural operations. The soil is invariably acid even in the virgin condition. The open and porous nature of the surface soil insures good drainage, yet the more retentive subsoil prevents any undue loss by leaching.

The following table shows the mechanical composition of this soil type:

TABLE 3.—*Mechanical Analyses of Mellen Loam.*

| Description | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|---|---|---|---|---|---|---|---|
| | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. | per ct. |
| Soil..... | .7 | 10.5 | 14.5 | 27.4 | 14.3 | 26.7 | 6.2 |
| Subsoil..... | .4 | 9. | 15.2 | 32.8 | 17.1 | 19.9 | 5.9 |

*Agriculture.* Only a small proportion of the Mellen Loam is under cultivation at the present time. In sections where farms have been in operation for some time, the agricultural value of this land has been demonstrated. It is well adapted to diversified farming, as well as to special crops where market conditions warrant. The small grains are oats principally; rye and barley are grown to less extent. The yields for these crops are excellent. Hay consists mainly of a mixture of clover, and timothy, and yields 1.5 to 2 tons per acre. The average farm in this section contains more or less poorly drained land, which serves admirably for hay and pasturage purposes so necessary for the dairyman. Corn may be planted earlier than on the heavier soil types of this section of the state, and consequently is more liable to reach maturity before autumn frosts. For ensilage purposes, it can always be depended on. As a result, dairying is becoming the main business in this section; cream being the principal dairy product sold. This industry is growing rapidly, and with the assistance of breeder's organizations, a better quality of stock is gradually being introduced.

This soil type is also especially well adapted to trucking crops, and in local areas, this industry is growing in importance. Potatoes are always a sure crop, and one of the principal truck crops grown. Yields range from 150 to 200 bushel per acre under ordinary conditions. Bush fruits, blackberries, raspberries, currants, and gooseberries, are grown with success.

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## CHELSEA LOAMS.

*Area.* The Chelsea Loams embrace an extensive tract in the southern tiers of townships of Burnett County, a considerable area in the northern half of Washburn County, and a small area in southwestern Sawyer County. There are also many smaller tracts, often widely separated throughout nearly the entire area. Most of these tracts are isolated areas of only a few square miles in extent, which often become prominent features of the landscape on account of their elevation above surrounding country. The Chelsea soil covers a large territory in the counties farther south and east, and described in previous soil reports.

*Surface Features.* The surface of this soil area has been influenced profoundly by the work of glaciers. Consequently considerable variations in the surface features have developed. In a general way, the surface is characterized by areas that are rough and undulating, gently rolling, and in areas of limited extent, nearly level. See plate VII. Scattered throughout the entire area are depressions, some of which are occupied by marshes, others by small lakes. Some of the hilly land has a relief averaging 75 to 150 feet, with rather steep slopes in places; while other areas are choppy and the elevations do not exceed 20 to 30 feet. Some of the principal hilly areas occur in the western part of township 37, range 13, and in the southeastern, and the north central part of Washburn County, and the southwestern part of Sawyer County.

Stoniness is a common characteristic, and occurs invariably to some extent over the entire area, and in places to such an extent as to interfere with cultivation. No limestone is found in the soil. Trap rock outcrops occur in the southeastern part of township 37, Range 18 in Burnett County.

*Native Forests.* Mixed hardwoods, and pine, are the usual tree growths associated with the Chelsea Loams. White pine, and Norway occurred exclusively in some areas, especially along the lower lying land, and scattered in through with the hardwoods in varying amounts. The hardwoods comprise maple, basswood, red oak, black oak, yellow birch, and elm. On some of the lighter soils the oak predominates forming oak ridges. The pine has all been removed, also the greater part of the hardwoods. The second growth which followed consists of poplar, white birch, and aspen making a dense thicket where left undisturbed.

*Soil.* The Chelsea Loams are glacial in origin, and include soils that show considerable variation in texture. In the area mapped, the predominant type is a greyish loam surface soil, followed by a greyish to reddish colored sandy loam subsoil to a depth of about 20 to 24 inches. Below 24 inches, the soil mass becomes somewhat coarser, as a rule, carrying frequently gravelly material in varying amounts. Oftentimes the subsoil at depths of 18 to 24 inches was found to consist of a reddish clayey sand, and extended down to a depth of 30 to 36 inches, where it was again followed by the usual sandy drift material.

VIEW SHOWING SURFACE FEATURES AND CHARACTER OF CUT OVER LAND OF CHELSEA LOAMS NEAR HAYWARD.

The surface of this soil area varies considerably. This view shows the more hilly phase. Where conditions are favorable the cut over lands are soon restocked with white birch, poplar and aspen.

While the predominant surface soil is loamy, there are areas, generally of small extent, which are either heavier or lighter in texture. The heavier soil is usually a grey silt loam, to a depth of 8 to 12 inches, followed by a lighter textured subsoil. The lighter soil members are sand and sandy loam. The areas of sandy soil are usually of only limited extent.

A detailed survey of this area would show a very "spotted" condition, with reference to soil types found; the changes oftentimes being very abrupt and widely different in character. This fact should be kept in mind by the prospective purchaser.

The following table gives the result of mechanical analyses of the surface soil to a depth of 8 inches and the subsoil from 8 to 24 inches, of an average loam of this type.

TABLE 4.—*Mechanical Analyses of Chelsea Loam.*

| Description | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|---|---|---|---|---|---|---|---|
| | Per cent. | Per cent. | Per cent. | Per cent. | Per cent. | Per cent. | Per ct. |
| Surface soil.. ..... | 7.81 | 12.8 | 10.3 | 28.4 | 15.8 | 15.2 | 9.1 |
| Subsoil ..... | 11.05 | 14.7 | 10. | 27.2 | 16.7 | 12.4 | 7.5 |

*Agriculture.* Owing to the variety of conditions found in the Chelsea Loams both with reference to the soil types, and to the surface features, a wide diversity of agricultural pursuits is possible. Tracts, the hillsides of which are too steep for cultivation, afford good pasturage conditions, and are splendidly adapted for grazing purposes. Several "ranches" have been started recently and found profitable, as a rule. On these places, which vary in size from less than a section to several thousand acres, there is always sufficient land suitable for growing much of the grain and forage required.

The soil area taken as a whole, however, is developing into a mixed farming section, in which dairying is the most important business. Cream is the principal dairy product sold at the farmer's door to nearby creameries. The sale of live stock is an industry that is growing in importance. The dairy and stock industry is certain to develop rapidly, especially in view of the many advantages of good pasturage conditions, the abundance of good water, and the excellent yields of hay and forage crops

obtained. Clover and timothy yield well and are easily grown. Oats is the principal grain crop, and yields 40 to 50 bushel per acre. Barley, wheat, and rye are also grown to some extent. The grains and forage grown are fed, as a rule, on the farm instead of being sold in the market. The fertility of the soil, by this system of husbandry, is thus more easily maintained.

Special crops are grown to some extent. Potatoes are found to be the most profitable in this line. Yields range from 150 to 200 bushel per acre, and add considerable to the farmer's income.

## MIAMI LOAM.

The Miami Loam embraces about one township in the southwestern part of Burnett County. It marks the northern extremity of a soil type extensively developed in Polk and St. Croix Counties, which is described as Cushing Loam in a report covering the latter counties.*

*Surface Features.* The surface features of the northern one-half of the Miami Loam are generally of a level to gently rolling character, while the area, chiefly, in Township 37, Range 18 West, is more hilly and undulating in contour, due in a measure to the presence of many lakes which occur in this section. In the more level areas, many poorly drained tracts occur, that could be benefited my tiling. Considerable tracts are now devoted principally to pasturage and hay meadows, which might be utilized for other crops, if the drainage conditions were improved. In some cases, this condition is due to obstructions, apparently the work of beavers, which serve to hinder the escape of storm waters along natural drainage channels, thus causing land to remain wet for a long time.

*Soil.* The soil to a depth of 8 inches is a greyish loam to silty loam followed by a lighter colored loam or sandy loam to a depth of about 20 to 24 inches, where it grades abruptly into a stiff sandy clay subsoil to 40 inches, varying from buff to greyish blue color, frequently iron stained. Upon exposure to

* Bulletin XXIII. Soils of Northwestern Wisconsin. Wisconsin Geological and Natural History Survey.

weathering influences, this material becomes reddish brown in color that is quite characteristic of the formation. In depth this "hardpan" as it is sometimes called, varies considerably. In places along road cuts the thickness was observed to be over 5 feet and is underlain by sandy drift material. A rather peculiar feature of this soil type is the presence of limestone material throughout the soil mass. Many of the pebbles which occur in the soil mass, are limestone, others are granite, quartz, and sandstone. Since the underlying rock is sandstone, the drift material now in the soil was evidently carried in by the Ice from regions where limestone abounds. The soil is invariably non-acid or only slightly acid, and not infrequently sizzles when acid is applied. The fact that this is a limey soil has considerable significance in general farm practice, especially with reference to growing legume crops.

*Native Vegetation.* The original timber growth consisted mainly of mixed hardwoods, and pine. At the present time, the timber most commonly found consists of white oak, black oak, maple, bass, iron wood, and ash. Of these the oak is the most abundant, and is used chiefly for fuel purposes.

*Agriculture.* The Miami Loam is practically all laid out in farms, and a large proportion of this soil is now under cultivation. The farmers are thrifty, specializing in dairying as their principal business. Corn is an important crop which is utilized largely for silage purposes. All ordinary small grains do well. Oats compose the principal grain crop raised, but little, if any of the grain is marketed. The main cash crops sold from the farm are dairy products and fattened live stock. Farmers are rapidly introducing pure bred and graded stock of the dairy type. Potatoes are also an important item in crops sold, especially in areas where soil is of a more loamy character. Clover and timothy are staple crops. Since the soil is, as a rule, non-acid, clovers do well. Alfalfa is being introduced, and promises to become one of the principal forage crops.

## KENNAN LOAM.

*Area.* The Kennan Loam is limited to the southwestern part of the area under discussion, where it occupies a tract about 50 square miles, chiefly in township 42, Range 2 west in Ashland County. A small area occurs also in Sawyer County.

*Surface Features.* The surface of this type is that of a gently rolling to level upland, with long, sloping hills. Poorly drained areas, some of which are peat marshes occur frequently throughout the tract. Over a portion of the Kennan Loam stoniness is a common characteristic. The stony material consists largely of hardheads, granites, and quartzites of varying sizes, ranging from less than a foot in diameter to large bowlders many feet in thickness. These need to be removed or put in large piles before the land may be properly worked. Near Glidden, rocks were made to serve an economic purpose by being crushed and used for improving highways.

*Native Vegetation.* The area of Kennan Loam was forested originally with a dense stand of mixed hardwoods—maple, birch, basswood, oak, and elm, with scattering pine and hemlock. The pine has all been removed, and also large quantities of hardwood, though considerable tracts are still heavily forested with the latter. The cut over land soon becomes densely covered with a second growth consisting of poplar, white birch, and hardwood.

*Soil.* The soil to a depth of 8 inches varies from a yellowish brown silty loam to loam; the surface 2 to 3 inches often being more distinctly a greyish brown color. The subsoil grades into a yellowish brown loam, becoming a sandy loam at depths of about 20 inches, and containing some pebbles and rock fragments. Below 24 inches, the material becomes lighter in color, more sandy, and carrying a considerable amount of pebbles and stone. In the area mapped, the heavier phase or silty loam predominates, the loamy type occuring in small local areas, and lacking the uniformity of the silty loam.

*Agriculture.* A portion of the Kennan Loam is extensively developed, while other areas are still timbered. The cost of carving out a farm on this soil type varies, depending on so many factors that it is difficult to make even an estimate. Where

the stumpage is largely hardwood, and the land not excessively stony, the cost ranges between 25 and 50 dollars per acre. Farmers are generally engaged in a diversified system of farming. Dairying is an important source of income for the new settler. Stump land affords excellent pasturage, thus affording means of getting returns from the land, while it is being brought under cultivation.

The soil is well adapted to the growing of small grains;—oats and barley being the principal crops. A large acreage on every farm is devoted to hay, chiefly mixed clover and timothy. Corn may be grown for ensilage purposes and brought to maturity in favorable seasons. Potatoes and root crops make excellent yields, and are grown extensively.

## SUPERIOR LOAM.

*Area.* Superior Loam embraces several small areas in Burnett County, the most important one of which is found in the vicinity of Orange. Other smaller tracts occur near Coomer, and north of Gaslyn.

*Surface Features.* This formation is of a generally rolling character, and, as a rule, is well drained. Sags and depressions are of frequent occurrence. Some of the poorly drained areas are covered with dense stands of swamp spruce, and black ash.

*Soil.* In the vicinity of Orange where it is typically developed, the surface 8 inches is a greyish loam, the surface 1 to 2 inches carrying considerable organic matter. From 8 to 16 inches it becomes lighter in color, and more of a sandy to sandy loam soil. A heavy clay subsoil is found underlying this loamy covering at depths ranging from 18 to 36 inches. In thickness, the clay varies from 1 to 3 feet, is usually reddish in color, but verges to a chocolate brown in places. In exposed cuts, this clay bed shows distinct stratification. It is underlain by stratified sandy or gravelly material to a considerable depth.

*Vegetation.* Originally the area supported a heavy stand of mixed hardwood and pine. The pine has long since been cut, and at the present time the forest remaining is largely hardwoods, consisting of white oak, maple, basswood, black oak, poplar, and white birch—the last named coming in as a second

growth. Often the black oak is the predominant tree over considerable areas.

*Agriculture.* This soil is well fitted for general diversified farming. Practically every crop that can be grown in this section of the state thrives remarkably well on this soil. Grasses and clovers make luxuriant growth and yield abundantly. Potatoes are an important cash crop. Dairy products, (chiefly butter) form an important source of income for the farmer. The tendency at present is set strongly toward dairying. Corn is a crop that matures, generally, and is used mainly for ensilage purposes.

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## SUPERIOR SANDY LOAM.

*Area.* The Superior Sandy Loam is found in each of the three counties bordering on Lake Superior. Much the greater portion, however, lies within Bayfield County, occupying mainly the so-called Peninsula. In Douglas County it occupies a belt of gently rolling land, bordering the red clay belt on the south. It occurs frequently as widely separated, isolated tracts, ranging from less than one square mile to ten or more in extent. The soils of the Apostle Islands are also largely made up of this formation.

*Surface Features.* The topography of Superior Sandy Loam varies from nearly level and gently rolling to rather hilly and undulating. The more undulating areas occur within the heart of the Bayfield Peninsula, where some rugged country obtains.

Rivers, which are directly tributary to Lake Superior, occupy basins that are rather wide near the mouth, and gradually taper toward the head of the stream. These streams are sometimes many miles in length, and permit uninterrupted air drainage for the valleys, the sides of which are sometimes steep and precipitous. Many of these valleys are ideally situated for orchard purposes. Post-glacial streams have eroded narrow V-shaped valleys along the slopes of these valleys, and also along the outer portion of the peninsula that has resulted in some rather broken country.

*Soil.* The surface soil of the Superior Sandy Loam varies from a reddish brown sandy loam to a fine sand, the surface 1 to 2 inches of which, as a rule, consists of a layer of light greyish

colored material. The subsoil underlying this formation is a heavy red clay of the same texture and origin as the type already described as Superior clay.

The depth at which this clay subsoil may appear is variable. Especially is this true in the areas that are rather undulating and hilly. Several conditions may be noted: (a) Sloping areas in which clay out crops at or near the foot of the slope, while on the higher ground near the top, the clay is not reached with a 40 inch auger, and may not be found at depths of 4 to 6 feet. Between these extremes, all gradations are liable to occur. It was also found by well records, that in some cases, the clay subsoil is entirely wanting on the higher ground. On the other hand, cases were observed where on the higher ground, providing it was level, the surface soil was found to be heavy clay followed by sandy subsoil. Such a condition was found on an upland 400 feet above lake level, east of Port Wing in Bayfield County. (b) Areas which are more nearly level or only gently rolling, and are less complicated in structure, have more uniform conditions in this respect. Over a large portion of the Superior Sandy Loam in Douglas County, and to some extent in the other counties, where similar surface conditions prevail, the heavy clay subsoil occurs at depths varying from 12 to 36 inches. In texture the soil varies from sandy loam to loam, usually reddish brown in color, and fairly uniform over considerable area. Frequently rock fragments are mixed in the body of the soil, while bowldery material is strewn over the surface. The soil possesses good drainage, as a rule, works easily, and is not subject to losses from drouth or excessive rainfall.

The results of mechanical analyses of a typical sample where the clay occurs in the subsoil at depths of less than 3 feet is shown in the following table. The sample was taken from Douglas County.

TABLE 5. *Mechanical Analyses of Superior Sandy Loam.*

| Description | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|---|---|---|---|---|---|---|---|
| | per ct. | per ct. | per ct. | per ct. | per ct. | per ct. | per ct. |
| Brown Sandy Loam, 0-18 inches..... | 4.0 | 14.3 | 12.8 | 29.4 | 14.2 | 15.7 | 9.2 |
| Red Sandy Clay, 18-36 inches..... | 1.0 | 7.5 | 8.9 | 24.3 | 13.6 | 17.1 | 27.6 |

The Superior Sandy Loam is an excellent general purpose soil, and well adapted to special trucking crops. Potatoes and root crops yield well. The usual grains,—oats, barley, and rye are grown to considerable extent. Corn for ensilage purposes may be depended upon, and early maturing varieties ripen, as a rule. Usually the early Dent varieties are the best now in use. Clover and timothy are grown and yield plentifully.

Where the climatic conditions favor, however, this soil is being extensively devoted to horticultural work. It is largely on this soil type that the famous Bayfield fruit industry is developing. See plate VIII. At the present time, a large area is devoted to small fruit—strawberries, and the more important bush berries, blackberries, raspberries, and currants. The Wealthy apple, and other leading varieties, are grown, the acreage of which now totals hundreds of acres. Cherries, pears, and plums, are also grown to some extent. The Bayfield strawberries come on the market later than the southern berry, and, as a rule, command good prices. The fruit industry has passed the experimental stage, the expansion and development of which will go steadily forward.

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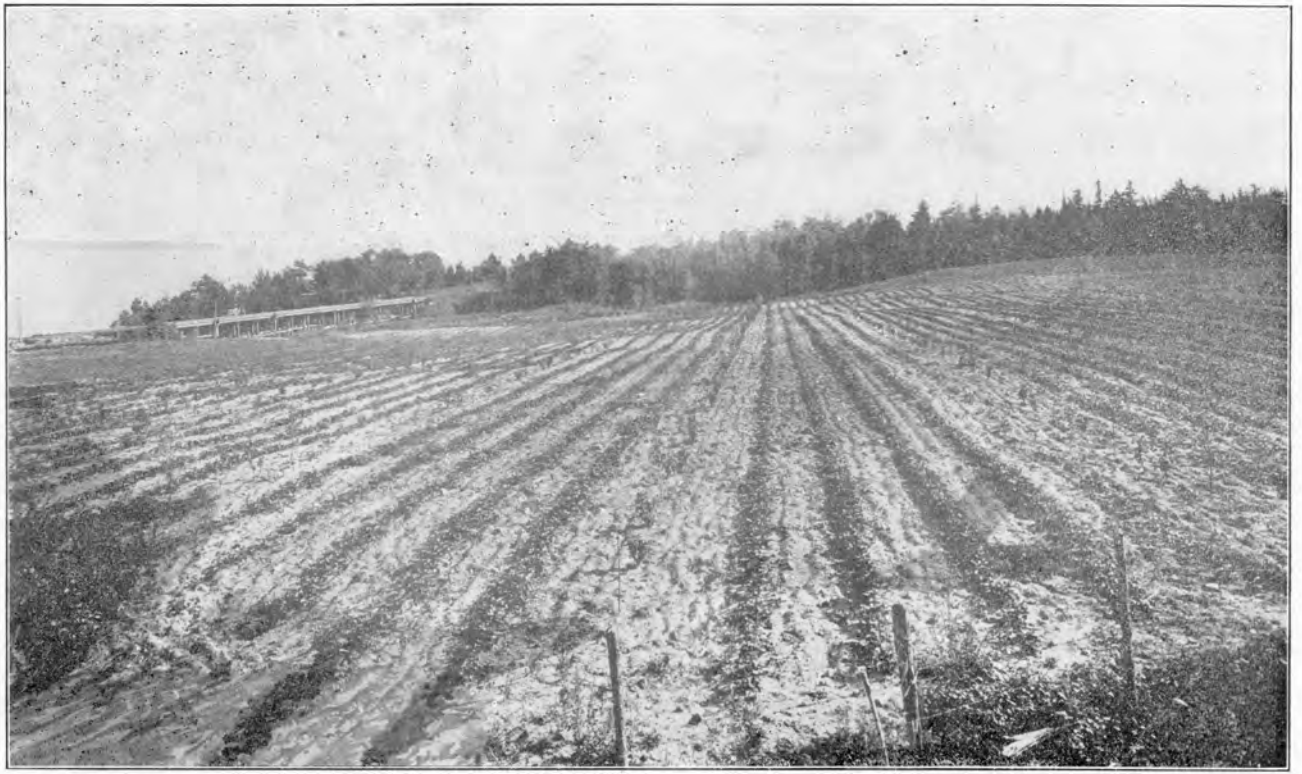
## WEBSTER LOAM.

*Area.* The area of the Webster loam lies entirely within Burnett County, occupying a tract nearly 100 square miles in extent. Grantsburg lies at the western extremity and Webster near the eastern. Falun and Siren, important trade centers, are also located within the area.

*Surface Features.* The Webster loam is characterized by a gently rolling to level surface, with considerable areas of wet land requiring drainage. On the more gentle rolling portions, drainage courses are fairly well established, which take care of excess water after spring freshets and heavy rainfall.

*Soil.* The characteristic feature of this soil type is the bed of heavy blue or grey clay which underlies this formation at varying depths. When it is typically developed, the surface soil varies from a sandy loam to loam, brownish in color, and extends down to a depth ranging from 8 to 24 inches, where the clay subsoil is encountered. This bed of heavy subsoil is usually



VIEW SHOWING AN IDEAL ORCHARD SITE NEAR BAYFIELD.

Until the orchard comes into bearing, the ground is occupied by bush fruit and strawberries, which yield handsome returns. The sloping land and the proximity to Lake Superior are to be noted.

less than 4 feet in thickness, on an average about 30 to 36 inches, and in turn is underlain by sandy material to considerable depths. In cuts, frequently strata of reddish clayey sand were found underlying this bed of clay, alternating with layers of fine sand. Below 4 feet the subsoil is generally found to be made up principally of sandy material. Southwest of Yellow Lake in Township 39, range 17, a small tract occurs in which the surface soil was found to be sandier than the average for this type, and the clay subsoil ranged in depth from 3 to 5 feet below the surface. This area represents the "lightest" phase of the type.

*Clay Loam Phase.* While the predominant soil is of this character, there are several areas included in this formation that differ to such an extent as to warrant separate description. The chief difference lies in depth of the loamy covering over the clay. In localities it may be entirely absent, the heavy clay constituting the surface soil. Over extensive tracts in the southwest quarter of Township 38, Range 18, and the northwest quarter of Township 38, Range 17, such areas occur. Where the clay becomes the surface soil, it is usually of a dark color to a depth of 1 to 2 inches, grading into a greyish or blue colored clay, which frequently is found to be iron stained. The Webster clay loam is a compact soil, and very retentive of moisture. After it has been cultivated for some time, and exposed to sunlight and air, the soil loses some of its tenacious qualities, and works more easily. These tracts are usually poorly drained.

*Native Vegetation.* The forest growth developed over this type is closely associated with the soil. In the clay loam areas, where the drainage conditions are less favorable, the prevailing timber is elm, soft maple, and ash. In other sections where sandy loam or loam obtains over clay, white oak, black oak, birch, maple, and bass are found. In a few areas, jack pine and white pine developed. Jack pine was found in the tract near Yellow Lake where the surface soil is more sandy and the clay lies somewhat deeper.

*Agriculture.* This soil is adapted to a considerable variety of uses. Dairying is found profitable on the clay loam. Excellent stands of grasses, and clover for hay are grown. Pasturage conditions are also exceptionally good. Oats is the principal grain crop; barley, rye, and wheat are grown to a small extent.

The sandy loam and loam soils are special crop soils, a large acreage of which is devoted to potatoes each year. Oats and rye are the principal grains grown. Corn is grown to maturity on the warmer, lighter soils, but less successfully on the poorly drained clay loam soils. Practically all the crops, except potatoes, and small amounts of grain and some hay are fed on the farm and sold as manufactured products—cream and fat stock. The dairy end of farming is destined to become more important. A better quality of stock is also being introduced more generally by the farmers.

*Drainage.* In order, however, to obtain the best results, and insure certainty of crops, it will be necessary to improve the drainage conditions on the more nearly level areas. This applies on the sandy loam as well as on the heavy clay loam soil. Surface ditches have been found helpful. Oftentimes, a farmer has difficulty in getting an outlet, unless adjoining farmers cooperate in constructing a final outlet to stream beds. Tile drainage has not been tried, many farmers doubting whether the heavy tight clay soil could be drained. On similar soils, tiles have been in operation for several years, and their efficiency can no longer be questioned. The soil, though fine and closely grained, possesses the peculiar property of checking and cracking, which assists in establishing water courses toward the tile. These become quite permanent after continued use, and serve as a means for rapid removal of water in the soil.

Depressions in the sandy loam areas which are often difficult to drain, and on which water stands frequently for a long time, may be benefitted by a vertical drain system. The heavy clay is practically impervious to moisture, but when an outlet is established through it by means of tile set on end, the water soon disappears in the deep bed of sandy material which underlies the clay.

## RICE LAKE LOAM.

This soil type embraces about three square miles in Township 37, Range 11 West, Washburn County. It is a continuation of the soil type mapped "Rice Lake Loam" in Bulletin No. XXIII, Soil Survey of Part of Northwest Wisconsin.

The soil to a depth of about 6 inches is a greyish silt loam, followed by heavy silt loam subsoil of distinctly buff color, to about three feet. Beneath this heavy subsoil, the soil grades into sandy to gravelly loam. The formation occupies nearly level bottom lands or valleys, and is of alluvial origin. Further south in Barron County the soil assumes more of a loamy character. In this area, however, it is distinctly a silt loam. For the most part this was heavily timbered with mixed hardwoods, only small areas of which now remain. Agriculturally, this is a highly productive soil, and is developing into one of the finest general farming sections of the state. Diversified farming is pursued, with dairying as the principal business; cream being the leading product sold from the farm. Potatoes and peas are special crops grown quite extensively. The usual small grains are generally grown and yield well. Corn is grown mainly for ensilage purposes.

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## GENESEE LOAM.

This soil type is made up largely of material that has been transported from higher land and deposited upon lower ground. It is of limited extent, and shows considerable variation in texture. The surface varies from a sandy loam to loam with subsoil that depends somewhat on the adjacent soils. In the area along the Marengo River and tributaries of White River, the subsoil becomes quite clayey, while the surface is a fine sandy loam. Along the Sioux River, in Bayfield County the surface 12 to 16 inches is a brown loam underlain by sand or sandy loam, followed by clay at a depth of 3 to 4 feet. The area in the vicinity of Shell Lake is a sandy loam with a subsoil to a depth of

3 to 4 feet of sandy material. The type is of too limited an area to be of much importance agriculturally. Wherever it occurs, the soil is found to be fertile and productive. It is subject to overflow in some instances, and is then adapted for pasturage purposes to advantage. Hay, corn, potatoes, and small grains are the usual crops grown.

# CHAPTER IV.

## GROUP OF SILT LOAM SOILS.

### KENNAN SILT LOAM.

*Area.* In the area under consideration, the Kennan Silt Loam includes nearly the south half of Sawyer County, and about one township in Ashland County. The total area mapped in this section of the state amounts to about 800 square miles. It is, however, one of the most extensively developed soil types in the north central part of the state, embracing a large part of Rusk County, parts of Chippewa, and Lincoln County, and is described in some of the previous reports as Kennan clay loam.

*Surface Features.* The surface of this formation is of a rolling character. A noticeable feature is the long sloping areas between drainage channels often spoken of as ridges. The Thornapple Ridge, east of Winter, Sawyer County, affords a good illustration. Occasionally, areas along streams or near marshes are found in which the surface becomes more choppy; the hills or knobs in such cases being only of moderate height and not too steep to permit cultivation. Again tracts of considerable area occur in which the surface is level and plain-like, and in which surface drainage is inadequate, and tiling will be needed in order to obtain the best results. In many of these level tracts, depressions occur in which vegetable material has accummulated and resulted in the formation of peat beds of varying extent. Areas comprising several square miles occur frequently, while smaller tracts are found commonly over nearly the entire area. As a rule they are heavily wooded with species adapted to these conditions. Cedar, spruce, tamarack, and ash, are the predominant forest trees found. Frequently one or two species predominate, but more often a mixture of all of these has developed. The Flambeau and the Chippewa rivers and their tributaries drain the tract.

Stoniness is a feature of local importance over the area. Much of this formation, however, is so inaccessible at the present time, that only a general statement may be made with reference to this feature. It may be said, however, that more or less stone are found scattered over the entire area, and in local areas in such quantity as to add considerably to the cost of clearing land.

*Native Vegetation.* This soil formation developed stands of timber consisting of mixed hardwoods, hemlock, and pine. The pine, (mainly white pine) was of relatively small importance. It occurred scatteringly throughout the mixed hardwoods, but often in local areas along lower ground it was the predominant species. Hemlock, yellow birch, and maple, in the order, made up the bulk of forest stand which in virgin state ranged from three to five thousand feet per acre of stocked areas.* The pine has been cut out and at the present time, hemlock, and birch is being rapidly removed. The wooded sections of parts of Sawyer suffered severely from wind storms, as indicated by numerous tracts of windfalls. Forest fires have also swept over considerable areas of the slashings and the timbered land. Within a few years after fires have run over the land, it is covered with a thick stand of volunteer poplar, birch, alder, and berry bushes.

*Soil.* The soil of this formation to a depth of 8 inches, is a grey to buff colored silt loam, carrying a considerable amount of very fine sand. The subsoil to a depth of about 18 to 24 inches is a yellowish to light buff colored silty to clayey loam. This is often mottled by iron stains which upon exposure gives the soil mass a characteristic greyish-yellow color. The mottling, while quite characteristic, is often lacking, especially if the surface silt loam is shallow and followed by sandy subsoil. Below 24 inches the subsoil becomes more of a clayey sand, reddish in color and carrying a small amount of medium sized pebbles. This stiff subsoil is often spoken of as hardpan, and varies from 12 to 24 inches in thickness. It is followed by a reddish colored loose sand and gravel for considerable depths. In cuts this loose material was seen to extend to a depth of 6 and 7 feet. The thickness of the surface silt loam covering varies considerably. Often times when the topography becomes roll-

*Forest Condition of Northern Wis. by Roth. U. S. Dept. of Agr.—1898.

ing to hilly, the higher points have a silty covering not to exceed 4 to 6 inches, and in some places observed the lower sandy subsoil has become exposed on the tops of knolls and formed the surface soil. Again over the more nearly level areas the silt covering may extend down 3½ to 4 feet, followed by the usual subsoil described above.

The following table gives the result of mechanical analyses of typical samples of this soil:

TABLE 6.—*Mechanical Analyses of Kennan Silt Loam.*

| Locality | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|---|---|---|---|---|---|---|---|
| | Per cent. | Per cent. | Per cent. | Per cent. | Per cent. | Per cent. | Per cent. |
| Winter— | | | | | | | |
| Surface soil.... | 1.1 | 1.9 | 1.5 | 3.3 | 29.2 | 44.0 | 18.8 |
| Subsoil..... | 1.9 | 3.2 | 2.2 | 4.3 | 37.3 | 36.4 | 14.6 |
| Exeland— | | | | | | | |
| Surface soil.... | 1.9 | 8.2 | 5.7 | 7.2 | 23.0 | 44.1 | 9.6 |
| Subsoil..... | 2.9 | 8.8 | 7.0 | 8.0 | 26.3 | 35.7 | 10.9 |

*Agriculture.* Probably less than two per cent of the Kennan Silt Loam is under cultivation. The land is either forested or cut over slashings through which forest fires have run repeatedly. The logging business is still an important industry in a large section of the area. Several fine farming communities have been developed. At Exeland, and also at Winter, in Sawyer County, good sized farms have been established, which show the agricultural possibilities of this soil type. The soil is of sufficient depth and of such a character that it retains an abundance of soil moisture needed for growing crops. Grasses and clover find in this soil conditions for exceptional growth, and no where in this section of the state are yields surpassed. Grains—oats, barley, and wheat are grown and produce plentifully. Peas, both for stock and for canning purposes, will be a profitable crop to grow. Root crops—mangels, rutabagas, and turnips are crops that make excellent yields. The dairy farmer will find these valuable as a source of succulent feed for his stock. Potatoes are grown to a considerable extent, and form an important cash crop for the farmer. Corn can always be relied upon to mature for ensilage purposes. The need is ap-

parent, however, for earlier maturing varieties. The work of acclimating a variety is dependent largely on local conditions, hence the need of selecting and planting only early maturing varieties.

Dairying will unquestionably develop as the most important business. The many streams furnish water in abundance for stock, except on the "Ridge" lands where wells are 100 feet or more in depth. Sufficient water for the home may be obtained in wells 25 to 40 feet in depth.

*Land Clearing.* Wild land is generally held at $10.00 to $25.00 per acre, depending on location. Improved farms with good buildings are valued at $60.00 to $80.00 per acre. One of the first questions asked by the prospective purchaser of land, after he has examined the soil conditions is, what is the cost of clearing the land and preparing it for cultivation. To answer this question at all satisfactory, one must know the condition of the land to be cleared with reference to the number, size, and character of the stumps per acre. Heavy pine stump land costs relatively much more to clear than hardwoods. The latter decay, especially if the land is pastured, while pine stumps are less subject to decay, and always require more energy in removing than do hardwoods. The length of time since the timber was cut has an important bearing on the cost of clearing. Hardwoods are affected to a greater extent in this respect than pine. The character of the soil is also an important factor in land clearing. On the heavy clay and loam soils, dynamite is more effective than on the lighter sandy types. On the other hand, the lighter soils are more easily broken than the loams. The condition of the soil is also important. As a rule, much more effective work can be done when the ground is wet than when it is dry. The amount of brush, dead timber, and second growth which is necessary to remove, varies considerably, and likewise the cost of doing this work.

The new settler seldom attempts to clear his breaking of all stumps and stones the first year. It is neither necessary nor profitable to do so. The preferable way for him to do is to clear the land of all underbrush, dead timber, and stumps that are easily removed. In most cases, in the mixed hardwood country, this may be done at a cost of about 6 to 10 dollars per acre. The land should then be seeded to clover, and harrowed with a spring

FIG. 1. A CHEAP BUT SATISFACTORY STUMP PULLER.

The best results are obtained by supplementing its use with dynamite.

FIG. 2. THE STEAM PULLER WITH ATTACHMENT FOR PILING STUMPS IN HUGE HEAPS.

This outfit does very effective and rapid work. The cost of this equipment limits its use, however, unless financed by a company which makes land clearing a business.

tooth harrow. This will afford excellent pasturage and hay for cows and stock, which prevents brush from coming up, and provides also a source of income for the farmer. A portion of the land may be utilized for small grains, potatoes, and other crops needed for maintenance. The stumps are then removed gradually year after year. Continued working and pasturing stump lands assist in decay processes, and afford better conditions for frost action, thus materially lessening the cost of final clearing.

Where the settler wishes to clear his land of all stumps and debris at once, the combined use of dynamite and some simple stump pulling outfit, has been found very satisfactory and economical. A drum and cable mechanism, or a wheel and axle mounted on a tripod are efficient machines to use. See Fig. 1, Plate IX. Home made affairs of either type are equally good. The cost of clearing land by this method on average mixed hardwood and pine land that has been cut over for a number of years, will range from $20.00 to $50.00 per acre, including the cost of dynamite.

Undoubtedly the use of more important methods, including the steam stump puller, (See Fig. 2, Plate IX) will do much to reduce the cost of clearing the vast areas of undeveloped agricultural lands in this section of the state. Thus far, the cost of large power equipment has made its use almost prohibitive, unless financed by a company who make land clearing a business. This it seems would be the most satisfactory way to handle the proposition. Steam pullers have been in use in Bayfield County and elsewhere the past few years.

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## MELLEN SILT LOAM.

*Area.* The Mellen Silt Loam embraces three widely separated tracts of nearly equal area—one in southwestern Douglas County, another at the intersection of Douglas, Bayfield, Sawyer, and Washburn Counties; and the third includes portions of the southern tiers of townships in Washburn County. The total area aggregates about 250 square miles.

*Surface.* The surface is generally rolling in character, some parts of the areas becoming nearly level, while others in the

vicinity of streams, are slightly rougher. Small, flat, wet areas occur frequently. These are usually poorly drained, and heavily wooded with tamarack, spruce, and cedar. Frequently areas occur which present a hummocky appearance, the elevations scarcely ever exceeding a height of 20 to 30 feet. This condition occurs in portions of southern Washburn, while the poorly drained flats are more commonly found in southwestern Douglas.

*Native Vegetation.* The original timber stand consisted of a dense growth of hardwoods, pine, and hemlock. The pine was cut 20 or 30 years ago, and the hemlock has been practically all removed during the last decade. At the present time, considerable maple, birch, bass, and oak remain. The second growth consists principally of aspen, birch, and hardwood saplings.

*Soil.* The Mellen Silt Loam to a depth of 8 inches is a grey to buff colored silty loam, underlain by a distinctly buff colored subsoil of silty material which is often mottled and streaked. The depth of this subsoil varies somewhat; ranging from 12 to 24 inches, where it is followed by a reddish fine sandy loam, or gravelly loam, which grades into reddish sand and gravel at lower depths. At depths of 10 to 15 feet, cuts showed the soil mass to consist entirely of sand. Small stone are often associated with this subsoil.

While the type runs in general quite uniform texturally, yet there are areas included which differ from the established type in that the covering of silt may be only a few inches thick or entirely wanting and the surface soil is found to be a greyish sandy loam with light textured subsoil. These areas are usually small, isolated tracts, occupying the ridges and crests of knolls. These local variations were impossible to separate, and in many cases, are too small to indicate on a map of the scale used.

The chemical analyses of this soil show a satisfactory condition with reference to the usual plant food constituents, with the exception of phosphorus, which is found rather low, averaging about 1100 pounds over an acre to a depth of 8 inches.

The results of mechanical analyses of a typical sample of the surface soil and subsoil of this type is shown in the following table:

TABLE 7.—*Mechanical Analyses of Mellen Silt Loam.*

| Description | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|---|---|---|---|---|---|---|---|
| | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. |
| Surface soil..... | .3 | 5.1 | 4.0 | 4.6 | 12.4 | 64.4 | 8.9 |
| Subsoil..... | .3 | 6.1 | 6.0 | 7.1 | 11.9 | 58.7 | 9.9 |

*Agriculture.* The Mellen Silt Loam where it has been brought under cultivation is found well adapted to diversified farming. The usual small grains—oats, barley, wheat, and rye, may be grown successfully. The principal grain crop grown is oats, the average yield of which ranges from 40 to 50 bushel per acre, barley 35 to 40 bushel, wheat 15 to 20 bushel. Clover and mixed hay yield 2 to 2½ ton per acre. Alfalfa has been tried, experimentally, with success. The soil, being acid, requires liming to insure a stand. Potatoes are a special crop. Corn is grown largely for silage purposes.

Dairying is the important business on the farms of this soil type. This industry is rapidly expanding, both as to numbers as well as in the quality of the stock maintained. The principal dairy product is cream sold to local creameries.

## ANTIGO SILT LOAM.

*Area.* The Antigo Silt Loam* occurs in limited areas in southeastern Burnett County, in the southern part of Washburn, and several areas in the northwestern part of Sawyer County. The tracts range from less than one square mile to ten or more in extent, and aggregate about 75 square miles.

*Surface Features.* The surface features of this formation are generally level to gently rolling. Frequently there are areas slightly rolling in character, in which sags and depressed areas occur, some of which are occupied by small lakes, others by marshes. These areas occupy, however, only a relatively small proportion of the total area.

*The Antigo silt loam has been mapped Milltown loam in Bulletin No. 23. South part of Northwestern Wisconsin.

*Native Vegetation.* This soil was originally densely forested with hardwoods, pine, and hemlock. The hardwoods consisted of maple, oak, yellow birch, and some basswood. At the present time all of the pine and hemlock, and most of the hardwoods have been removed. Poplar, birch, and maple form dense stands of second growth where the cut over lands have been left unimproved.

*Soil.* The soil to a depth of 8 to 10 inches is a greyish silt loam, followed by a buff colored clayey silt loam to a depth of 24 to 30 inches. The depth of this clayey subsoil may vary somewhat. In several places it was found to extend down to a depth of 3 to 4 feet, though the average depth is less. This tenacious subsoil is frequently mottled, and often carries a small amount of rock fragments. Below 30 inches the subsoil grades into reddish sandy material, with which a varying amount of gravel is associated. This subsoil condition is very favorable for underground drainage, while the blanket of heavy surface soil is everywhere sufficient to retain moisture for the growing crop. Over some of the more level tracts, the need of artificial drainage is apparent; but, as a rule, the land has good natural drainage. Aside from variations in the depth of the heavy subsoil, this type is quite uniform in character. The soil is generally free of stone, works easily, is not subject to baking, and considered one of the most durable soils in the entire area. The results of mechanical analyses of a typical sample of the soil and subsoil, taken near Sarona, in Washburn County, is shown in the following table:

TABLE 8—*Mechanical Analyses of Antigo Silt Loam.*

| Description | Fine gravel | Coarse sand. | Medium sand | Fine sand | Very fine sand. | Silt | Clay |
|---|---|---|---|---|---|---|---|
| | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. | per cent. |
| Surface soil..... | .2 | 3.0 | 3.3 | 3.8 | 12.0 | 68.8 | 8.7 |
| Subsoil..... | .3 | 2.6 | 3.0 | 3.5 | 11.6 | 65.8 | 13.4 |

*Agriculture.* A general diversified system of farming is followed on this soil type. It is capable of maintaining excellent dairy farms, and the tendency in that direction is now well established. In some of the communities where dairying has been

established for some time, graded and pure blooded stock is rapidly replacing the unprofitable scrubs. This phase of dairying deserves greater attention by farmers who have in many cases not appreciated its importance. The principal dairy product is cream. Stock raising is also important; fat cattle and hogs being the principal products sold.

Oats is the principal grain crop raised and yields well. Wheat, barley, and rye, are also grown, but to less extent. Mixed clover and timothy hay occupies considerable acreage on every farm. Many instances were observed, however, where fields were left in hay too long, resulting in unprofitable yields. Corn is a crop largely used for ensilage purposes, but may also be grown to maturity. In common with all northern sections of the state, the work of selecting and growing early maturing strains is of vital importance in assuring a crop each year. Wisconsin No. 8 Yellow Dent, and Yellow Flint, are varieties of corn that thus far have been found very satisfactory both as to yield and maturing qualities.

The areas in Burnett and Washburn Counties, and some in Sawyer are practically all divided into farms, some of which have 50 to 75 per cent of the land now under cultivation. Improved farms are held at $75.00 to $100.00 an acre, depending on the improvements and location. The unimproved land is held at $15.00 to $25.00 per acre.

## COLBY SILT LOAM.

*Description.* The Colby silt loam soil embraces a portion of one section in Washburn County in Township 37, Range 11, West. This small area marks the northern boundary of a soil type that occurs extensively throughout Central Wisconsin. It is described quite fully in preceding reports, covering this section of the State. The soil to a depth of 6 or 8 inches is a greyish silt loam, followed by a buff colored silty subsoil. Below 18 to 24 inches the subsoil becomes more clayey in character, and is frequently iron stained.

The surface of this formation is rolling, with broad, long, sloping valleys. Areas of comparatively level land are also common.

The forest growth consisted mainly of mixed hardwoods, and pine. The latter has all been cut, but considerable tracts of mixed hardwoods still remain. While the work of clearing this land is somewhat slow, yet fine farms are developing quite rapidly. Dairying is of first importance, and keeps pace with the increase in cleared land. The usual small grains are grown. Root crops, and such special crops as peas, sweet corn, and beans, are also grown quite extensively. Clovers and timothy are big yielding crops. Corn occupies a large acreage, and may be grown to maturity, as a rule.

# CHAPTER V.

## SUPERIOR CLAY.

*Area.* The area of the Superior clay is included in a broad belt bordering Lake Superior, and extending inland a distance varying from a few miles to nearly 20. On the south, the clay belt terminates rather abruptly in higher land. That portion of the belt skirting the Bayfield Peninsula has been modified somewhat by ice movements, so that the formation is irregular in outline. Here it occurs more often as small areas varying from a few square miles to a township or more in extent. On either side of these small areas, usually occur ridges of higher land described as Superior sandy loam. The total area of Superior clay approximates 1000 square miles.

*Soil and Surface Features.* The Superior clay is a heavy compact soil of a distinctly reddish color. The subsoil differs but little from the surface soil in color or in compactness. Usually a thin coating of vegetable material is found over the surface. From well records and exposures along stream cuts, the clay from the lower sections was found identical with that near the surface, both as to color and texture. After the land has been cultivated for some time, and exposed to air and sunlight, and more vegetable matter from crop residues has been incorporated into the soil, it gradually "lightens" up, is less reddish in color, and assumes more of a clay loam character. This is the condition in older sections of the state, where the same soil type has been devoted to farming for 40 to 50 years.

Here and there sags or depressions occur, in which the drainage is usually poor, and the accummulation of vegetable matter gives the soil a black color. These areas are small as a rule, and when drainage conditions are improved, soon work in with the rest of the soil. Owing to the fineness of this soil, it has a tendency to retain moisture, and when saturated with water, is

slow in giving it up. Upon drying out it contracts considerably, causing the soil to check and crack into small blocks somewhat cubical in form. In the management of this soil, due care must be taken not to plow or cultivate it when in a wet condition. It will invariably bake and form large clods that are not easily broken up. Fall plowing for this reason is preferable to plowing in the spring.

Frequently "white clay" spots are found. These have a tendency to run together when wet, and become heavily encrusted when dry. This condition may be remedied by incorporating more vegetable matter in the soil.

The Superior clay, on account of its high content of fine earth, (about 75 per cent of the soil mass consists of clay and silt, which are the two finest divisions of earth particles) is liable to erode badly, especially if the slope is sufficient to cause water to move rapidly over it. See Plate X. At first only small V-shaped water courses are formed, tributary to some river or stream, which carries water during the entire year. The small water courses, which are active only during spring freshets, or after heavy rains, soon become deeper and wider with other tributaries leading to them. These V-shaped ravines vary in depth from a few feet at the head of stream beds, to 50 or even 100 feet near the outlet. As a result, in some sections the land is cut up badly, making a convenient arrangement of fields on a farm often times impossible. The interstream areas are broad, plainlike, with gradual slope toward Lake Superior. (See Plate XI.)

The area of Superior clay included in the belt beginning in the vicinity of Port Wing, and extending around the Peninsula almost to the Ashland County line, has been modified to some extent by the movement of the ice over it. The clay on the Apostle Islands has also been modified in this manner. The soil within this area lacks uniformity, and is less tenacious, as a rule, than the clay found elsewhere. A thin covering of sandy or silty material is frequently found overlying it. Generally the deep gullies are of less frequent occurrence. The surface features are rolling with some level areas; stoniness is common, though not sufficient to interfere with agricultural operations.

The following table gives the results of the mechanical an-

VIEW SHOWING THE UNEVEN SURFACE FEATURES OF SUPERIOR CLAY.

The valleys are more often steep sided and narrow, causing considerable difficulty where they occur in the laying out of fields conveniently. This condition is especially developed over areas where the land slopes markedly.

VIEW SHOWING THE LEVEL CHARACTER OF SUPERIOR CLAY NEAR SUPERIOR.

This is characteristic of large areas lying between stream beds. View also shows quality of crop grown on this soil.

alyses of a typical sample of this soil, and also of a sample that has been modified by ice action.

TABLE 9.—*Mechanical Analyses of Superior Clay.*

| Description | Fine gravel | Coarse sand | Medium sand | Fine sand | Very fine sand | Silt | Clay |
|---|---|---|---|---|---|---|---|
| | Per ct. | Per ct. | Per ct. | Per ct. | Per ct | Per ct. | Per ct. |
| Typical Superior Clay: | | | | | | | |
| Soil | .3 | 1.8 | 2.0 | 6.4 | 7.3 | 38.8 | 43.4 |
| Subsoil | .1 | 1.5 | 2.9 | 8.0 | 5.4 | 36.9 | 45.2 |
| Modified Superior Clay: | | | | | | | |
| Soil | .6 | 2.8 | 4.7 | 11.6 | 12.6 | 31.3 | 36.4 |
| Subsoil | .9 | 3.9 | 6.0 | 13.9 | 14.2 | 29.8 | 31.3 |

*Native Vegetation.* This soil formation produced a heavy growth of white pine, Norway pine, hemlock, and mixed hardwoods mainly yellow birch. In the western section of the area, little if any hemlock developed. The pine has practically all been removed. The second growth now developing is largely composed of aspen, poplar, white birch, and balsam.

*Agriculture.* This is one of the most important soil types in the area. Agriculturally the soil is productive and yields profitably under proper management. Development, however, has been retarded, due in part to clearing, which is always slow in a heavily wooded country. Again, large tracts were kept off the market until recently by mill owners, until the timber had all been cut.

With improved and cheaper methods of clearing land by use of power pulling machines, cheaper form of explosives, and more intelligent care in their use, this area will see a rapid expansion in the development of fine farms. The cost of clearing varies, depending on the character and number of stumps per acre, and length of time since the timber was cut. When the work is done by hired help, the cost ranges from $25.00 to $40.00 per acre, including the cost of dynamite and plowing. Invariably the new settler clears and develops his land as his time and means permit. Grass seed and clover sown among the stumps affords excellent pasturage, as well as hay for his use. The stumps are then gradually removed, and the cost of clear-

ing much lessened. Cut-over lands in an undeveloped state can be bought for $10.00 to $25.00 per acre. Similar soil in old farm sections of the state is valued at $100.00 per acre and over.

While a limited amount of good water may be obtained in shallow wells, it is insufficient for general farm supply. It has been the experience of farmers, that to get a sufficient flow, deep wells are required. From a large number of wells investigated, the average was found to be between 100 to 200 feet, entailing considerable expense in drilling.

The area is well fitted for diversified farming. Dairying has been found a profitable means of converting crops grown on the farm into cash. Clover and grasses are crops, the yields of which cannot be surpassed. Alfalfa has proved successful on well drained land. The soil being of a limey nature supplies one of the conditions essential for its growth. The splendid adaptability of the soil has led many to follow hay farming exclusively. Weed infested fields are a natural result. Growing alsike clover for seed has been found profitable business. It produces good crops of forage, besides yielding 4 to 6 bushel of seed per acre. Alsike is invariably a sure crop. Small grain, especially wheat, have given excellent yields. Root crops —rutabagas, turnips, cabbage, and potatoes—are dependable crops, as a rule. Turnips and rutabagas afford valuable succulent feed and may be used to supplement corn silage. Corn does not always reach maturity, except for ensilage purposes. The Flint varieties have been found best adapted to this section. Field peas are profitable crops and should be more generally grown. Yields of 35 to 40 bushels per acre have been obtained on this soil at the Ashland Branch Experiment Station, under ordinary methods of tillage and fertilization.

*Management of Clay Soil.* In the proper management of this soil, due regard must be had, (1) to insure proper drainage conditions, (2) to improve the physical condition of the soil, and (3) to increase the supply of phosphorus, which repeated chemical analyses has shown to be below normal.

Poor drainage is the limiting factor in crop production over large areas. Plowing in narrow lands, and connecting up the dead furrows about 3 to 5 rods apart with an outlet ditch, is one of the cheapest, as well as one of the most efficient means of removing surplus storm waters. Due to the

compactness of this soil, the water is absorbed very slowly, so that the need of removing surface water quickly, is apparent. The soil, however, when once saturated is slow in giving up its moisture, if dependent upon evaporation alone. Consequently the soil is slow in warming up in the spring, and growth is retarded accordingly. Tile drainage has been found effective in removing surplus water, even though the soil is very clayey and compact. It has been found that this type of soil is given to checking and cracking upon drying out, causing seams and cracks to form which serve as water ways toward the tile, and, by continued use, become fixed. In some instances, surface ditches may suffice; while in others, tiling supplemented by surface ditches are essential in order to insure maximum crops.

The physical condition of the soil may be improved by thorough cultivation, including plowing, and the incorporation of organic matter—crop residues, green crops, and barn yard manure. Plowing should always be done when the land is sufficiently dry, so as to avoid puddling. The first plowing should not exceed 4 to 5 inches, in order not to turn under too deeply the vegetable mold with which bacteria and other organisms are associated. Ultimately the plowing should be deepened, the work to be done gradually, however, until a depth of 7 to 8 inches is reached. Not only should this soil type be plowed deeper, but it should also be plowed oftener. In too many instances the land has been left in old hay meadows, which become weed infested and difficult to get in good tilth when it is again plowed.

The organic matter content in ths soil in the original state is relatively small, and when it is understood that soil nitrogen is combined with the organic matter, the importance of increasing the supply of this material in the soil can be fully appreciated. Turning under an occasional clover crop or other legume is the ideal way of adding organic matter, since legumes have the ability to utilize atmospheric nitrogen, and possess this advantage over other green manuring crops. The incorporation of more organic matter also intends to improve the tilth of this soil, making it more mellow and more easily worked.

From a considerable number of chemical analyses it was found that the phosphorus content to a depth of 8 inches over an acre was about 900 pounds. This is scarcely sufficient to grow 100

twenty five-bushel wheat crops. In order to maintain good yields the supply of this element should not only be maintained, but increased, if possible. Plot tests using phosphatic fertilizers have, in every instance, borne out the results of chemical analyses, by producing bigger and better crops. At the Ashland Branch Station where these fertilizer tests have been conducted for several years the following data were obtained:

| | 10 ton manure only. | 10 ton manure and 1000 lbs. rock phosphate. | Per cent of increase. |
|---|---|---|---|
| Potatoes | 87 bu. per acre | 128 bu. | 47% |
| Rutabagas | 108 " " " | 137 " | 27% |
| Corn | 30.4" " " | 36.8 bu. | 21% |
| Clover Hay | 2,223 pounds. | 3,177 pounds | 43% |
| Clover Seed | 217.5 " | 336.7 " | 47% |

These results leave no doubt as to the benefit of supplementing manure with rock phosphate.

For further discussion as to the management of clay soils, the reader is referred to Bulletin 202, a copy of which can be obtained by addressing the College of Agriculture, Madison, Wis.

# CHAPTER VI.

## PEAT.

Peat represents an accummulation of vegetable matter composed chiefly of roots and tops of grasses, sedges, moss, leaves, and other decaying organic matter in various stages of decomposition. Sometimes small amounts of earthy material are incorporated in it. The term muck is often applied incorrectly to the same material. Muck, however, contains much clay and silt; is usually darker in color, and the smaller content of organic matter is in a more advanced stage of decomposition than that of peat.

The one condition which is largely responsible for the formation of peat is poor drainage. Such a condition may be brought about in various ways. In this section of the state, the movement of the ice over the country has been an important agent in causing the formation of peat bogs; either by blocking established drainage channels, or in forming depressions containing water a part of the year. The plant growth developed in these sags on account of excessive moisture and lack of air, soon accummulated and formed a peat bog. Old abandoned stream channels often afford suitable conditions for such accummulations of plant residues. The process of peat formation may often be observed along the shores of some lakes where a border of swamp vegetation fringes the shore and gradually keeps encroaching until the entire surface is matted over with decaying matter.

Considerable variation exists as to the quality of peat, depth, color, and stage of decomposition. It is generally fairly well decomposed, and when wet, dark brown to black in color. The depth is variable; in many cases ranging from less than a foot on the edge of the marsh to many feet near the center. The subsoil beneath the peat depends to a large extent upon the adjacent upland, and as a rule, is similar to it. Invariably this

material is acid. Included within the area mapped as peat, there are conditions of drainage, and of native vegetation that may be best described separately. In a broad, general way, three types may be noted.

1. Areas spoken of as open marshes, and upon which timber developed only in small isolated tracts or islands of upland. The best expression of this type is found in towns West Marshland, and Anderson in Burnett County. In each of these areas there are vast tracts of a prairie-like country, studded here and there by small clumps of Jack Pine, which developed on the upland soils within the main body of the marsh. These isolated wooded areas range in size from a few square rods to several acres, and cannot be shown on a small scale map. The vegetation consists principally of wire grass, the production of which has given rise to the important industry in fiber mat and carpet manufacturing.

The development of this industry in Burnett County has been rapid, so that at the present time practically all available ground suitable for wire grass is taken up by several textile manufacturing companies. Considerable money is expended in building roads and constructing ditches and otherwise improving the marshes so that best results are obtainable. Peat land that was considered at first only of nominal value has been sold upward of $30.00 per acre, and now devoted to growing wire grass. Yields range from 1 to 1.5 tons per acre. The peat is well decomposed, of rather dark color, and quite uniform in character. The subsoil is usually sandy. From a limited number of analyses this peat appears to contain higher percentage of essential plant food constituents than many of the peats in the state.

2. The next type embraces 75 per cent or more of the entire peat area, and is frequently spoken of as swamp land. This group differs from the preceding in that as a rule it is heavily timbered, or was so at one time, and now is cut over or burnt over land. The timber growth varies markedly both as to species developed, and the stand. While often it is difficult to classify areas on account of intermingling of species, yet areas in which tamarack is the predominant tree growth occur; in others, cedar, or black spruce, or the black ash. As a result such terms as tamarack swamp have arisen, meaning that tamarack is the pre-

dominant tree growth. The stand of timber has been remarkably dense in places. This is especially true of some areas in Douglas and Ashland counties. The soil is generally well decomposed peat, and varies considerably in depth. Very often it carries considerable earthy material washed in from adjacent upland.

3. The last type is one which is separated on the basis of drainage. This area includes tracts, some of which are quite extensive, as the one north of Odanah in Ashland county, bordering along the shore of Lake Superior. These areas for the most part are subject to overflow, and are usually classed as swamps in the true sense. Generally there is only a relatively small difference between the level of the water and the surface of the swamp, so that only by expensive methods of drainage could these tracts be reclaimed. In some cases, sand bars or series of bars are thrown along the outer edge of the marsh. In most cases, these low areas lie along meandering streams which flow through them. Agriculturally, these are of little value, except in local areas. Portions were heavily wooded where conditions favored tree growth.

*Management of Peat Soil.* The first step in the development of a peat marsh is drainage. In the case of a large marsh, a drainage district may be organized by the several owners, and the work done more cheaply that way. Small areas may be drained by open ditches, or by drain tile where the fall is sufficient for an outlet.

The marsh when once drained should be plowed, preferably in the summer or early fall months. Compacting the soil by the use of a heavy roller firms the soil, greatly improving the seed bed for crops. Rolling also hastens the chemical decomposition of the peat, thus liberating plant food. Chemically, peat soil differs from upland soil in that it has a very large amount of nitrogen, due to the high content of organic matter, and, relatively, a much smaller amount of the other essential plant food elements,—phosphorus and potassium. This difference is brought out clearly in the table giving the average composition of upland loam soils and marsh soils expressed as per cent and as pounds per acre eight inches.

| | Per cent. | | | Pounds per acre 8—inches. | | |
|---|---|---|---|---|---|---|
| | Potassium. | Phosphorus. | Nitrogen | Potassium. | Phosphorus. | Nitrogen |
| Peat | .50 | .098 | 2.30 | 1,750 | 343 | 8,050 |
| Upland loam | 1.90 | .070 | .12 | 38,000 | 1,400 | 2,400 |

The high nitrogen and the low phosphorus, and potassium content, is at once apparent, and furnishes some information with reference to the fertilizer treatment of peat land. In general, it may be said that it is poor economy to apply fertilizer of any description which contains nitrogen, such as stable manure or mixed fertilizers. Barnyard manure should, therefore, be applied to the upland soils, and only such commercial fertilizers purchased as are really needed. This will usually include phosphorus and potassium, and may be supplied in the form of rock phosphate and sulphate of potash. Wood ashes also contain considerable amounts (4 to 5 per cent) of potassium. The peat marshes in northern Wisconsin are invariably acid, indeed so strongly acid that it is not practicable to neutralize the acidity. Nor is it necessary to correct the acid condition for the crops usually grown on peat soil. The crops which may be grown are limited by the length of the growing season, and injurious frost conditions which prevail in some places, especially in areas of insufficient air drainage. Splendid yields of timothy and alsike hay are obtained from marshes where the peat has been properly pulverized. A hay meadow should not be permitted to lie too long, but plowed up, and a grain or cultivated crop removed before reseeding. Oats and barley are good grain crops, and return good yields. Cabbage, turnips, and potatoes may also be grown.

The result of fertilizer treatment on yields of hay are interesting, and indicate the possibilities of this soil type when properly fertilized.

TABLE 10.—*Yields and Treatment of Peat Soils at Phillips, Price County, Wisconsin.*

| Plot. | Treatment, pounds per acre. | Hay per acre. |
|---|---|---|
| | | Pounds. |
| O | Sulphate of potash, 100 | 4,588 |
| P | Acid phosphate, 275 | 5,015 |
| Q | Sulphate of potash, 100; acid phosphate, 275 | 4,848 |
| R | Blank | 2,727 |
| S | Sulphate of potash, 100; acid phosphate, 275 | 4,906 |
| T | Sulphate of potash, 100 | 4,781 |
| U | Acid phosphate, 275 | 5,158 |
| V | Manure, 15 loads | 2,476 |

## MARL.

Very frequently deposits of marl are associated with peat beds. This whitish sticky material represents an accummulation of shells of fresh water molluscs, and indicates that the bog was formed from the choking up of a lake by the accummulation of vegetable matter. Marl, in the dry condition, is a very fine powdery material and composed principally of lime carbonate. It is mentioned in this connection on account of its value as a neutralizer of acidity in soils. For this purpose it is equal in value to ground limestone. The deposits found were usually of small extent, and considerable distance from shipping facilities. They are, however, valuable locally to farmers within reasonable hauling distance. It should be spaded out and allowed to dry, when large quantities can be hauled. One to two tons is an average application, depending somewhat on the degree of acidity. Marl deposits were found in Section 36, Township 37, Range 19 West; Section 5, Township 44, Range 9 West, along the Clam River in Section 16, Township 38, Range 15 West, near the Yellow River in Section 2, Township 38, Range 13 West. Along the Trade River in Sections 26 and 27, Township 37, Range 18, a tract 20 acres or more in extent occurs. Unquestionably many similar deposits occur elsewhere in the area under discussion.

# CHAPTER VII.

## MISCELLANEOUS.

### Meadow.

Meadow comprises land lying along river bottoms, and represents areas once submerged, but owing to readjustment of drainage conditions, have been left as dry land adjacent to present stream beds. Practically the entire type occurs along the Brule and the St. Croix River channel. In early geological periods, this channel was occupied by a single stream which embraced the entire width of the present bottom lands, and whose course was in the direction of the present St. Croix.

The width of the bottoms varies from a few rods to a mile or more in the vicinity of the St. Croix flowage in Douglas county. The soil is difficult to classify, and varies from deep deposits of peat to sandy loams and even clay loams. Extensive areas of peat have been shown on the map wherever they occur. The sandy or sandy loam types of soil predominates, but lack uniformity over any considerable area. In the vicinity of Gordon, heavy red clay out-crops near the surface in places, or occurs as subsoil. Stoniness is very common, and in local areas, the stone cover the ground almost completely. Frequently, patches occur in which a heavy accumulation of moss and vegetable matter over-lie the harder soil beneath.

Nearly all the meadow land was forested; the growth in some places being very heavy and consisting of cedar, spruce, elm, and jack pine. Agriculturally, it has little value, except locally where a number of farms have been developed. Good pasturage and hay may be secured from some of it.

## BEACH SAND.

This formation is of limited extent and is found only in places where the combined action of the wind and waves makes its deposition possible. Along the border of the Apostle Islands it is usually found in small, isolated, sheltered areas along the south or west sides. Along the mainland, several long narrow areas occur, some of which are of considerable economic importance. The Duluth-Superior harbor is protected by Minnesota Point—a narrow body of beach sand which has been deposited by the St. Louis River, at its mouth, and piled up to a considerable height by the action of waves and wind. Long Island, formerly a point off the mainland of Ashland County, was also formed in a similar manner.

The material is usually a light colored fine to medium sand with no apparent difference in soil and subsoil. It supports scant vegetation of sand cherries, wild vetch, and some blueberries. On some of the older and larger tracts, a growth of small pine has developed.

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## ROCK OUTCROP.

Rock outcrop includes areas where the underlying rock of the region is exposed, or comes very near the surface. These areas occur principally in Ashland, Douglas, and Bayfield Counties. They are indicated by means of a symbol wherever the outcrop occurs within any particular soil type.

## CHAPER VIII.

## CLIMATE.

The agricultural possibilities of any section are profoundly influenced by its climatic conditions. For certain lines of agriculture, the climate may be of even more importance than the soil. The fruit industry is a localized business, the success of which is largely dependent upon its location with reference to freedom from late frost, a cool ripening period, and absence of extreme winter temperature. Likewise, the maturing of certain crops as corn, for example, requires a growing season 100 to 130 days in length. Again, the amount and distribution of rainfall is an important factor in limiting the crops which may be grown profitably.

The climate of a portion of this section is modified considerably by its nearness to Lake Superior. The influence of this large body of water is very pronounced along a narrow belt bordering the shore, and extends a considerable distance inland, where the topography does not interfere with the free passage of the winds. The Lake influence is especially marked in cases where valleys, occupied by streams tributary to the Lake, extend many miles inland, and permit of free circulation of air, modified by the presence of this extensive body of water. From a strip along the shore where the effect is greatest, the influence of the Lake becomes of less importance as we proceed into the interior, disappearing at a distance of about 20 to 25 miles.

Besides the Lake influence, the greater part of the six counties, included in the area are subject to the general atmospheric disturbances known as cyclonic storms. These disturbances have their origin in areas where the barometric pressure is low, toward which winds blow from all directions. These areas of low pressure have also a forward movement which affects the direction of wind in its path. The rate at which these storm areas move varies considerably, and usually requires 3 to 6 days

for their passage across the continent. In the United States these storm centers or "lows", as they are designated on weather maps, usually originate in the west or northwestern part of the country, and move across the country, leaving the United States in the neighborhood of the St. Lawrence Valley along the Canadian border.

In connection with the climate of any locality, we are concerned chiefly with the amount and distribution of rainfall, and the general temperature conditions which prevail. Throughout the area under consideration, there are at present, nine stations from which weather reports are obtained, for the United States Weather Bureau. Some of these have been in existence only a comparatively short time, while in others, the records are incomplete or badly broken, thus lessening their value very much. Four of the stations have records for only a short period of 3 to 6 years; while others have been in existence over 20 years. The stations at present, together with the length of record of each are:—Ashland 24 years, Bayfield 6 years, Cornucopia 3 years, Grantsburg 24 years, Hayward 24 years, Iron River 6 years, Solon Springs 9 years, Spooner 21 years, and Superior 6 years.

*Temperature.* In preparing the maps* on temperature for the different seasons for the northwestern section of the state, data from the following stations were used—Superior, Solon Springs, Spooner, Grantsburg, Ashland, Iron River, Hayward, and Bayfield. By examining the maps it will be noticed that the lines of equal temperature, or isothermal lines do not run east and west across the area, but follow a general northeast to southwest, or northwest to southeast course; especially is this the case in summer and in winter. The modifying factors in this connection are, (a) the presence of a large body of water to the north, (b) the topographic features,—high, plateau-like uplands ranging from 500 to 1200 feet above the clay plains which are 10 to 15 miles in width and border the lake shore; (c) the soil conditions, (d) and the influence of the Mississippi Valley which is of minor importance, and only affects the extreme western part of the area under consideration.

The influence of these various factors is quite strikingly illustrated in the mean summer and winter temperatures of the

*From Bulletin No. 223 Climate of Wisconsin, a copy of which may be secured from Agricultural Experiment Station, Malison, Wis.

area, figures 3 and 4. This is especially noticeable in the case of the mean summer temperature in a strip along the shore of Lake Superior, where the mean temperature ranges from 60 to 65 degrees, while the greater part of the area directly to the south has only a range of 1 to 2 degrees, and is included within

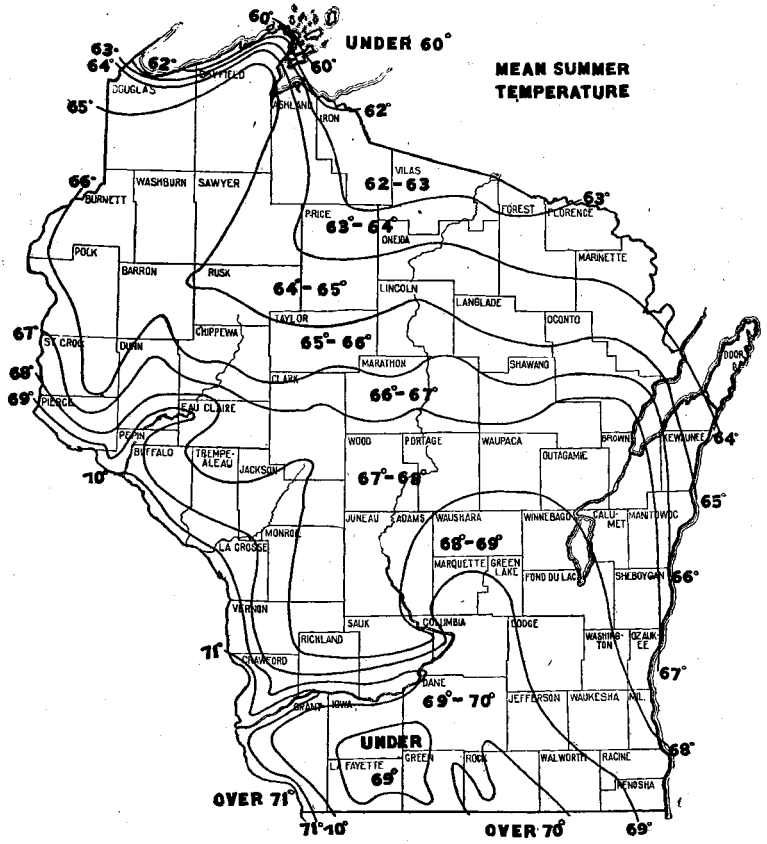


FIGURE 3. COMPARATIVE MEAN SUMMER TEMPERATURE

Average of the daiy maxima and minima for June, July, and August.

the zone of 65 to 66 degrees. This is similar to the north central part of the state; the isotherm of 65 degrees, it will be noticed, passes through northern Taylor and Lincoln counties, and then veers off east and southeast through the central part of Kewaunee County.

The mean winter temperature of the Lake border is likewise

modified by its proximity to the Lake; the temperature range for a narrow strip along the shore being 13 to 17 degrees above zero, while the larger part of the six counties has a mean temperature of 12 to 13 degrees above zero.

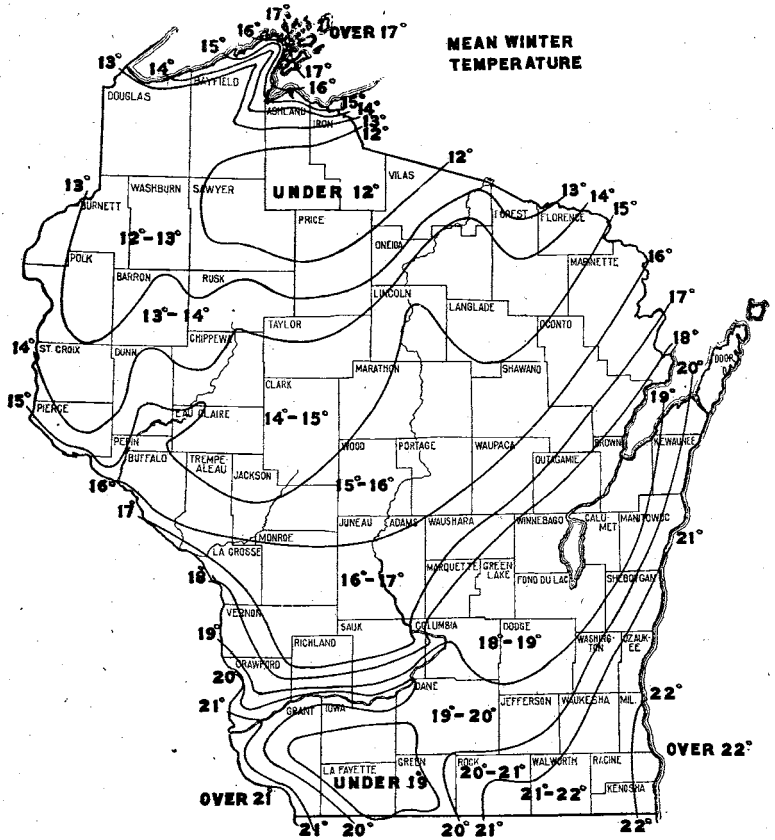


FIGURE 4. COMPARATIVE MEAN WINTER TEMPERATURE

Average of the daily maxima and minima for December, January, and February.

The mean spring and fall temperature, figures 5 and 6, show more uniformity and regularity in the zones. The spring temperatures are lower along the shore, and the season is retarded accordingly. This condition is especially desirable for fruit growing since the fruit buds are retarded until danger of spring frosts has passed. In the fall the land loses heat more rapidly than the water, and consequently the mean

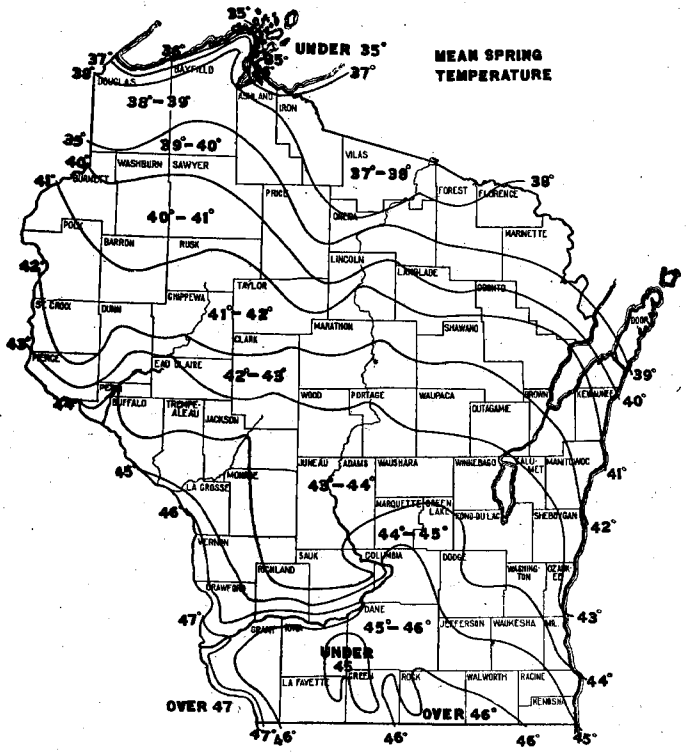


FIGURE 5. COMPARATIVE MEAN SPRING TEMPERATURE
Average of the daily maxima and minima for March, April, and May.

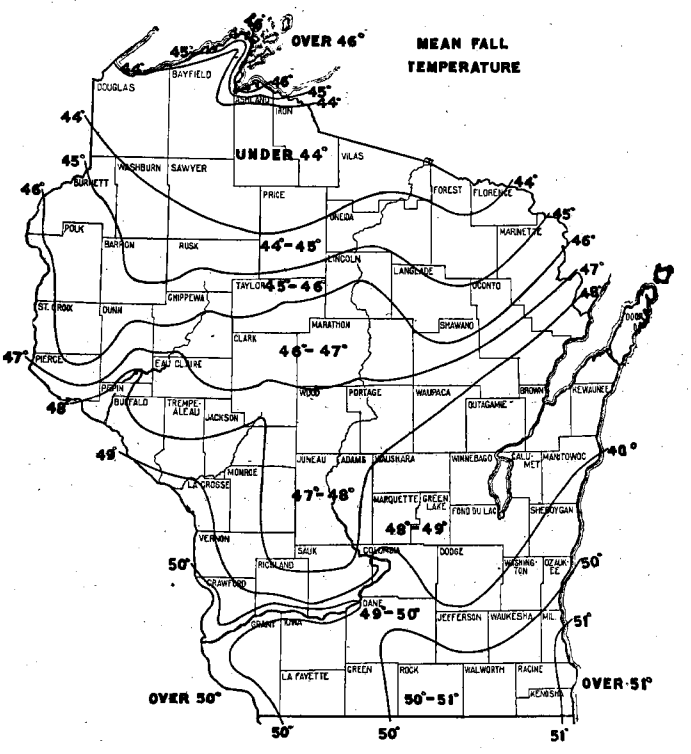


FIGURE 6. COMPARATIVE MEAN FALL TEMPERATURE
Average of the daily maxima and minima for September, October, and November.

temperature is lower inland than near the Lake shore. The mean fall temperature of the interior ranges from 44 to 46, while farther north and along the shore the range is about the same.

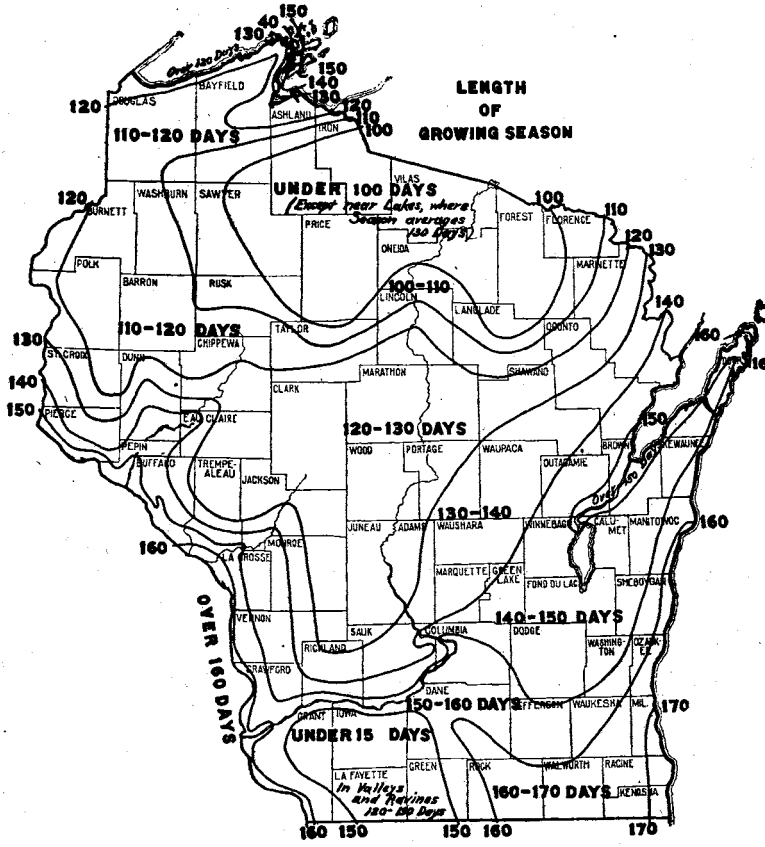


FIGURE 7. COMPARATIVE LENGTH OF GROWING SEASON

This map shows the average number of days between the last killing frost in the spring and the first in the fall for twelve years, 1899 to 1910.

This section of the state has a considerable range of temperature. As a rule, there are a number of days each summer in the interior when the temperature exceeds 100 degrees; the highest thus recorded being 105 degrees. The mean winter temperature is about 12 degrees in the interior. Extremes of 20 or more degrees below zero are frequently experienced. The lowest tem-

pérature thus far recorded is 50 degrees below zero. Similar extremes are recorded in the southern and central parts of the state.

*Length of Growing Season.* In connection with the climate and its influence on agriculture, the length of the growing season deserves consideration. By the length of the growing season, is understood the average number of days between the

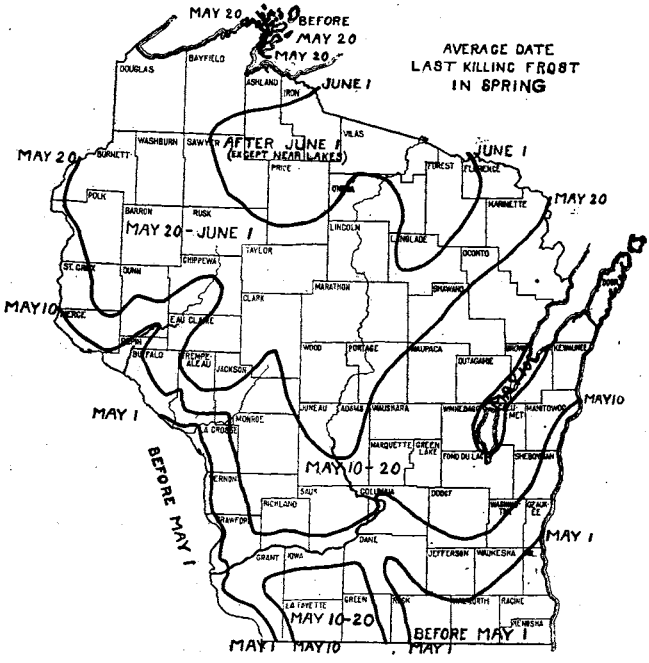


FIGURE 8. LAST KILLING SPRING FROST

last killing frost in the spring, and the first destructive frost in the fall. From this data, the length of growing season has been determined as indicated in figure 7. Figures 8 and 9 show average dates of destructive frosts in the spring and the fall over a period of 12 years. The influence of the Lake, and to a small extent the Mississippi Valley, is quite noticeable. The range from 100 to 130 and 140 days within a short distance is also especially striking.

*Effective Heat.* In order, however, to interpret intelligently the map showing the length of the growing season, it should be studied in connection with the map on comparative effective

heat, figure 10. A word of explanation may be necessary as to the meaning of the term "effective heat." Plants and vegetables, as a rule, do not germinate or show noticeable growth until a temperature of several degrees above the freezing point is reached. In this discussion 42 degrees was arbitrarily selected as the starting point from which to estimate the amount of heat available for crops. Figure 10 shows by zones the com-

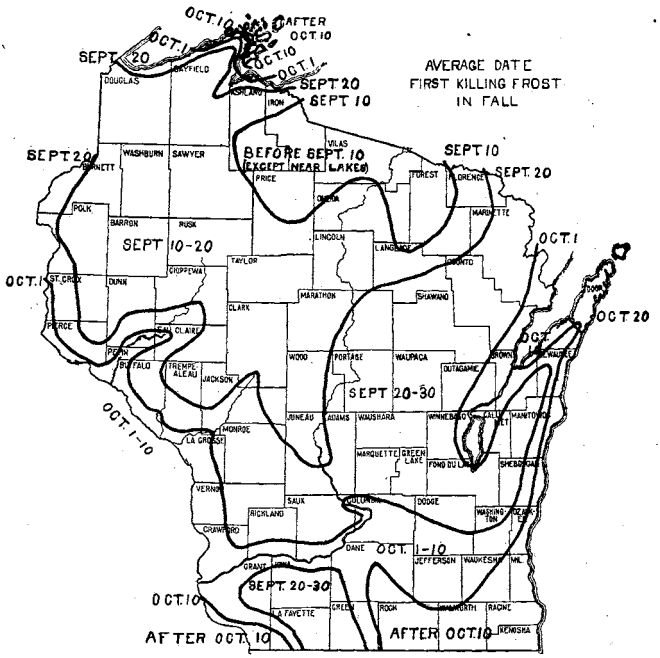


FIGURE 9. FIRST KILLING FALL FROST

These maps have been prepared from the original monthly reports of the observers of the U. S. Weather Bureau for twelve years, 1899 to 1910, supplemented by private records loaned to the authors.

parative amount of heat available for crops from April to September inclusive, and was prepared by deducting 42 degrees from the mean temperature of each station during the 6 months, April to September. In comparing the maps, figures 8 and 9, it is observed at once that while the length of the growing season along the Lake shore of the northern counties may exceed the length of the growing season of the inland regions by 10 to 30 days, yet this advantage is offset to a large extent by the difference in effective heat in the respective areas. This fact is

also borne out by actual experience, where it is found possible to mature corn in the areas with the shorter growing season more often than in regions having a longer growing season. In part this is due to a difference in the soil; one being sandy loam, and the other being clay. The influence of the large body of

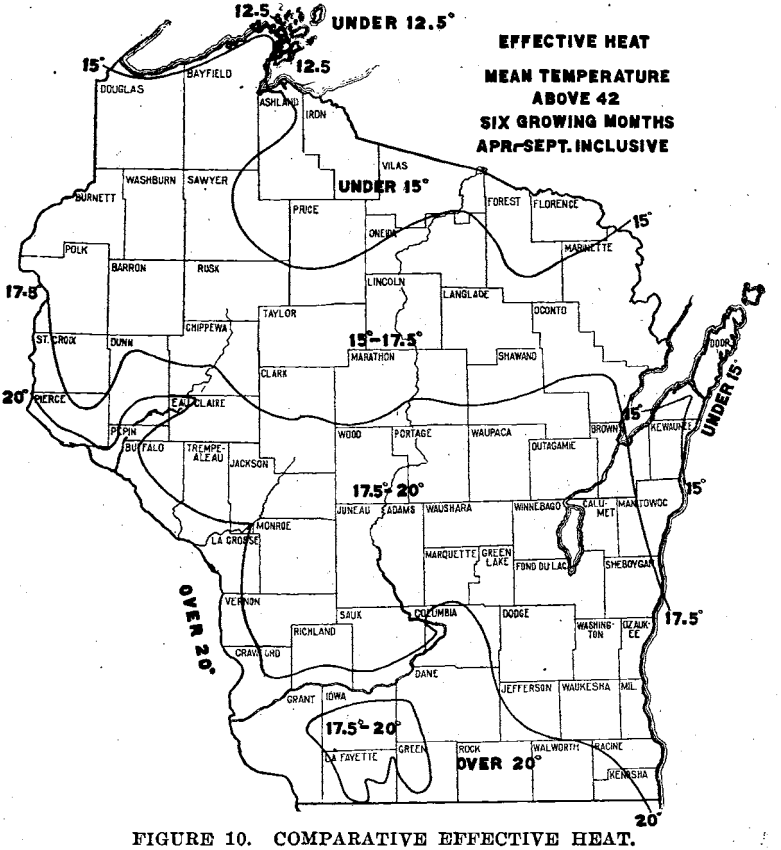


FIGURE 10. COMPARATIVE EFFECTIVE HEAT.

water is, however, of greater importance and tends to prevent extreme temperature conditions, and maintain a more nearly equable temperature throughout the entire year. The growing season is, therefore, cooler near the Lake than in the interior regions not affected by this influence.

Practically the entire area is included in the zone having 15 to 17½ degrees effective heat, and in this respect is as favorably situated as a large portion of Central Wisconsin. "The lower

Mississippi Valley receives the greatest amount of effective heat, the mean temperature at Dubuque and Prairie Du Chien during this period being about 22 degrees above this temperature of 42 degrees. Taking this lower Mississippi Valley as a standard it will be noted that the northern highlands receive one-third less effective heat, while the Michigan shore, and northwestern Wisconsin average about one-fourth less heat; Kenosha County receiving about as much as Buffalo County, Sheboygan as much as St. Croix, while Barron and Washburn Counties during these months are as warm as Manitowoc or Kewaunee, Marathon, or Taylor Counties."

In this connection it is also interesting to note that owing to its northern latitude, this section of Wisconsin receives more sunlight during the growing season than the southern part of the State. During the summer season, this may amount to one-half to three fourths hours daily.

*Wind Direction.* Along the Lake shore and extending into the interior for some distance the winds are influenced to a large extent by the Lake. For about six months, April to September, this section is in the path of steady north easterly winds which blow sometimes with marked severity, and are frequently accompanied by cold, wet weather. In the winter, the conditions are changed, and the prevailing winds are southwest. The interior sections are in the path of southwest winds during the spring and summer months, while in the winter more variable conditions obtain, and winds from the south, southwest and northwest occur.

*Rainfall.* The total amount of rainfall as well as the distribution throughout the growing season is of great importance agriculturally. The following table shows the average monthly rainfall, and also the annual amount for each of the stations for the entire period of record to 1913.

TABLE 11.—*Average Monthly Precipitation for the Growing and Non-Growing Season for the Entire Period of Record of Each Station to 1913.*

| | Ashland. | Bayfield. | Iron River. | Superior. | Solon Springs. | Hayward. | Spooner. | Grantsburg. |
|---|---|---|---|---|---|---|---|---|
| April | 2.00 | 1.62 | 2.18 | 1.69 | 1.79 | 1.90 | 1.78 | 2.57 |
| May | 3.48 | 4.35 | 4.17 | 4.20 | 3.59 | 3.59 | 3.52 | 4.10 |
| June | 3.17 | 3.36 | 2.59 | 1.69 | 2.55 | 3.81 | 3.40 | 2.41 |
| July | 4.14 | 3.57 | 5.32 | 5.66 | 5.23 | 3.77 | 3.94 | 4.54 |
| August | 3.04 | 3.05 | 2.87 | 3.00 | 3.21 | 3.41 | 3.39 | 3.50 |
| September | 3.15 | 4.57 | 3.44 | 3.44 | 2.62 | 3.29 | 3.14 | 3.94 |
| Mean for the growing season | 18.98 | 20.52 | 20.57 | 19.68 | 18.99 | 19.77 | 19.17 | 21.06 |
| January | 1.07 | 1.59 | .90 | .45 | .83 | 1.02 | .85 | 1.08 |
| February | 1.15 | .60 | .91 | .40 | 1.22 | 1.06 | .89 | 1.08 |
| March | 1.44 | .82 | 1.41 | .81 | .73 | 1.62 | 1.72 | 1.60 |
| October | 2.70 | 2.54 | 2.57 | 1.91 | 1.90 | 3.11 | 2.79 | 2.56 |
| November | 1.48 | 1.64 | 1.84 | 1.07 | 1.39 | 1.42 | 1.33 | 1.36 |
| December | 1.22 | 1.49 | 2.13 | 1.05 | 1.19 | 1.12 | .88 | 1.28 |
| Mean for the non-growing season | 9.06 | 8.68 | 9.76 | 5.69 | 7.26 | 9.35 | 8.46 | 8.96 |
| Mean annual | 28.04 | 29.20 | 30.33 | 25.37 | 26.25 | 29.12 | 27.63 | 30.02 |

Since the amount of rainfall during the growing season is of much more value to crops, the table has been prepared showing the total precipitation during six months of the year, April to September, or the growing season and a like period from October to March, or the non-growing season. By referring to the table it is found that practically two thirds of the total annual rainfall occurs during the growing season when it exerts most influence on crops. The heaviest rainfall occurs generally in July. In 1910, Ashland and Superior recorded the least rainfall since the establishment of the station, the former indicating 17.59, and the latter 15.67 inches. The wettest years marked a rainfall of 35.7 at Ashland, and 32.92 at Superior. Grantsburg recorded 47.2 in 1903, and 22.90 in 1893, Hayward 42.00 inches in 1900, and 19.65 inches in 1894, and Spooner 42.86 inches in 1900, and 20.63 inches in 1895.

# CHAPTER IX.

## AGRICULTURE.

That there are opportunities in this area as well as in other sections of Northern Wisconsin for considerable agricultural expansion has been heralded by the press and by men interested in developing the state. It will, therefore, not be out of place to devote a brief chapter to the resources, crops grown, and other statistical matter that will furnish some information with reference to the agricultural opportunities of this section of the state. One of the leading questions to consider in this connection is the character of the soil, and the amount of unimproved land that is adapted for agricultural purposes. The soil conditions and their adaptibility have been discussed in previous chapters. Data as to the acreage of farm land, not improved, hitherto published, has not been satisfactory in many cases. Much of it has been prepared when the land was not easily accessible, and some times by men whose training was along other lines than agriculture. The result has been that invariably the amount of land adapted for agricultural purposes was underestimated. In some cases, this discrepancy was found to be 50 per cent of the true condition.

It should also be said, however, that there may be considerable variation in the agricultural value of much of the land, the same as in any other section of the state. Yet these areas are agricultural land, and will sooner or later be developed. As a rule, the better quality of land is selected first, and while much of this class remains, the less valuable will not be taken up. The cry heard so generally respecting the higher cost of living tends to make more people seek land for a home, as well as a livelihood. This tendency will have the ultimate effect of settling up land more rapidly—the poorer quality as well as the better. Again the work of experiment stations and agricultural colleges, in advancing better methods of soil management, and

selecting crops adapted to particular soils has done much in assisting the agricultural development on all types of soil.

The following table gives the total land acreage, together with an estimate of the amount of undeveloped land that is adapted for general farming. This estimate is based upon data obtained by the writer and his co-workers in connection with the survey of the soils of this section, and while there may be inaccuracies, it represents approximately the conditions as they exist at present. The total land acreage and the acreage of improved land were taken from the United States Census for 1910.

TABLE 12.—*Condition of Farm Land in Northern Wisconsin.*

| COUNTIES. | Total Land Surface (U. S. Census 1910). | AGGREGATE AMOUNT OF AGRICULTURAL LAND. | | TOTAL ACREAGE OF AGRICULTURAL LAND. | |
|---|---|---|---|---|---|
| | | Per cent | Acres. | Improved land. | Unimproved land. |
| Ashland | 692,480 acres | 70 | 484,700 | 24,300 | 460,400 |
| Bayfield | 961,920 " | 65 | 625,200 | 21,600 | 603,600 |
| Burnett | 550,400 " | 75 | 412,800 | 56,600 | 356,200 |
| Douglas | 855,680 " | 80 | 684,500 | 19,900 | 664,600 |
| Sawyer | 844,800 " | 70 | 591,300 | 10,400 | 580,900 |
| Washburn | 534,400 " | 70 | 374,000 | 41,500 | 332,500 |
| | 4,439,680 " | 71 | 3,172,500 | 174,300 | 2,998,200 |

Per cent of Total Agricultural land now improved 5.5.

From this table it will be noticed that about 70 per cent of the entire land area is agricultural land, and that less than 6 per cent of this is now under cultivation. Expressed in terms of acres, it may be stated that less than a quarter million acres are improved out of a total of over three million acres in the area. There is certainly room for more settlers.

That this section of the state is becoming rapidly settled and land brought under cultivation is seen from the following table:

TABLE 13.—*Acres of Improved Land 1910 Compared with 1900—(U. S. Census 1910).*

| Counties. | 1900. | 1910. | Per cent increase 10-year period. |
|---|---|---|---|
| Ashland | 13,611 Acres | 24,374 Acres. | 77 Per cent. |
| Bayfield | 8,022 " | 21,661 " | 70 " " |
| Burnett | 32,626 " | 56,601 " | 73 " " |
| Douglas | 5,234 " | 19,920 " | 280 " " |
| Sawyer | 4,871 " | 10,428 " | 110 " " |
| Washburn | 13,039 " | 41,587 " | 210 " " |

The per cent increase of improved land has been especially marked in the case of Douglas, Washburn, and Bayfield Counties in the 10-year period. It may be confidently predicted that the next decennial period will see an even greater increase.

*Crops.* In connection with the development of a new country, it is interesting to note the principal crops grown, the acreage of each and the general trend during the 10-year period 1899 to 1909. In general, oats is the principal grain grown in the area, wheat next, and followed by barley, and rye in the order named. Burnett County, however, produces on the average a larger yield of rye than barley, and more corn than grain. Douglas County also produces more rye than barley. Corn is grown only to a limited extent, especially in the counties bordering the Lake. The census figures, however, are not complete, and a considerable amount of corn cut for silage purposes is not recorded in the census reports.

TABLE 14.—*Acreage and Yield of Principal Crops Grown in 1899 and 1909* (United States Census).

| Crops. | Ashland | | Bayfield. | | Burnett. | | Douglas. | | Sawyer. | | Washburn. | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A. | Bu. | A. | Bu. | A. | Bu. | A. | Bu. | A. | Bu. | A. | Bu. |
| Corn | | | | | | | | | | | | |
| 1899 ... | 44 | 1,190 | 50 | 1,760 | 2,362 | 51,780 | 73 | 2,490 | 55 | 2,520 | 894 | 18,790 |
| 1909.... | 32 | 751 | 255 | 6,338 | 5,494 | 146,792 | 519 | 11,430 | 166 | 12,575 | 2,887 | 85 6 |
| Oats | | | | | | | | | | | | |
| 1899 | 1,217 | 34,490 | 152 | 4,740 | 3,073 | 99,690 | 135 | 3,120 | 686 | 22,660 | 1,260 | 33,400 |
| 1909 | 2,165 | 55.769 | 1,608 | 44,681 | 5,109 | 43,219 | 839 | 22,108 | 1,244 | 32,529 | 3,731 | 91,505 |
| Wheat | | | | | | | | | | | | |
| 1899.... | 133 | 2,450 | 10 | 200 | 2.790 | 50,580 | 11 | 180 | 53 | 890 | 783 | 12,200 |
| 1909 | 411 | 5.040 | 245 | 3,690 | 3,951 | 58,309 | 159 | 2,368 | 103 | 1,352 | 1,347 | 15,621 |
| Barley | | | | | | | | | | | | |
| 1899.... | 156 | 3,580 | 7 | 150 | 122 | 2,710 | 12 | 160 | 9 | 240 | 106 | 1,890 |
| 1909.... | 419 | 8,944 | 132 | 2,604 | 558 | 2,494 | 97 | 1,811 | 84 | 1,718 | 413 | 7,637 |
| Rye | | | | | | | | | | | | |
| 1899.... | 744 | 4,650 | 25 | 568 | 1,228 | 16,070 | 13 | 190 | 5 | 150 | 217 | 4,350 |
| 1909.... | 66 | 1,222 | 60 | 1,091 | 822 | 9,397 | 212 | 2,521 | 143 | 2,407 | 391 | 5,460 |
| Potatoes | | | | | | | | | | | | |
| 1909 | 724 | 94,551 | 1,461 | 159,710 | 2,435 | 287,735 | 971 | 111,103 | 520 | 69.961 | 1,729 | 201,534 |
| Medium Clover & Timothy Hay..... | T. | T. | T. | T. | T. | T. | T. | T. | T. | T. | T. | T. |
| 1909 | 1,018 | 13,288 | 8,760 | 10,418 | 1,130 | 16,503 | 6,700 | 7,887 | 2,365 | 2,670 | 8.615 | 10,841 |

The most important crop in point of acreage is hay, which is largely a mixture of clover and timothy; only a small amount of clover hay is grown. Burnett County, which has the largest acreage of improved land, ranks first in the production of hay, as well as corn. Burnett County also leads in the number of dairy cattle. Attention has already been called to the fact that many of the hay meadows are allowed to remain in hay too long. Many of these old timothy hay meadows produce meager yields, and become sod bound, and are infested with weeds. The progressive farmer may well turn to red clover as a substitute for part of his hay crop.

Specialized industries are important. Potato culture demands more attention in some sections than anything else. The Nemakagon Valley is developing into a tuber section. Small fruits, and orcharding on a commercial basis, are attracting the

attention of the Lake Shore Counties. On the lighter soil types beans are important cash crops raised. During recent years, cranberry culture has received attention. At present there are three cranberry bogs in operation and another under construction. There are many ideal locations in the area for this industry.

*Dairying*. The dairy industry is an important one in all of the counties of the area. Burnett ranks first, having in 1910 nearly three fourths as many milch cows as all the other counties taken together. The value of the dairy products in each of the counties exceeds the value of the grain raised.

(TABLE 15. *Dairy Statistics—U. S. Census 1910*).

| Counties. | Number of milch cows. | Value of dairy products. | |
|---|---|---|---|
| Ashland | 2,590 | 77,621 | Dollars |
| Bayfield | 2,385 | 77,211 | " |
| Burnett | 7,634 | 211,900 | " |
| Douglas | 2,085 | 96,242 | " |
| Sawyer | 829 | 20,694 | " |
| Washburn | 3,401 | 101,598 | " |

The dairy products sold from the farm are mainly butter and butter fat. Creameries are centrally located, many of which maintain collecting wagons, which are sent around to gather the cream from the farmers. This system of farming is found profitable. It provides good cash returns from crops grown, the fertility of which is returned to the soil in a large measure.

*Population*. The population of the six counties from 1890 to 1910 is shown in the following table:

TABLE 16.—*Population of Counties.*

| Counties | 1890 | 1900 | 1910 |
|---|---|---|---|
| Ashland | 20,063 | 20,176 | 21,965 |
| Bayfield | 7,390 | 14,392 | 15,987 |
| Burnett | 4,393 | 7,478 | 9,026 |
| Douglas | 13,468 | 36,335 | 47,422 |
| Sawyer | 1,977 | 3,593 | 6,227 |
| Washburn | 2,925 | 5,521 | 8,196 |

The greater portion of the population, while mainly native born, is of foreign extraction, chiefly of Scandinavian descent. In Douglas and Bayfield Counties, numerous settlements of Finlanders have segregated themselves in small farming communities. Similar colonies of Poles, Slavonians, Austrians, and Hollanders have been formed in Bayfield County. The Germans are found in less numbers throughout the entire area. In Ashland and Washburn Counties, a considerable number of Canadian French have established small farming communities.

*Markets.* This area of six counties is located advantageously with reference to markets. Excellent railroad facilities lead to splendid consuming markets at the head of the Lakes—Superior, Duluth, and the Range country to the north. The Twin Cities, Minneapolis and St. Paul, are also commanding markets within easy reach. Good home markets are also maintained, the more important ones of which are as follows:

TABLE 17.—*Population of Cities.*

(U. S. Census 1910)

| | | | |
|---|---|---|---|
| Ashland | 11,594 | Spooner | 1,453 |
| Bayfield | 2,692 | Shell Lake | 902 |
| Washburn | 3,830 | Hayward | 2,869 |
| Iron River | 1,696 | Grantsburg | 721 |
| Superior | 40,384 | Mellen | 1,833 |

During the summer months, packet steamers ply between the Lake ports daily, carrying produce to Superior and Duluth. This is of special importance to the fruit shipper without rail facilities.

In the more settled portions, good wagon roads are maintained. Abundant material is near at hand for road building in many parts of the area.