Wisconsin Geological and Natural History Survey

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Bulletin No. L Soil Series No. 15

RECONNOISSANCE SOIL SURVEY

OF

NORTH PART

OF

NORTH CENTRAL WISCONSIN

BY

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OF THE

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

AND

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OF THE

UNITED STATES DEPARTMENT OF AGRICULTURE

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

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MADISON, WISCONSIN

PUBLISHED BY THE STATE.

1916

Wisconsin Geological and Natural History Survey

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NOTE

The soil survey of Wisconsin is being made along two lines; first a general survey of the northern and less developed portions of the State, and second a detailed survey by counties of the southern and older portions. The northern part of the State has been divided into five areas of each of which a general map of the soils is being prepared.

The first area surveyed included Portage, Wood, Clark, Taylor, Lincoln, Marathon, and portions of Price and Langlade Counties. The first survey of the soils of this area was made a number of years ago by Doctor Samuel Weidman in connection with the geological survey, and the classification followed in this work differed somewhat from that at present in use, and the maps do not show as much detail. The reports of this survey are no longer available. An entirely new survey of this area was made in 1915, and a report and map including Clark, Taylor, Marathon and Lincoln Counties will be published during the summer of 1917. Wood and Portage Counties were surveyed in detail and separate reports will be published on each of these counties.

The second area, called the South Part of North Western Wisconsin, included Polk, Barron, most of Rusk, and all of Chippewa, Dunn, St. Croix, Pierce, Pepin, and Eau Claire Counties. The edition of this report has been exhausted.

The Third area, called the North Part of North Western Wisconsin, included Burnett, Washburn, Sawyer, Douglas, and Bayfield counties, and most of Ashland County. The reports on this area are so nearly exhausted that it is only possible to loan copies for a short time.

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 called North Eastern Wisconsin includes Florence, Forest, Langlade, Oconto, Marinette, and Shawano Counties. The report on this area is now available.

This report is on the fifth area, called the North Part of North Central Wisconsin, including Iron, Vilas, Price, and Oneida Coun-

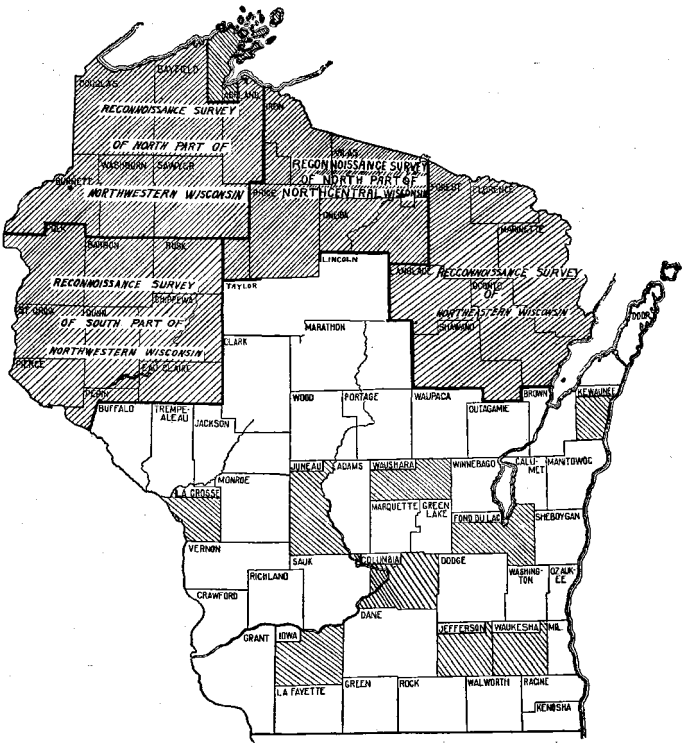
ties and the eastern portions of Ashland and Rusk Counties. A special report on the soils of Vilas County and portions of adjoining counties was prepared during the season of 1914 at the request of the Legislature when that body was considering the extent to which the development of forest reserve should be carried. Mr. T. J. Dunnewald was in charge of the field work of this survey. The map accompanying this report is included in the report on the soils of the North Part of North Central Wisconsin as well as the more important portions of the report itself, but copies of the special report and map are still available.

RECONNOISSANCE SOIL SURVEY OF NORTH PART OF NORTH CENTRAL WISCONSIN

CHAPTER I

GENERAL DESCRIPTION AND HISTORY OF THE AREA

Location and boundaries.—The area included in the Reconnoissance Soil Survey of the North Part of North Central Wisconsin



is located in the extreme north portion of Wisconsin, bordering the Upper Peninsula of Michigan. It is made up of the four counties of Vilas, Oneida, Price, and Iron, and also includes five townships

of Ashland and six townships of Rusk County. It comprises a total area of approximately 4,230 square miles or 2,707,200 acres.

Topographic Features.—The surface features are characteristic of a glacial region, and the topography varies from level to rolling and hilly, and is even quite broken in places. Part of the area consists of terminal and recessional moraines which alternate with less broken tracts of ground moraine, with basins, extensive outwash plains, and numerous swamps and lakes. In northern Iron County there are two parallel ranges which appear to have been modified but little by glacial action, as the bed rocks outcrop extensively, and where there is a covering of soil it is often thin. These are known as the Penokee Range, or the "Iron Range" because of the large deposits of iron ore, and it is the most conspicuous topographic feature in the area.

Lake Superior which borders this area on the north has an elevation above sea level of 602 feet. Lac Vieux Desert, which is the source of the Wisconsin River, has an elevation above sea level of 1630 feet. The Penokee Iron Range attains an extreme elevation of approximately 1800 feet. The drainage divide crossing the area from east to west, and sending the waters north to Lake Superior and south through the Wisconsin and Wolf Rivers, consists of a plateau from 18 to 30 miles from Lake Superior, in large part covered with swamps and lakes and so flat that in many cases the water from the same swamps may flow both north and south. South from this plateau the general slope is gradual. North it is also gradual until the Penokee Range is reached, from which there is a rapid descent to Lake Superior.

Water Power.—The streams flowing north into Lake Superior have a very rapid fall, and a large amount of power could be developed from them, but up to the present time but little development of water power in the area has been made. The Montreal River is approximately 50 miles long and from its source to Lake Superior has a fall of approximately 1000 feet. The highest gradient is concentrated within the last ten miles. The Potato River, which has its source in Iron County, but joins the Bad River in Ashland County, has a total length of 30 miles and a total fall in this distance of 900 feet. On the streams flowing south there is much less of an opportunity for water power development.

For a fuller discussion of the water power possibilities of this region see Bulletin XX of the Wisconsin Geological and Natural History Survey on "Water Powers of Wisconsin," from which the above data has been largely taken.

Settlement.—Probably the earliest permanent settlement in the region was on Spirit River in the southeastern portion of what is now Price County, where a small saw mill was established in 1860. About this mill the "Spirit River Settlement" grew up, but its growth was slow until the coming of the first railway when a small colony of Swedes located in this region. In 1880 there were two saw mills in Phillips. The first mill at Butternut was established in 1879. Other mills sprang up rapidly all along the line of the railroad.

The first railroad to reach this portion of the state was the Wisconsin Central, now owned by the Minneapolis, St. Paul and Sault Ste. Marie Railway (Soo Line). This road reached what is now Price County in 1873, and was extended on to Ashland in 1877. The City of Philips, and also Fifield, was platted and recorded in 1876, and Butternut in 1878.

The discovery of iron and the development along this line brought many people into the northern portion of this area, and the adjoining portion of Upper Michigan. What was considered to include most of the mineral land in the Penokee Range in Iron County was entered between 1874 and '76. The first work on this range and on the Gogebic Range in Michigan was in 1878.

The early settlers of this area represent a large number of nationalities. Probably the greater proportion of the inhabitants at present are American born. As indicated elsewhere, a colony of Swedes settled in southeastern Price County, and a colony of Germans in the vicinity of Butternut in Ashland County. In the vicinity of Hurley and through the northern part of Iron County there are a large number of Polish, Finlanders, and some Italian people who first worked in the mines, woods, and mills, and later took up small tracts of land. These same classes of people are also settling in other parts of the area. Many of the settlers throughout the area came from adjoining states where land values are high, and some came from Canada.

In 1910 the population of Price County was 13,795, Oneida County 11,433, Iron County 8,306, Vilas County 6,019; and the fractions of Ashland and Rusk Counties about 2,600, making a total of approximately 32,150 for the whole area. The population is rather unevenly distributed, and there are numerous townships in which no roads or settlers are found. During the summer season thousands of people come to the lake region within the area to enjoy the fishing, boating, and delightful climate. Northern Wisconsin is coming to be recognized as the playground for the Middle West. In the fall large numbers of hunters also visit this region, for birds and deer are plentiful.

Chief Towns.—Hurley, the county seat of Iron County, has a population of about 3,000, and is one of the chief towns along the Iron Range in northern Wisconsin. Mining is the most important industry, though agriculture is gradually coming to the front in this region. Mercer, Saxon, Upson, Moore, Pence, and Iron Belt are among the smaller towns within Iron County.

The county seat of Vilas County is Eagle River, with a population of about 1200. Other smaller towns and villages in this county are Phelps, Conover, Arbor Vitae, Lac Du Flambeau, and Sayner.

The county seat of Oneida County is Rhinelander, with a population of about 6,000. This is the largest place in the area surveyed. A million dollar paper plant is located here, and this gets most of its power from the Wisconsin River. Other smaller towns within Oneida County are Pelican, Monico, Three Lakes, Woodruff, Minocqua, Hazelhurst, Harshaw, and Gagen.

Phillips, with a population of about 2000, is the county seat of Price County. There is located at this place one of the finest electrically equipped saw mills in the state. Park Falls is about the same size and also has a large saw mill. Fifield, Prentice, and Kennan are among the smaller towns within Price County.

Transportation Facilities.—Excellent transportation facilities are afforded nearly every portion of the area that is developed and lines lead into many of the undeveloped regions where lumbering is being carried on. Lines belonging to four of the largest railway companies in the State traverse the area surveyed. These are the Minneapolis, St. Paul and Sault Ste. Marie, the Chicago and Northwestern, the Chicago, Milwaukee & St. Paul, and the Duluth South Shore, and Atlantic.

Markets.—The cities, towns, lumbering camps, and mines within the area afford a market for a large amount of farm produce. Green Bay, Milwaukee, and Chicago also provide a ready market for all classes of produce. The extensive lumbering interests in this portion of Wisconsin and northern Michigan, together with the iron and copper mining districts, require large amounts of produce, and for this Chicago prices plus freight charges are usually paid when it can be secured locally. It is therefore to the advantage of the farmers within this region to attempt to supply this market.

Public Roads and Schools.—Within the area extensive settlements are limited and there are large tracts of undeveloped country where there are no public roads. The main roads between towns are usually graded and kept in good repair, while side roads are usually not given much attention. A number of roads are now being improved under the State Highway Law, through which the State cooperates

with the county and township. All such roads are constructed under the supervision of the State and are built according to the most improved scientific methods. All of the counties in the area are now making road improvements under this provision and considerable progress has been made.

Rural free delivery mail routes have been established in nearly all portions of the present survey, and by far the greater proportion of the families of this region have their mail delivered daily. The rural telephone is also in common use, and many farmhouses are supplied with this convenience.

The rural school buildings will average of better grade than those in the southern portion of the State. In a number of instances several districts have consolidated, and the children are carried to and from school in public conveyances.

ORIGIN AND GENERAL NATURE OF SOILS

The underlying rocks from which most of the soils of this region were formed are of igneous character, largely of granite, syenites, and other crystalline sorts. A small area of sandstone occurs in the northern part of Iron County. From these rocks a residual soil had been formed preceding the glacial period. During the glacial period the ice moving largely from the northeastward brought a large amount of loose surface material from the adjacent portion of northern Michigan, and at the same time removed much of the residual soil previously formed, carrying it farther to the southwest. In this way a large amount of sand was brought from the sandstone region of northern Michigan and deposited in Vilas, northern Oneida, and eastern Price County.

A small area of Superior clay soils in northern Iron County and in other parts of this region, were originally deposited by the lake water and in part have been worked over by the ice of later glacial periods.

The glacial period did not consist of a single invasion of the ice, but of several, the material of which the geologist has been able, with more or less certainty, to distinguish. While most of the glacial action above mentioned is that of the last glaciation, the flow of which was from the northeastward, preceding ice invasions had come from the northwest and were much older. The soils of some portions of this area were almost entirely formed by this earlier ice invasion—the later ice sheet apparently having flowed over it with very little effect. For the most part the soils mapped as

Colby were formed by the earlier ice invasions, and those classed as Kennan are of the last ice age, but in the mapping of the soils their physical character and agricultural value has been given first place, and no particular effort has been made in this study to distinguish the soils deposited by the different ice sheets.

From a geological point of view, the soils, therefore, include ground moraine of different ice ages, recessional moraines of which there are a considerable number, over-wash plains, and stream terraces. As this report is intended primarily for agricultural readers, no attempt is made to discuss the geology of the region.

The Kennan series is the most extensive and consists of glacial material which has been derived largely from crystalline rocks. It is light colored and formed part of the Late Wisconsin Drift Sheet. It is always sufficiently rolling and the subsoil is sufficiently porous so that the natural drainage is always fair to good, and no mottled condition is found in the subsoil. The types mapped as belonging to this series are the silt loam, loam, and fine sandy loam.

The Colby series is very similar to the Kennan and is glacial material from crystalline rocks, but appears to have been deposited by an older ice invasion; and the material is more thoroughly weathered, the topography is more level, and there are fewer bowlders upon the surface. The subsoil is always mottled and the natural drainage conditions are somewhat inferior to those of the Kennan series. The types mapped were the silt loam and fine sandy loam.

The Mellen series includes soils derived by glacial action from the Huronian iron bearing rocks, to which has been added a considerable amount of material of sandstone origin. In texture, topography, color, and structure the soils very closely resemble the Kennan. The types mapped were silt loam, loam, and fine sandy loam.

The Vilas series embraces all glacial-till soils which are derived from crystalline rocks or Keweenawan sandstone and which are lighter than a fine sandy loam in texture. It comprises the bulk of the rolling white pine lands of the area. The sandy loam portion has a fair water-holding capacity, but the lighter types are subject to drought. The types mapped as belonging to this series are the sandy loam, fine sand, sand, and stony sand.

The Superior series is made up of soils composed largely of heavy lacustrine or lake laid material having a characteristic red or pinkish red color in the subsoil. Certain areas have been more or less modified by glacial action giving rise to a rolling topography and a surface soil different from the characteristic red clay. The loam is the only type of the typical soil mapped in the area, but rolling phases of fine sandy loam, loam, and clay loam were mapped.

The Antigo series includes all alluvial soils of a heavier texture than a sandy loam and occurs as glacial outwash plains, glacial terraces, and filled in valleys. The surface is level but owing to the presence of a gravelly porous subsoil, the drainage is usually sufficient. Only two types—the silt loam and fine sandy loam were mapped.

The Plainfield series consists of light colored soils of the outwash plains, terraces, and filled in valleys. Only soils of a lighter texture than fine sandy loam are included in this series. These soils as a rule have a low water-holding capacity and a comparatively small amount of original virgin fertility. Three types—the sandy loam, sand, and fine sand were mapped in the area.

The Coloma series includes light colored glacial material occuring chiefly as ground moraine, where the material has been derived largely from the Potsdam sandstone. The topography is quite rolling and the soils are subject to drought. Only one type—the Coloma sand was mapped.

The Genesee series represents light colored first bottom soils within the glaciated region. Genesee sandy loam is the only type mapped as belonging to this series.

Peat includes decaying vegetable matter in varying stages of development, with which there has been incorporated in some cases small amounts of mineral matter.

Rough stony land includes tracts where extensive rock outcrops occur, and where the surface is so steep and rocky as to be unsuited to agricultural development.

SOIL CLASSIFICATION

Many of the most important qualities of the soil depend on the relative amounts present of soil of different sized grains. This is called the *texture* of the soil. In order to classify soils it is therefore necessary to determine the relative proportion of the soil made up of each of the different sized grains. This separation of the soil is called *mechanical analysis* and in the system most commonly used seven different sizes of grains are recognized and named as follows: fine gravel, coarse sand, medium sand, fine sand, very fine sand, silt, and clay. Practically all soils have at least a small amount of each of these different sizes. The following table gives the average texture of the most important classes of soils:

Average Texture of Important Classes of Soils.

Class of Soil	Mechanical analysis giving average percentage of soil separates in each class.						
	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
Coarse sandy soil	5	15	25	30	10	10	5
Sandy loam soil	5	10	10	25	15	20	15
Fine sandy loam soil	1	4	5	20	25	30	15
Loam soil	1	3	4	15	20	40	17
Silt loam soil	1	1	2	6	10	60	20
Clay loam soil	0	1	2	5	15	42	35
Clay soil	0	1	2	5	12	30	50

Soils, of course, vary in many other respects than texture, due to their origin. This affects the topography or lay of the land, drainage conditions, and chemical composition including the amount of organic matter. All of these factors are included in the series to which proper names have been given. The Kennan series, for instance, as mapped in this area, includes three types differing in textures, but all of which were formed by glacial action on granitic rocks and are low in organic matter and undulating to rough in topography. Each of the other series, such as the Colby, Vilas, etc., have similar characteristics which are described in the following pages.

For convenience in discussing their agricultural value and management these 28 types of soil are classified into five groups—(1) a group of heavy soils, (2) a group of medium heavy soils, (3) a group of medium sandy soils, (4) a group of sand soils, and (5) a group of poorly drained soils.

CHAPTER II

GROUP OF HEAVY SOILS

KENNAN SILT LOAM

Extent and Distribution.—The Kennan silt loam with its rolling phase, which is described later, is one of the important types in the present survey. The most extensive tract is located in the northwestern portion of Price County in Towns 38, 39, and 40 North, and Range 1 and 2 West. Another important tract is found in the extreme southeastern part of the county in Town 34, Range 3 East. In the eastern part of Rusk County there are a number of small areas, and in Oneida County immediately north of Lennox there is a tract of several square miles of excellent land of this type. Other smaller patches are found in various parts of the survey.

Description.—The surface soil of this type consists of a brown or light brown friable loess-like silt loam extending to an average depth of 12 to 14 inches. The subsoil consists of a light yellow or a yellowish-brown silt loam to silty clay loam which usually becomes somewhat heavier with depth, and silty clay loam or a clay loam may be reached at 18 to 20 inches. This heavy layer usually extends to an average depth of 30 inches; the lower portion of this section frequently contains some sand. Below 30 inches the subsoil grades into a bed of unassorted glacial till consisting of fine and medium sand and gravel with only a small percentage of silt and clay. Stones and bowlders are present upon the surface, though not as numerous as on some of the other soils of the area. It is seldom that large bowlders are found on this type, and most of the stones range in diameter from a few inches to 12 or 14 inches.

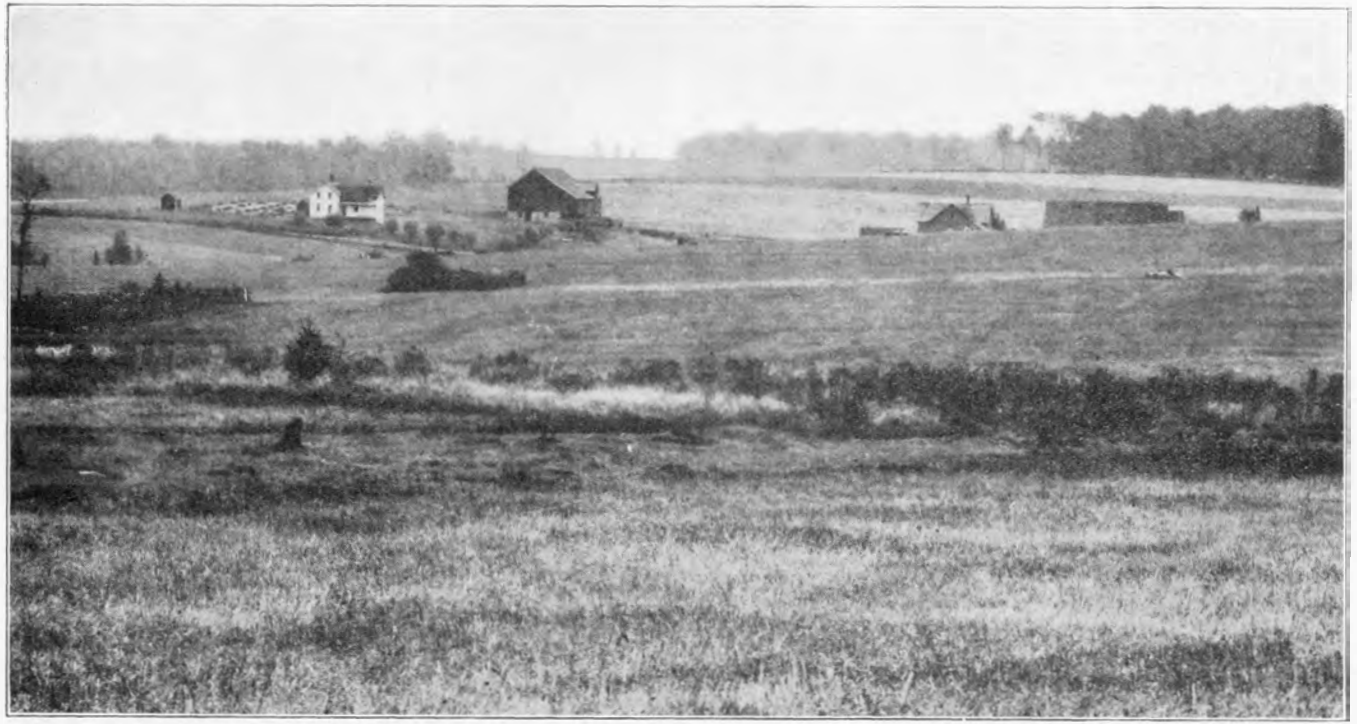
There are some variations in this soil worthy of note. The most important is the depth of the silty layer to the underlying lighter textured material. There are a few places, especially in Rusk County, where the depth is greater than usual and where the entire section is loess-like and sometimes entirely stone free. In a few places the heavy material was known to extend to a depth of from 3 to 5 feet. On the other hand, limited tracts were found where the sandy and gravelly material came within one foot of the surface.

Topography and Drainage.—The surface of this type varies from undulating or nearly level to gently rolling. In most cases the natural drainage is good. The slope is usually sufficient to give good surface drainage and the underlying gravelly material usually provides underdrainage. Where the surface is nearly level, however, and where the silty covering is deeper than typical, the drainage is sometimes deficient and tile drains will be found desirable and possibly necessary when such tracts are improved.

Origin.—It appears that this type of soil has had its origin both from the weathering of the loess-like mantle that covers the till as well as from the weathering of the glacial till itself. With the possible exception of the silty covering, the material forming this soil consists of unassorted glacial till which was deposited by the ice sheet in the form of ground moraine, and which extends to a depth of from a few feet to over 100 feet. The material was practically all derived from the crystalline rock formation which underlies the greater part of the area. No calcareous rocks are present and both soil and subsoil are found to be in an acid condition.

Native Vegetation.—The timber growth consists chiefly of maple, birch, and hemlock. Basswood, elm, and white pine are found in smaller numbers. Most of the pine has been cut, but the greater proportion of the hardwood is still standing. Some very fine timber was seen on this soil, especially in northwestern Price County.

Agricultural Development.—Only a small proportion of this soil is cleared and under cultivation, although it is one of the most desirable types in the area. Much of it, however, is located at a considerable distance from transportation lines, and much of it is also still in virgin forest. The largest amount of cleared land is in the southeastern part of Price County. The type of farming followied is general farming with dairying developing into the most important feature. The crops grown and the yields obtained are oats 40–60 bushels, hay from 2 to 3 tons, potatoes from 150 to 250 bushels per acre. These are the most important crops grown at present but in addition corn is raised for silage, and frequently allowed to mature when danger from frost seems slight. From 40 to 50 bushels per acre are secured. The silage yields well and is of excellent quality. A small amount of barley is also grown, but not as extensively as oats. Grasses do very well, and the cut-over lands afford excellent grazing. Clover does very well, especially on new land. Very satisfactory returns can often be secured from the clover seed. Peas and sugar beets will do well, and could be successfully raised. Wheat can also be successfully grown.



TYPICAL VIEW OF IMPROVED FARM LAND ON KENNAN SILT LOAM

This soil is confined largely to Northwestern Price, Ashland and Iron counties. It is an excellant soil and capable of being highly improved. Most of it is still timbered.

COLBY SILT LOAM.

View showing typical surface features and well improved farmstead. This soil is confined chiefly to southern Price and eastern Rusk counties. It is excellent grass land and well adapted to general farming and dairying.

KENNAN SILT LOAM—ROLLING PHASE

Extent and Distribution.—This is one of the extensive and important types in the area. There is probably somewhat more than 125 square miles of the Kennan silt loam—rolling phase—in the area. The largest tract occurs in the portion of Ashland County included in this area, and in the adjoining portions of Iron County. Between this extensive tract and Mercer there are several other smaller patches. There are also several areas in Oneida County worthy of mention. These are in Town 35, Ranges 9 and 10, in Town 36, Ranges 7 and 8, and in Town 37, Ranges 6 and 7. Other scattering areas occur in this county and also in Price County.

Description.—The rolling phase of the Kennan silt loam is quite similar to that of the typical soil in point of texture of surface soil, but the depth is somewhat less. In this phase the surface brown or grayish-brown silt loam extends to an average depth of about 10 inches. This is smooth and friable but as a whole does not contain quite as high a percentage of silt as does the typical soil. In places a small amount of sand and fine gravel may occur, and bowlders are much more common and larger than found on the typical soil. While the stones and bowlders are not sufficiently numerous as to discourage agricultural development, there are places where the stoniness will delay development, and sometimes cultivation will be impossible on account of the number of stones.

The subsoil consists of a yellow or yellowish-brown silt loam which usually becomes slightly heavier with depth and frequently becomes a silty clay loam at 20 inches. At a depth of from 20 to 24 inches fine gravel is often incorporated with the material and the sand and gravel increases with depth until at 24 to 30 inches the greater proportion of the mass is made up of sand and gravel. The underlying material is unassorted glacial till, chiefly sand and gravel.

Variations frequently occur in this soil and the most important one is in the depth to the underlying sand and gravel. The chief points of difference between this phase and the typical soil are that the rolling phase is rougher, has more stones upon the surface, and the covering of silt over the subsoil is not so great as in the typical soil.

Topography and Drainage.—The surface of this type ranges from gently rolling to rolling and hilly, and even broken in a few places, though the major portion may be classed as rolling. In a few places the surface occurs in the form of parallel ridges, but this condition is not as common as in the country to the east in Forest County.

The slopes are usually long, and seldom steep enough to prevent the use of modern farm machinery. In the vicinity of Butternut in Ashland County, where the largest area of this soil is found, practically all of this soil can be placed under cultivation when cleared. In the depressions between the hills throughout this type there are numerous marshes of varying extent, and these consist chiefly of Peat.

Because of the uneven character of the surface and the loose open structure of the deep subsoil, the natural drainage is excellent and the internal drainage is very good. On many of the steeper slopes erosion will be a problem which will require attention when the land is cleared. Where fields have been cleared and cultivated on the steeper slopes small ravines soon form if the surface of the ground is not covered by a growing crop most of the time. These ravines enlarge quite rapidly and in time would cut up the fields badly unless checked. As the country is still new and as little land has been cleared, means of preventing erosion should be adopted as soon as cultivation begins.

Native Vegetation.—The timber growth on this soil consisted chiefly of hardwoods and hemlock with a scattering of white and Norway pine. Practically all of the pine has been cut but there are still some extensive tracts of hardwood and hemlock. The hardwood consists of maple, birch, basswood, elm, and a little oak. On the heavier phases of the soil maple is usually the most abundant, but as the soil becomes lighter in texture the hemlock becomes more plentiful. The basswood appears to be confined most largely to the heavier soil, and on a number of ridges where the soil is heavy basswood was found to be very plentiful.

*Agricultural Development.**—Probably about 12 per cent of the rolling phase of the Kennan silt loam is under cultivation at the present time. Most of this development is in Ashland County in the immediate vicinity of Butternut. In Oneida County where more of the soil occurs in fairly good sized tracts, there is comparatively little improvement. Where under cultivation the crops grown and yields obtained are practically the same as on the typical soil. Oats, hay, corn, potatoes, some barley, are the chief crops. Peas and root crops of various kinds do well but are not grown to any marked extent. The soil is well adapted to general farming and the tendency at present is towards the development of the dairy industry. The soil is well adapted to producing hay and grasses and where rough or stony, such tracts can be used to very good advantage as grazing land along with less stony areas which will be put under cultivation.

*For chemical composition and improvement of Kennan silt loam, including the rolling phase, see page 25.

MELLEN SILT LOAM

(*Including Rolling Phase*)

Extent and Distribution.—The Mellen silt loam occupies a total area of approximately 50 square miles, including both the typical soil and that mapped as the rolling phase. The typical soil occupies $\frac{1}{3}$ and the rolling phase $\frac{2}{3}$ of the total area. All of this soil is found in the northern portion of Iron County and it is confined to the vicinity of the Iron Range. The largest tract is located between the lines of the Chicago and Northwestern and the Soo Railways north of the range in the north-central portion of Iron County. Most of this is rolling phase, but a considerable area of the typical soil is found along its northern border, beginning about one mile south of Saxon and extending east for 6 to 8 miles. More of the typical soil is found immediately west of Upson, and also 4 miles southeast of Iron Belt. A few other scattered tracts of both the typical soil and the rolling phase are found in the vicinity of the range.

Description.—The surface soil of the Mellen silt loam to an average depth of 10 inches consists of a brown or grayish-brown silt loam which frequently takes on an ashen appearance in cultivated fields when thoroughly dry. The upper subsoil consists of a silt loam somewhat lighter in color than the surface material and extending to 16 or 18 inches, where a reddish-brown loam occurs. Beneath this depth the subsoil continues to become lighter in texture and grades into more sandy gravelly material at from 24 to 30 inches. In the lower subsoil a heavy reddish sticky layer is often encountered. The reddish-brown color usually continues throughout the lower subsoil, and frequently a slightly pinkish tinge is noticeable. Bowlders are common upon the surface, and a small amount of gravel is frequently found over the surface and mixed with the soil. The amount of stones will range about the same as on the Kennan silt loam, there being some tracts which are nearly stone free, and others, of small extent, where the surface is nearly covered with rocks. The area mapped as the typical soil south of Saxon and extending east for 6 to 8 miles is more stony than the average and the subsoil is somewhat lighter than typical. The surface, however, is only undulating and it was therefore classed with the typical soil. Variations in texture and depth of the heavy material over the coarser gravelly subsoil are common.

Topography and Drainage.—The surface of the silt loam varies from undulating to rolling and hilly. Because of the wide variation

in the surface features, a separation was made on the basis of topography, and the roughest portion of the type is referred to in the report and is indicated on the map as the rolling phase. The typical soil varies from undulating to gently rolling. Throughout the rolling portion there are small patches of more nearly level land, which, if larger, would have been separated as the typical soil, but in this general survey such detail could not be undertaken.

Because of the surface features and the sandy gravelly nature of the deep subsoil, the natural surface and underdrainage is good.

Origin.—The material forming the Mellen silt loam consists of glacial debris which has been ground by glacial action from the Keweenawan sandstone, Keweenawan conglomerates, and the Huronian iron bearing rocks of the iron range country. On examining the fine gravel in road cuts it is found that sandstone makes up fully 40 per cent or more of this material, while the remainder consists chiefly of gravel from dark colored rocks. The reddish color comes in part from the sandstone, which is frequently referred to as red sandstone, and in part from the iron of the iron bearing formations along the range. Refuse from the mines is often used as road building material and the wash from these red roads gives the impression that the soil as a whole has a deeper red color than is actually found on boring into the soil No calcareous rock material entered into the formation of the soil, and both soil and subsoil are in an acid condition.

Native Vegetation.—The native timber on this soil consists of maple, birch, with some basswood, hemlock, and a few scattering white pine. Practically all of this soil is still in virgin forest.

*Agricultural Development.**—As but very little of this land has been cut over only a few farms are in operation on this soil, and data as to crop yields, etc., are therefore very limited. The agricultural value of this type is practically the same as the Kennan silt loam; and development will doubtless be along the same lines— that is, general farming with dairying as a main feature. The land is well adapted to grasses and clover. It supplies excellent grazing and small grains also do well. Potatoes and other root crops thrive, and corn can be grown as well as on other soils of the area. The stoniness will interfere somewhat with cultivation in places and steep slopes will sometimes have to be avoided, but these features will not discourage nor seriously retard agricultural development. None of the type is remote from railroads and this land will all be converted into farms as rapidly as the timber is removed.

*For chemical composition and improvement see page 25.

VIEW SHOWING THE UTILIZATION OF STONY LAND IN NORTHERN WISCONSIN.

Tracts as stony as this are sometimes found but they are of limited extent. Where the soil is a fine sandy loam or heavier such land can often be profitably cleared and utilized for cultivated crops though where very stony it is more profitable to use as pasture land.

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 THE 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.

COLBY SILT LOAM

Extent and Distribution.—This is one of the most extensive types of soil in the area, although it is not as widely distributed as some of the other soils. It is confined to Price and the southern portion of Oneida County, and the portion of Rusk which is included in the survey. The largest and most uniform tract occurs in the extreme southwestern portion of the survey extending from Catawba to Glen Flora, and south to the southern border of the area.

Description.—The surface soil of this type to an average depth of 10 inches consists of a smooth friable silt loam which varies in color from gray or grayish-yellow to light brown. The lower portion of the soil is frequently mottled with rusty brown, yellow, and drab. The supply of organic matter present is comparatively small, and the soil is always found to be in an acid condition.

The subsoil consists of a yellowish or yellowish-brown silt loam to silty clay loam which is highly mottled with more pronounced yellow, drab, rusty brown, and gray. To the depth of 3 feet the soil is quite uniform, except that there is a somewhat higher percentage of clay in the lower portion, so that below two feet the material is often a compact silty clay loam. Small layers of sand are not uncommon, and while the section is often entirely free from coarse material, angular gravel and rock fragments may be encountered in the soil. Stones and bowlders occur upon the surface, but not in as great numbers as on the Kennan silt loam, and very seldom in sufficient amounts to retard or discourage agricultural development. The compact portion of the subsoil is frequently referred to as a hardpan, and this appears to have considerable influence upon the movement of water through the soil and upon resulting drainage conditions. Below this hardpan and below the reach of the auger there is a larger amount of sand and gravel than in the surface 3 or 4 feet. The material is not sufficiently open and porous to permit the passage of water freely as in a loam soil, neither is there sufficient clay present so that when dry the soil will crack and thus form crevices through which the soil may be aerated and surface water may pass downward. This condition makes the drainage of the Colby silt loam difficult.

While the Colby silt loam as a whole is more uniform than most soil types, there are a few variations which are worthy of note. These variations may be found in many different localities, but are most common along the margins of the type and where small tracts of this soil are associated with other lighter textured soils. The variations indicated, however, were never found of sufficient extent

or importance to map separately. In a number of places the lower subsoil below two feet was found to be compact sandy clay instead of silty clay loam. Varying amounts of fine sand were also found in the subsoil at a number of places. The mottling in the subsoil is subject to quite a wide range both in the degree of mottling and also in the coloring. Very often the entire soil is strongly mottled, while in other places only the subsoil shows this condition to a marked extent, and it is not uncommon to find a reddish tinge throughout the subsoil material. The occurrence of bowlders is irregular. Numerous areas are stone free, while over a few limited tracts large bowlders are sufficiently numerous to interfere with the use of modern farm machinery.

Topography and Drainage.—The surface of this type varies from nearly level to undulating, and sometimes very gently rolling. It frequently occurs in long gentle rolls, with a considerable difference between the highest and lowest points, but never having a pronounced slope. Usually there is sufficient slope so that the surface water will drain off quite readily. On account of the heavy compact character of the subsoil and its peculiar structure, the water does not move through it readily, and the internal drainage of the entire type is deficient. The improvement of this condition presents the largest problem in the management of this type of soil.

Native Vegetation.—The tree growth on this type consists of maple, birch, hemlock, basswood, elm, a few ash, and a scattering of white pine. Practically all of the pine has been cut, and considerable tracts of the hardwood have been cut over. There are, however, extensive forests of virgin hardwood and hemlock on this soil. Where cut over, a second growth has sprung up in which poplar and birch are the most common. In a few places where the drainage is the most deficient, as on the lower slopes, where seepage from the higher land comes to the surface, spruce and cedar are found.

*Agricultural Development.**—While the standing timber has been removed from large areas, and while there are more farms being operated in Price County on the Colby silt loam than on any other type of soil, there is, however, not over 3 per cent of the Colby silt loam which is under cultivation at the present time. The leading type of agriculture followed is general farming in conjunction with dairying, to which this class of land is well suited. Grasses make a vigorous growth, and clover does well, especially on new land where drainage conditions are fair. Oats yield from 40 to 60 bushels per acre, mixed timothy and clover hay about two tons per acre, and potatoes about 125 bushels per acre. Corn is also grown, chiefly

*For chemical composition and improvement of this soil see page 25.

for the silo, and an excellent quality of silage is secured. Flint corn will usually mature, and some of the early varieties of dent corn will mature when early fall frosts do not occur; but corn cannot be counted upon to mature every season. The soil is especially well adapted to grasses, and along old logging roads throughout the region there is always a luxurious growth of grass. When the forests are removed and the underbrush is not too dense the growth of grass is soon sufficient to supply excellent grazing. As this region is comparatively new as a farming section, no well defined systems of crop rotation have been worked out as being especially adapted to this type of soil. Probably the most common practice is to follow oats with clover and timothy for two years and then plow up the land either for corn or potatoes. The soil is somewhat more difficult to cultivate than most of the other soils of the area, but if plowed when the moisture conditions are the most favorable, but little difficulty is experienced in securing a good seed bed.

ANTIGO SILT LOAM

Extent and Distribution.—The Antigo silt loam covers a total area of approximately 45 square miles, and is found in all counties within the area, except Vilas. In Oneida County it occurs directly north of Starks and several miles to the southwest from Rhinelander on what is known as "Crescent Flats." In Price County it is found 3 miles southeast of Phillips and five miles southeast of Pennington. In Iron County is it confined to the southwestern portion. Other smaller areas occur scattered throughout these counties, and also in the parts of Ashland and Rusk Counties included within this survey. The type is closely associated with the heavy soils of the Kennan and Colby series, and never occurs within the more sandy portions of the survey.

Description.—The surface soil of the Antigo silt loam where typically developed, consists of a light brown or grayish-brown friable silt loam which extends to an average depth of 12 inches. The amount of organic matter present is comparatively small and the soil as a whole is in an acid condition. The subsoil consists of a yellowish or yellowish-brown silt loam which gradually becomes heavier with depth and grades into a silty clay loam. At a depth of from 20 to 30 inches the material grades abruptly into beds of stratified sand and gravel. The depth to the sand and gravel is variable, however, and differences of from 1 to 4 feet may occur within a distance of a few rods. There is frequently a sprinkling of gravel upon the surface and a few small stones may be present, though over

areas where the silt is best developed but little gravel and very few stones are found.

Topography and Drainage.—The surface of this type varies from level to very gently undulating. In the tract north of Starks there are a number of pot holes occurring singly and in groups, and these cause a somewhat more irregular topography, but as they are of limited extent this condition was not separated. The drainage conditions vary somewhat with the depth to the underlying sand and gravel. Where the silt covering is deepest the drainage is somewhat deficient and tile drains would be beneficial. Where the sand and gravel occur within 12 to 18 inches the drainage is usually sufficient.

Origin.—The material composing the Antigo silt loam is alluvial and occurs as outwash plains and stream terraces, and was deposited by streams issuing from the ice sheet during glacial times. The underlying rock is chiefly granite and a large proportion of the material came from this source.

Native Vegetation.—The original timber growth on this soil consisted of hardwood and hemlock with a generous sprinkling of large white pine. Of the hardwoods maple predominated, with birch, basswood, elm, ash, and oak in smaller amounts. Most of the original forests have been cut, and where not improved the land supports a second growth of poplar and birch among the stumps.

Agricultural Development.—This is one of the best soils within the area for general farming. Being level and stone free makes it especially desirable. Probably a larger proportion of this soil is under cultivation than of any other within the area. The crops generally grown and the yields obtained are oats 40 to 60 bushels, barley about 35 bushels, hay 1½ to 2½ tons, and potatoes from 150 to 200 bushels per acre. If not killed by frosts, corn yields from 35 to 45 bushels of corn per acre, and sometimes considerably more. Excellent silage can always be secured, and yields of from 12 to 16 tons per acre are usually secured.

The leading type of agriculture followed consists of general farming in conjunction with dairying, with rapid development of the dairy industry to which this soil is well adapted. The soil is very well adapted to grasses, and alfalfa can be grown successfully if lime is used. The most common rotation followed consists of corn one year followed by one or two years of small grain, which is seeded to clover or clover and timothy and cut for hay for one or two years. Clover seed is sometimes grown. Potatoes may be grown in place of corn, or they may come in as another step in the rotation.

CHEMICAL COMPOSITION AND FERTILITY OF MELLEN, COLBY, ANTIGO, AND KENNAN SILT LOAMS

The soils of the Mellen, Colby, Antigo, and Kennan series have a good supply of the mineral elements phosphorous and potassium.

Phosphorus.—The total amount of phosphorous in an acre to a depth of 8 inches varies from 1100 to 1400 pounds. This would be sufficient for 100 to 150 crops if all were available, but it is never practicable to secure good growth from such soils after the total phosphorus has been reduced to six or eight hundred pounds and better results are always secured when the total phosphorous content of this layer of soil is retained at from 1500 to 2000 pounds per acre 8 inches. A farmer on this land, therefore, should adopt plans which will maintain the present supply of this element rather than attempt to draw on it even for a short number of years. The availability of this element requires a good supply of organic matter.

Potassium.—The element potassium exists in very much larger amounts in these soils than does the element phosphorous—in fact they contain on the average approximately 30,000 pounds of this element per acre to a depth of 8 inches. This is a sufficient supply to meet the demands of heavy crops for several hundred years. The entire problem with reference to potassium, therefore, is connected with its availability. When a good supply of active organic matter is present it can be assumed that there is sufficient potassium made available for practically all crops grown on this land. In the case of a few special crops requiring unusually large amounts of this element, such as cabbage and tobacco, the use of potash fertilizers may in some cases be profitable. The system of farming followed will also influence the potassium supply. A large part of this element goes to the stalks and straw of the plant so that if the hay and rough forage is fed the greater portion of this element is returned to the land in the manure—differing radically from phosphorus which goes to the grain and is, therefore, more likely to be sold.

Organic Matter and Nitrogen.—Compared with prairie soils which have shown a lasting fertility, these soils are distinctively low in organic matter and nitrogen. In fact, most upland soils of wooded regions are low in organic matter. However, the vegetable matter which they do contain when first cleared and broken is of an active character, but provision should be made for maintaining and increasing this material. When stock raising is practiced manure is available and is of course good as far as it goes, but on comparatively few farms is there sufficient manure produced to maintain the organic matter in soils of this character and other means should be used to

supplement the barnyard manure. Green manuring crops should be used as far as possible, turning under the second crop of clover whenever this can be done rather than using it for pasture. Seeding clover in corn at the last cultivation will secure good growth when the season is favorable. Cultivated ground when used for pasture should not be grazed closely.

Nitrogen is perhaps the most essential element of plant food and large amounts are used by all crops. It exists only in organic or vegetable matter of the soil, there being none whatever in the earthy material derived from the rocks. Soils which are low in organic matter are, therefore, also low in nitrogen. By all means the cheapest source of this element is through the growth of legumes such as clover, alfalfa, soybeans, etc., which collect it from the atmosphere. When these crops are turned under they contain an abundance of this element. When fed to stock a portion only is returned to the land. But when land of the character of that under discussion is used for mixed farming so that at least one-fourth produces a good crop of clover or alfalfa each year the supply of nitrogen can be maintained on a dairy or stock farm, but where any considerable portion of the land is in crops which are sold entirely one-third or more would have to be in some legume crop to maintain the nitrogen supply.

Acidity and Liming.—Since all of these soils were formed from rocks not containing lime carbonate they are essentially all acid. The degree of acidity varies from one which would require 1000 to that which would require 5000 pounds or more lime to correct. This acidity is not in itself a direct detriment to the growth of most farm crops, but does interfere with the growth of the best legumes. Clover will do well while this soil is new even though acid, but after this land has been cropped a number of years the acidity should be corrected to secure the best results with medium red or mammoth clover. Alfalfa is very sensitive to acidity and lime in some form must be used to secure good results with this crop even on new land.

Crops.—The Mellen, Antigo, and Kennan soils are adapted to a wide range of crops including corn, potatoes, and root crops as well as grasses and small grains. The Colby soils are not particularly well adapted to root crops on account of their rather inadequate subsoil drainage and their stickiness. They are, however, exceptionally well adapted to grains and grasses. Fields on the Colby soils having good slope and surface drainage can be made to produce good crops of corn by careful management. The soils of these types are well adapted to the development of dairy farming on account of their unusual fitness for the growing of hay and pasture.

SUPERIOR CLAY LOAM—ROLLING PHASE

Extent and Distribution.—The Superior clay loam—rolling phase is of very limited extent and does not extend over a total area of more than 4 square miles. One small tract occurs 4 miles east and ½ mile north of Ogema in Price County, and the remainder is all confined to the extreme northern part of Iron County within a few miles of the shore of Lake Superior. The largest tract is found about 2 miles northwest from Saxon.

Description.—The surface soil of the Superior clay loam to an average depth of 8 inches consists of reddish-brown clay loam, over the surface of which there is frequently an inch or two of lighter colored silty material. The subsoil consists of a heavy compact red clay which extends to a depth of more than 3 feet. A few pebbles may be mixed with the soil and subsoil, but the surface is practically stone free.

Topography and Drainage.—The surface of this type varies from gently rolling to rolling. It is not cut up by ravines to as great an extent as is some of the Superior loam and practically all of the soil can be cultivated and farmed with modern machinery. Because of the surface features the natural drainage is good, but the heavy subsoil makes the movement of water through the soil rather slow, and where low places occur between areas of higher land a line of tile drain may be found profitable.

Origin.—The material forming this soil has been derived from the weathering of lacustrine deposits, which since their first deposition have been modified by glacial action. The mass of the material is quite calcareous, but the surface has been leached to such an extent that a slightly acid condition now exists in places.

Native Vegetation.—The original timber growth consisted chiefly of maple, birch, pine, and some hemlock. All of the merchantable timber has been removed, and most of the land is in the "cut-over" stage of development.

*Agricultural Development.**—Probably about 15 per cent of this type is under cultivation at present, and practically all farms being operated are the homes of new settlers. This is a very good general farming soil and is developing along the line of general farming and dairying. Oats, hay, and potatoes are the chief crops. It is very well adapted to clover and grasses, and the land not being cultivated provides excellent grazing as soon as the brush is removed. This type is more difficult to cultivate than the lighter textured soils, but if plowed when the moisture conditions are the most

*For chemical composition and improvement of this soil see page 30.

favorable but little difficulty is experienced in securing a good seed bed.

It is thought that the fruit industry, especially the growing of apples, could be profitably developed on this type of soil.

SUPERIOR LOAM

Extent and Distribution.—The Superior loan is all confined to the northern portion of Iron County and the major portion of it occurs in one solid body, beginning about one mile north of Saxon and extending to the northeast to the Montreal River, which stream it borders for a distance of over 5 miles. It occupies a total area of about 10 square miles.

Description.—The surface soil of this type to an average depth of 10 inches consists of a brown to a grayish-brown loam. This is underlain by a somewhat lighter colored loam which at a depth of from 16 to 24 inches grades into heavy red clay. This heavy compact red clay extends to a depth of over three feet. In a few places lenses of fine sand were encountered in the subsoil, but such variations were of limited extent. The type as a whole is very uniform.

Topography and Drainage.—The surface of the Superior loam is level to very gently undulating, and on account of this and the heavy nature of the soil and subsoil the natural drainage is deficient, and tile drains are needed.

Origin.—The material forming this type has been derived from the weathering of lacustrine material, which may or may not have been modified to a limited extent by glacial action. The lacustrine material is calcareous, but the soil has been leached so that the amount of lime carbonate in the subsoil is much greater than is now found in the surface. In fact, an acid condition may be found in places in the surface few inches.

Native Vegetation.—The timber growth on this soil consists of maple, birch, hemlock, with scattering white pine. Most of the timber has been removed and poplar forms the second growth in many places. Over the eastern portion of the type along the Montreal River there is some standing timber and logging operations were being carried on while the survey was in progress.

*Agricultural Development.**—Only a very small proportion of this type is in farms and under cultivation at the present time, and most of the people on the farms now in operation are new settlers; so that the amount of crop data available for this particluar soil is limited. It may be said, however, that this is a very good general farming

*For chemical composition and improvement see page 30.

soil, and well adapted to grasses, clover, small grains, and root crops. Potatoes give good yields, but the soil is not so well adapted to this crop as are some of the lighter textured soils. General farming and dairying are the lines along which development is now taking place. While corn cannot be expected to mature every year, it frequently ripens, and can always be counted on to supply excellent silage.

SUPERIOR LOAM—ROLLING PHASE

Extent and Distribution.—This type occupies a total area of approximately 8 square miles. The greater proportion is found in one body in the vicinity of Saxon and extending along the D. S. S. A. Railway for a distance of about 6 miles. Another smaller tract occurs to the northeast of Saxon bordering the Montreal River.

Description.—The surface of the Superior loam—rolling phase—to an average depth of 10 inches consists of a heavy loam which takes on a reddish-brown color and becomes heavier with depth. The subsoil consists of a heavy compact red clay which extends to a depth of over 3 feet. Frequently a small amount of fine sand may be incorporated with the subsoil, and small pebbles sometimes occur both in the soil and subsoil. The type is quite free from stones and bowlders, and there are no rock outcrops to be seen.

Topography and Drainage.—The surface varies from undulating to rolling. Over the portions of the type which are in general the most nearly level, there are frequently small ravines from 10 to 12 feet deep which cut up the surface and interfere somewhat with cultural operations. This condition prevails most extensively in the type as found bordering the Montreal River, while over the tract about Saxon the surface is rolling, but not cut up by ravines. On account of the surface features the natural drainage is good. The subsoil, however, is very heavy, and on long gentle slopes tile drains could be installed with profit even though the surface water may escape readily.

Origin.—The material forming this type is largely of lacustrine origin, but since its first deposition it has been influenced to a greater or less extent by glacial action and there has been incorporated with it small pebbles and varying amounts of sand, which are usually not found in the purely lacustrine beds. The mass of this material is calcareous but the surface soil has been leached to such an extent that a slightly acid condition is frequently found.

Native Vegetation.—The original timber growth consisted chiefly of maple, birch, and hemlock, with a second growth largely of poplar.

Practically all of the merchantable timber has been removed from this type.

Agricultural Development.—While this soil is limited in extent there is probably a greater proportion of the type under cultivation than is the case with other soil in the present survey. Fully 40 per cent of the Superior loam is being cultivated and more is being included in farms each year. It is a good general farming soil and because of its freedom form stones it is often selected in preference to other types. The chief crops grown are oats, hay, and potatoes, and all of these give good yields. Clover and grasses do especially well, and while corn is not grown to such extent it provides excellent silage and frequently matures when early varieties are grown. Dairying is the leading branch of farming and the land is well suited to this type of agriculture.

The fruit industry, especially the growing of apples could doubtless be profitably developed on this soil.

CHEMICAL COMPOSITION AND FERTILITY OF SUPERIOR LOAM AND CLAY LOAM

The chemical analysis of the Superior loam and clay loam soils shows that their phosphorus content is somewhat lower than the average of other silt loam and clay loam soils in the state, while the potassium content is considerably larger. Their content of organic matter is somewhat below the average of soils of this texture. In regard to lime they vary within very wide limits, in some sections being acid, while in other they contain as high as 25 or 30 per cent of lime carbonate.

Phosphorus.—The comparatively small total amount of phosphorus contained in these soils together with the relatively large amount of iron oxide renders this element somewhat unavailable to growing crops and makes it important that farmers operating on this type of soil see to it that the available supplies of this element are maintained or increased either through the use of feeding stuffs high in this element or the purchase of sufficient phosphate fertilizers. Experiments on this soil at Ashland showed a large increase through the use of phosphate fertilizers in addition to manure. The following table gives the results of some of these experiments.

Crop	10 tons manure only	10 tons manure and 1000 lbs. rock phosphate	Per cent of increase
Potatoes	87 bu. per A	128 bu. per A	47
Rutabagas	108 bu. per A	137 bu. per A	27
Corn	30.4 bu. per A	36.8 bu. per A	21
Clover Hay	2223 pounds	3177 pounds	43
Clover Seed	217 pounds	336 pounds	47

The importance of having sufficient supplies of this element is made still greater by the relatively poor drainage which the Superior clay loam has and its consequent tendency to be cold so that crops are slow in maturing. The element phosphorus is particularly helpful in hastening the maturity of crops and the formation of seed.

Potassium.—These soils average over 50,000 pounds of this element per acre to a depth of 8 inches. This potassium, however, in the form in which it exists in the soil is not available to crops and becomes so only as a result of chemical changes which are chiefly brought about through the action of organic matter. When a good supply of active organic matter is maintained the quantity of potassium is sufficient to supply growing crops almost indefinitely and it is only in the case of fields low in organic matter or where crops using unusually large amounts of available potassium are grown that fertilizers containing this element need be used.

CHAPTER III

GROUP OF MEDIUM HEAVY SOILS

KENNAN LOAM

(Including Rolling Phase)

Extent and Distribution.—The Kennan loam occupies a total area of at least 100 square miles. It is confined to Price, Ashland, and Iron Counties, with by far the most extensive tracts in Iron County. The greater proportion of this type is found in a belt extending in a northeasterly and southwesterly direction through Iron and the southeastern portion of Ashland County, and lying between Turtle River and the Mellen soils which occur in the vicinity of the Iron Range. Areas of this soil range in size from a square mile or less to 10 or 15 square miles. In Price County the type is limited to a few small scattered patches, none of which are over 3 square miles in extent. Most of these occur in the east-central and the southeastern portions of the county.

Description.—The surface soil of this type to an average depth of 12 inches consists of a light brown or grayish-brown loam containing a high percentage of silt and fine sand. The subsoil is a yellowish-brown loam, which grades into a yellow silty fine sandy loam or a sandy clay loam. The subsoil sometimes grades into material which is quite gravelly below three feet. Some gravel may be found upon the surface and scattered through the soil section, and bowlders are plentiful upon the surface. The stoniness is about equal to that of the Kennan silt loam, and as on that soil there are numerous areas which are stone free. The stony condition is not such as to retard or discourage agricultural development.

Where the soil occurs in small tracts as in Price County it is frequently quite variable, and ranges from a fine sandy loam to a silt loam, depending upon the character of the soils with which it may be associated.

Topography and Drainage.—The surface of this type ranges from undulating to rolling, with the greater proportion having a topography which is gently rolling. The amount of territory which is

undulating is rather small. On the soil map the rolling portion of the type is indicated by crosslining. On account of the topography the natural drainage is good.

Native Vegetation.—The predominant growth on this soil is maple and birch, with a small amount of hemlock and basswood, and a scattering of white pine. The greater proportion of the soil of this type in Iron County is still in virgin forest.

*Agricultural Development.**—Only a very small proportion of this type is under cultivation at the present time. The cultivated tracts occur chiefly in southeastern Ashland County in T 42 and 43 N-R 1 N where a few farms are being operated. This is a very good general farming soil—in fact, it may be considered as among the best in the survey. The type of farming which is being developed, the crops grown, and the yields obtained are practically the same as on the Kennan silt loam. The chief crops are oats, hay, potatoes, corn, and some barley. Root crops are also grown on a small scale by some of the farmers. Clover and grasses do very well, excellent corn silage can be produced and the region is well adapted to the development of dairying along with general farming.

KENNAN FINE SANDY LOAM

Extent and Distribution.—The Kennan fine sandy loam is one of the most extensive types of soil in this area, and it is well distributed throughout the region covered, being found in every county except Rusk. Probably the most extensive tract occurs in the northeastern portion of Price County, beginning some distance south and west from Phillips and extending to the north and the northeast into Ashland County. In the vicinity of Park Falls and for about nine miles east this is the predominating type. In Vilas County important tracts occur in the vicinity of Phelps and about Winchester, while in Oneida County it occurs about Sugar Camp and Thunder Lakes, about Oneida and Hancock Lakes, in the vicinity of Goodnow, and to the southwest from Rhinelander. There are numerous areas south of the Iron Range in Iron County and in the southeastern part of Ashland County. Smaller irregular patches are also found through various portions of the survey.

Description.—The surface soil of the Kennan fine sandy loam to an average depth of 12 inches consists of a brown, or slightly reddish-brown, or grayish-brown fine sandy loam. The lower portion of the soil section frequently becomes somewhat coarser in texture and approaches a sandy loam. The subsoil consists of a light brown or

*For chemical composition and improvement see page 45.

yellowish-brown fine or medium sandy loam with which there may be varying amounts of fine gravel incorporated. More sand and gravel are encountered with depth, and the deep subsoil is usually a gravelly sandy loam grading into unassorted glacial till consisting of coarse sand, gravel, stones, and only a very small proportion of silt and clay. Some stones and bowlders are found upon the surface.

Variations in the surface soil are frequent, but none of them were found to be of sufficient extent or importance to warrant separating the type into phases on the basis of texture. In Town 41, Range 10 the heaviest soil, which ranges from fine sandy loam to a loam, is found upon the wooded ridge tops, while the lower slopes and valleys often have a lighter soil. In places south of Tenderfoot Lake and east of Phelps the soil also becomes a heavy fine sandy loam. This same condition was found in a number of other sections of limited area. On the other hand, small patches frequently occur where the surface approaches a fine sand. In the vicinity of Winchester a red clay layer was found in local areas. This layer varies from a few inches to six feet in thickness and lay at or near the surface, and sometimes at a depth of five feet. This layer may be seen in railroad cuts and it indicates its presence by an undrained and springy condition. In all cases the clay was found to be underlain by a sandy gravelly loam subsoil.

Topography and Drainage.—The surface of the Kennan fine sandy loam varies from undulating to gently rolling. The most rolling portion is usually found along stream courses or bordering lakes or swamps. Where the surface became extremely broken or morainic over large areas, such tracts were separated and indicated as the rough phase, but where variations of this kind were of only limited extent, no separation was made. The surface of practically all of the typical soil is such that improved farm machinery can be used upon it when the land is cleared and placed under cultivation. Some kettle basins and other small depressions are sometimes found, and marshes are very often found associated with this type, as with many other types within the survey. On account of the sandy gravelly nature of the subsoil and the character of the surface, the natural drainage is good.

Origin.—The material from which the Kennan fine sandy loam has been derived consists of unassorted glacial till which occurs chiefly in the form of ground moraine. There are a few places of limited extent where eskers and kames occur, and in which the material is stratified, and road cuts sometimes show stratification in the ground moraine. The parent rock from which most of the material came is chiefly granite, as this formation is found underly-

VIEW OF FARM ON KENNAN FINE SANDY LOAM, SOUTHEAST OF MERCER.

Shows very gently rolling topography and characteristic crops, with hardwood timber in the background. This is a good general farming soil.

VIEW OF KENNAN FINE SANDY LOAM, ROUGH PHASE.

This view is characteristic of this type of soil as found in northwestern Vilas county. The soil itself is of good quality but the rough, broken surface renders it undesirable for growing cultivated crops.

ing practically all of this part of the state. A small amount of sandstone material may also be incorporated with this type, especially in the soil nearest the Iron Range country. This was carried by ice action from the shore of Lake Superior where sandstone forms the surface rock. No calcareous material has entered into the formation of the soil and both soil and subsoil are found to be in an acid condition.

Native Vegetation.—The Kennan fine sandy loam is almost exclusively a hardwood and hemlock type of soil. In the larger areas where most typically developed the timber consists of maple, basswood, birch, and hemlock, with a few scattering white pine. On the more sandy portions the hemlock usually predominates with birch usually second in point of numbers. In a few more sandy tracts the the soil supported for the most part large white pine which has been cut, and only scattering oaks, hemlocks, maple, and birch remain among the heavy second growth which consists chiefly of poplar and birch. The virgin hardwood remains in places, but large amounts of it have been cut and the land is now in "slashings."

*Agricultural Development.**—The Kennan fine sandy loam promises to be the most valuable soil of the area. Numerous small tracts have been cleared and placed under cultivation so that a good idea can be obtained as to the results which may be expected from this class of land, though probably not over two per cent of the entire type is under the plow at present. Some farming is carried on in the vicinity of Phillips, Park Falls, southwest from Rhinelander, south and west of Sugar Camp Lake, east and south of Conover, and south and east of Phelps. General farming, dairying, and the raising of small grain are the chief lines followed. The crops grown and yields obtained are oats from 35 to 60 bushels, barley from 25 to 35 bushels, corn often matures and yields from 35 to 50 bushels, hay from 1½ to 2 tons, and potatoes from 150 to 250 bushels per acre. The most common rotation consists of small grain seeded to clover or clover and timothy mixed, and this cut for hay one or two years before being plowed again for corn or potatoes. Commercial fertilizers have not been used to any extent, but a few people are now experimenting along this line. In Price County the application of 400 pounds of acid phosphate and 300 pounds of potassium sulfate resulted in a yield of 396 bushels of potatoes per acre, as compared with a yield of 258 bushels on the unfertilized plot.

*For chemical composition and improvement of this soil see page 45.

KENNAN FINE SANDY LOAM—ROUGH PHASE

Extent and Distribution.—The rough phase of the Kennan fine sandy loam covers about 60 square miles of territory, largely in the vicinity of Winchester and Winegar in northern and northwestern Vilas County. In Price County small patches of this phase were also found, but because of their small extent and irregular outline they were not separated from the typical soil.

Description.—The surface soil to a depth of 8 to 10 inches consists of a dark brown fine sandy loam. The surface 2-inches is usually grayish-brown or sometimes darker, overlying a rather heavy brown fine sandy loam, which grades into a brown loamy sand at 20 to 24 inches. The amount of coarse sand and fine gravel increases with depth. In places the deep subsoil is made up largely of reddish sandy clay loam, or a layer of red clay 2 to 4 inches thick may be found. Deeper layers of red clay are also found in the vicinity, but only occasionally in this phase of the soil. This material is the same as forms the Superior soils, but because of its limited extent and irregular occurrence no attempt was made to map this variation separately. Some stones and bowlders appear upon the surface and mixed with the soil, but these are no more numerous than on the typical soil, and not as plentiful as on the Kennan silt loam. The stoniness in itself would not retard agricultural development.

Topography and Drainage.—The surface of this phase is extremely rough, broken, and irregular. It frequently consists of a series of sharp ridges between which narrow strips of marsh occur. Pits and potholes are numerous. Over the greater portion of this phase the natural drainage is excellent, but a considerable amount of wet land consisting of small gully or pothole marshes in the depressions is included. Springy slopes and pockets are also common in places. The lack of drainage in many places about Winchester is in part due to the thin layer of red clay or compact reddish sandy clay loam in the subsoil.

While small pieces of from 1 to 10 acres in extent may be found which are neither exceedingly rough nor wet, the majority of the phase is too rough and uneven to permit the use of farm machinery, and it was chiefly because of this condition that such lands were separated and indicated as a phase on the soil map.

Origin.—The material forming this phase of the Kennan fine sandy loam is of glacial origin and occurs chiefly as recessional moraines. The parent material was largely from granitic rocks which form the bed rock throughout this region. A small amount of material of sandstone origin may also be incorporated, this having been carried

by glacial action from the sandstone formations along the south shore of Lake Superior. No calcareous material is found, and both soil and subsoil are in an acid condition.

Native Vegetation.—The native timber growth consisted chiefly of hardwoods, maple, basswood, and birch, with a few scattering balsam, hemlock, and white pine. In a few places where the soil is more sandy than usual, hemlock and birch predominate, but in most cases the maple and basswood are the most plentiful. Much of the timber near Winchester and Winegar has been removed, leaving the land covered only with brush and young growth familiarly known as "cut-over" land.

*Agricultural Development.**—Little or no farming has been done on this soil. While the texture of the soil and its timber growth invite settlement, the roughness of its topography discourages any attempt at farming. The soil will produce good pasture, and portions of it could be used for stock raising where it occurs in connection with land of better topography and for that reason could be classed as soil of fair agricultural value. But where such topography occurs in extensive areas much of this soil has been classed with the soils of low agricultural value.

MELLEN FINE SANDY LOAM

(*Including Rolling Phase*)

Extent and Distribution.—The Mellen fine sandy loam is all confined to the northern portion of Iron County, but throughout this section of country it is well distributed. It is closely associated with the Mellen loam and Mellen silt loam. On the accompanying soil map this soil is shown by means of two colors, one representing that portion which is rolling and hilly and the other that which varies from undulating to gently rolling. The rolling phase is by far the more extensive. Probably the most extensive tract of this soil is found lying to the north and to the south of Hurley, along the Montreal River which separates Wisconsin from Michigan. To the northwest of Upson along the Potato River there is also an extensive tract of this soil, most of which is rolling phase. The largest tract of undulating to gently rolling portion of the type occurs at Hurley, and extends west for about 4 miles. Other smaller tracts of this soil are scattered throughout northern Iron County.

Description.—The surface of the Mellen fine sandy loam to an average depth of 10 inches consists of a brown or slightly reddish brown, fine sandy loam containing only a moderate amount of or-

*For chemical composition and improvement see page 45.

ganic matter. The subsoil is also a fine sandy loam somewhat lighter in color than the surface, and also somewhat coarser. Some gravel appears upon the surface and mixed with the soil, and the amount gradually increases with depth so that on account of the gravel and stones in the subsoil it is often impossible to bore more than 20 to 24 inches with the soil auger. The deeper subsoil to 3 feet or more has a reddish or reddish-brown color and there is usually sufficient clay present to make the material compact and quite sticky when wet. The type is subject to some variation and frequently approaches a loam in the texture of the surface soil. The surface is usually quite stony, and in this respect resembles the loam and silt loam types. Rock outcrops occur frequently, and over small tracts the bed rock may be close to the surface. Usually, however, the depth to rock is from 10 to 50 feet or more.

Topography and Drainage.—As indicated above, two classes of topography were recognized on this type and a separation was made on this basis. By far the greater proportion of the Mellen fine sandy loam is rolling to hilly, with numerous small pot holes, swales, and small marshes scattered through it. The surface is more irregular and choppy than either the loam or silt loam, but there are only a few slopes which are sufficiently steep to prevent the use of modern farm machinery. The remainder of the type is undulating to gently rolling and is all very good agricultural land. Because of the surface features and the gravelly nature of the subsoil, the natural surface and under drainage is excellent, but seldom excessive.

Origin.—The material forming this soil has been derived from the weathering of glacial debris, which has been ground by ice action from the Keweenawan sandstone and the dark colored rocks of the Huronian iron-bearing formation. Of the fine gravel over 40 per cent is estimated to be sandstone, while the remainder is chiefly the dark colored rocks. Fragments of these formations make up the stones and bowlders which appear upon the surface. Many of these have been somewhat rounded by glacial action, though few of the bowlders have been carried more than a short distance by the ice. No calcareous material is incorporated with the glacial debris, and both soil and subsoil are in an acid condition.

Native Vegetation.—The native timber growth on this type consists of hemlock, maple, and birch, with a few scattering white pine. Where the texture approaches a loam the proportion of maple and birch becomes somewhat larger. By far the greater proportion of this soil is still in virgin forest.

*Agricultural Development.**—The only development which has taken place on this soil is in the vicinity of Hurley, where a number of

*For chemical composition and improvement see page 45.

small farms have been started, chiefly by people who previously worked in the iron mines. The chief crops grown are potatoes, hay, oats, and root crops. Clover and grasses do very well, and all portions of the type from which the timber has been removed supply excellent grazing. The type is well adapted to general farming and dairying, and this is the line along which greatest development will doubtless take place as the timber is removed. Because of the small amount under cultivation, the crop data available from this type is limited. The yields obtained, however, compare very favorably with those secured on the loam and silt loam soils. For potatoes it is probably somewhat better than the heavier types. Strawberries, bush berries, and truck crops also do well on this type, and it would seem that this industry could well be extended, since the mining country affords good markets for all farm and garden produce.

MELLEN LOAM

(Including the Rolling Phase)

Extent and Distribution.—This type has a total area of approximately 105 square miles and it occurs chiefly in one large body. The Soo Line Railway runs along the northern margin, and the towns of Montreal, Pence, Iron Belt, and Moore are located upon it. The type extends south of the Soo tracks for a distance of from 4 to 8 or more miles, being widest along the west county line and narrowest near Montreal. It covers much of the region taken up by the Iron Range, but extends south from 3 to 10 miles from the range.

Description.—The surface soil of the Mellen loam to an average depth of 12 inches consists of a brown loam which often contains a few small pebbles. The subsoil consists of a lighter brown loam or fine sandy loam, and the texture usually becomes lighter with increased depth. The amount of gravel and coarse material also usually increases with depth, but the deep subsoil often has sufficient clay incorporated with it to make it quite sticky. This material has a marked reddish-brown color. Stones and bowlders are common upon the surface, but they are seldom present in sufficient numbers to discourage or retard agricultural development. In places small areas of fine sandy loam were included with this type, but as a whole it approaches a silt loam more nearly than a fine sandy loam.

Topography and Drainage.—Very nearly all of it varies from rolling to hilly, but about 5 square miles is undulating or gently rolling. The soil map indicates these conditions by means of cross lining on the color used for the Mellen loam. Where the surface is the roughest the soil is not quite as deep as where the topography is only

gently rolling or undulating. Because of the surface features and the coarse material in the subsoil, both the natural surface and under drainage are good.

Origin.—In origin this type is practically the same as the Mellen silt loam, it being composed of glacial debris ground from the Keweenawan sandstone and Keweenawan conglomerates, and from the dark colored rocks of the Huronian iron-bearing formations. Road cuts show that the fine gravel is made up of over 40 per cent of sandstone, while most of the material is of the dark colored rocks. As the type approaches the Kennan soils which it borders on the south, there is some granitic rock material mixed with the soil. This gradually increases as the distance from the range increases until there is a sufficient amount present to classify the soil as Kennan rather than as Mellen. There is no calcareous material with this type and both soil and subsoil are in an acid condition.

Native Vegetation.—The native timber on this soil consists of maple, birch, with a small amount of basswood and hemlock. There is more hemlock than is found on the silt loam type, but not as much as on the fine sandy loam soil. A few scattering white pine are also found. The greater portion of the soil is still in virgin forest.

*Agricultural Development.**—Probably not over 2 per cent of this type is cleared and under cultivation at the present time and therefore the crop data available is very limited. All of the improvement on this type has taken place along the Soo Railway, and the largest amount of cleared land is in the immediate vicinity of Iron Belt. The crops grown are oats, hay, potatoes, and other root crops, and a small amount of corn. The soil may be considered as well adapted to general farming and dairying, and the development which is now taking place is along these lines. The soil is especially well adapted to grasses and clover, and even where the most stony it is all well suited to heavy grazing. Many tracts are nearly stone free, and when such places are selected for the point at which to begin farming operations, no difficulty is experienced in dealing with the stones. The yields obtained are practically the same as on the Kennan loam and silt loam, and the type has practically the same value.

ANTIGO FINE SANDY LOAM

Extent and Distribution.—The Antigo fine sandy loam occupies a total area of about 45 square miles and is found most extensively in Price, Oneida, and Vilas Counties. The largest area occurs in central Price County extending about 7 miles to the northwest from

*For chemical composition and improvement of this soil see page 45.

VIEW OF A FARM ON ANTIGO FINE SANDY LOAM, SOUTH OF HAZELHURST.

Shows typical level surface and crops of clover and corn. Hardwood timber in background.

VIEW OF VILAS SANDY LOAM.

Note the undulating to gently rolling surface and character of present growth. Pine stumps in the foreground and poplar, birch and second growth pine in the background.

Phillips. Another tract lies to the southeast from Phillips. An area of about 2 square miles occurs about the town of Three Lakes in Vilas County. Another tract of similar size occurs in parts of Sections 7, 17, and 18 in Town 40, Range 10, northeast of Eagle River. Two areas of about one square mile each are found south of Phelps in Town 41, Range 11 and Town 41, Range 12. An area of about 5 square miles occurs north of Arbor Vitae, while smaller tracts are scattered over Vilas, Oneida, the southern part of Iron, and a little is also found in Ashland County.

Description.—The surface soil of the Antigo fine sandy loam consists of about 2 inches of a grayish fine sandy loam, which is underlain to a depth of 8 to 10 inches by a grayish-brown or dark brown fine sandy loam. Below this the soil merges into a grayish-brown fine or medium sandy loam containing more or less gravel. Brown sandy loam containing much medium and coarse sand as well as gravel is generally found at 18 to 20 inches. This extends to 40 inches or more in depth. The area at Three Lakes is quite variable and the surface soil is frequently a silt loam, while in other places gravel appears at the surface. In Price County the soil frequently has a slightly reddish-brown color and often contains enough silt and clay so that it is sticky when wet. Silty spots similar to those at Three Lakes are also found in Price County, but none of the variations were of sufficient extent or importance to be separated on the map. Aside from the variations in texture there is a variation in topography and in Price County there is an area which might be called a low phase if of sufficient extent to map. The water table comes close to the surface so as to make it rather poorly drained. The color of this phase is a light gray or drab at the surface, and the subsoil is often mottled with brown, yellow, or drab.

Topography and Drainage.—The surface of this type is level to very gently undulating. In a number of places there are bowl-shaped depressions 50 to 100 feet in diameter and from 10 to 25 feet deep. These may occur singly or in groups, and are known as pits. Because of their limited extent and infrequent occurrence, they do not detract from the value of the land to any appreciable extent. The natural drainage of this soil is generally good, with the exception as referred to above where the water table comes closer to the surface than typical. The drainage is seldom excessive and the soil contains a sufficient amount of silt and clay so that it resists drought well.

Origin.—The material forming the Antigo fine sandy loam is alluvial in origin, and was deposited in the form of outwash plains by streams issuing from the ice sheet which covered this region. Most of the material undoubtedly came from the granitic rocks which

form the bed rock throughout this region. There is no calcareous material present and both soil and subsoil are in an acid condition.

Native Vegetation.—The Antigo fine sandy loam supported a growth of mixed hardwood, hemlock, and pine. In places the pine was the predominating growth, while in others hemlock and maple were the most plentiful. The pine was mostly large white pine with some Norway.

*Agricultural Development.**—Only a small proportion of this type of soil is under cultivation. The largest tracts of improved land of this class are in the vicinity of Three Lakes in Vilas County, and to the northwest from Phillips in Price County. Good crops of oats, barley, clover, corn, and potatoes are produced. Some rye and buckwheat are also raised. Yields of 150 to 250 bushels of potatoes are common; barley yields up to 30 bushels; oats from 35 to 50 bushels; clover 2 tons; and as much as 50 bushels of corn per acre have been secured, though it is not certain to mature every year. Grasses do very well even on land which has not been cleared except for the removal of the thickest brush.

This may be considered one of the most desirable soils of the area surveyed, although it is much more limited in extent than several other types. It is well adapted to a combination of small grain and potato farming. It is also well suited to general farming in conjunction with dairying, and it is along these lines that development is now being made. Alfalfa could be raised successfully on this soil if the acid condition were corrected by the use of lime. Liming would also help out the clover crop, especially on soil which has been under cultivation for some time.

SUPERIOR FINE SANDY LOAM—ROLLING PHASE

Extent and Distribution.—This soil comprises a total area of approximately 12 square miles. This is nearly all included in one body and is confined to the northern portion of Iron County bordering the south shore of Lake Superior and lying north of the D. S. S. A. Railway.

Description.—The surface of this type to an average depth of 10 inches consists of a brown to grayish-brown fine sandy loam which in places has a yellowish-brown color. The subsoil consists of a grayish to reddish fine sandy loam which becomes more sandy with depth. At from 24 to 30 inches a heavy compact red clay is encountered. The depth to the clay varies from 18 to 36 inches, but will average about 24 inches.

*For chemical composition and improvement see page 45.

Topography and Drainage.—A large portion of the surface of this type is nearly level, but it has been deeply cut by numerous ravines to such an extent that this condition will tend to retard agricultural development. Other portions have a rolling to hilly topography. Because of the surface features and the character of the upper subsoil, the natural drainage is good and but seldom excessive.

Origin.—The heavy red clay subsoil is doubtless of lacustrine origin, which has been modified somewhat by glacial action. The sandy covering doubtless owes its origin largely to glacial action. The parent material appears to have been sandstone. This sandy covering is usually slightly acid, while the heavy red clay subsoil is calcareous.

Native Vegetation.—The timber growth consisted chiefly of hemlock, maple, birch, and also considerable white pine. The greater part of the type has been cut over, and a second growth in which poplar is plentiful now occupies the land.

*Agricultural Development.**—Not more than one or two farms have been started on this type of soil, and so the crop data available is very limited. Because of the number of ravines and the resulting irregular surface, it is not nearly as desirable for farming purposes as the loam or clay loam of the Superior series. The soil in itself is well adapted to strawberries, bush berries, and the like; and apples and cherries should also do very well. Conditions of the soil and climate are very similar to the Bayfield region, and it seems, therefore, that as much of the type is within easy reach of shipping points that the development of the fruit industry might well be considered.

COLBY FINE SANDY LOAM

Extent and Distribution.—This type is confined to Price and Oneida Counties, and is of rather limited extent. The largest tract occurs in Town 38 N, Range 3 E, with smaller tracts southwest of Cranberry Lake, south of Dardis Lake, and in the vicinity of Sassons, Price County. In Oneida County most of the type is confined to the southeastern portion.

Description.—The surface soil of this type to an average depth of 10 inches consists of a light brown or gray fine sandy loam which is frequently mottled with yellow and rusty brown. The subsoil to a depth of 24 or 30 inches is a gray or drab fine sandy loam heavily mottled with yellow, rusty brown, and red. Below 24 inches the subsoil frequently consists of a clay loam or sandy clay which is very compact and is referred to as a hardpan. This hardpan strata fre-

quently extends to 36 inches and is usually underlain by unassorted sand and gravel which contains only very small amounts of finer material. Some gravel may be found throughout the soil section and also on the surface. The hardpan layer may be entirely lacking and in its place the fine sandy loam subsoil may extend to a greater depth than usual. Stones and bowlders occur upon the surface and through the soil. They appear to be larger and more plentiful on the type as a whole as mapped in Oneida County than in Price County. In a few places the stones are sufficiently numerous to interfere with agricultural development. Two such areas of small extent are found in the southeastern corner of Price County, where bowlders almost completely cover the ground. In some places there is a thin layer of peat or muck overlying the surface soil.

Topography and Drainage.—The surface of the Colby fine sandy loam is undulating to very gently rolling. It has a more nearly level surface than the Kennan fine sandy loam. Because of the surface features and the compact layer which usually occurs in the subsoil, the natural drainage is deficient over practically the whole type.

Origin.—This type of soil has practically the same origin as the silt loam, except that in this case there is probably no loessial material present. In general appearance the surface resembles the Antigo soils, but the Antigo series represents water-laid material, while this type is unassorted glacial debris derived from crystalline rocks. There is no calcareous material present and both soil and subsoil are strongly acid.

Native Vegetation.—The original timber growth consisted of maple, birch, and hemlock, with a considerable amount of white pine in places. Spruce, cedar, and tamarack are also found to a limited extent in the low places where the natural drainage is the most deficient. Most of the merchantable timber has been removed, and a second growth consisting largely of poplar, birch, alders, and willows has sprung up.

Agricultural Development.—But very little of this type of soil is under cultivation at the present time. Owing to its poorly drained condition, it is naturally cold and backward in the spring, and before the best results can be obtained some system of drainage is necessary for much of this land. When thoroughly drained the type will be fully equal in producing power to the Kennan fine sandy loam.

CHEMICAL COMPOSITION AND FERTILITY OF LOAMS AND FINE SANDY LOAMS

These soils are only a little more open in texture than the silt and clay loam types. They have a good water-holding capacity and will support very good pasture, but the somewhat higher percentage of fine sand which they contain reduces the water content of the surface somewhat so that they warm up more readily in the spring and have less tendency to bake and crack than the heavier soils. These qualities make them better adapted to such crops as corn and potatoes than are the heavier soils.

The total amount of the plant food elements, phosphorus and potassium, is nearly if not quite as large in the Kennan and Mellen fine sandy loams as in the Kennan silt loams. However, they have rather less organic matter and this together with the somewhat coarser texture results in a slower rate of chemical change by which the inert plant food of the soil becomes available to crops. For this reason the increase in the supply of active or fresh organic matter and the use of available plant food either in the form of stable manure or of commercial fertilizers becomes more important and especially when crops such as potatoes which are sold from the farm, and of which heavy yields must be grown to be profitable, are produced.

The increase in the supply of active organic matter is of the utmost importance. A high degree of fertility cannot be maintained in these soils unless about twice as large an amount of organic matter is developed in them as that which they originally have. The plowing under of legumes, such as a second crop of clover or a crop of soybeans, is the best method of securing this result. The application of phosphorus and potassium fertilizers can best be made for these crops, since it secures a much larger growth of these crops themselves and becomes available through their decomposition to the following crops of corn or potatoes.

These soils were derived from rocks devoid of lime carbonates and therefore have a marked tendency to become acid. The degree of acidity is usually only slight in the new soil, but increases as the land is cropped from year to year. This acidity does not affect the growth of most crops directly, but makes it more difficult to maintain a good degree of fertility. This is true because it is a condition unfavorable to the continued growth of the best legumes—clover and alfalfa. The slight degree of acidity does not interfere with the growth of clover while the soil is comparatively new, but does reduce the yields as the fertility is reduced by further cropping and even in the virgin condition on this soil acidity interferes with the growth of

alfalfa. It is also a condition unfavorable to the maintenance of a good supply of readily available phosphorus in the soil. These objections are probably not sufficient to make necessary the use of lime to correct the acidity on all of the land under cultivation for a number of years, but does make it desirable that farmers wishing to grow alfalfa should lime as well as inoculate the soil for this crop and also to watch the growth of clover carefully from year to year, so as to begin the use of lime on the fields as they are sown to clover as soon as it becomes difficult to secure a good stand.

These types of soils are well adapted to general farming and some special crops such as potatoes can also be grown to good advantage.

CHAPTER IV

GROUP OF MEDIUM SANDY SOILS

VILAS SANDY LOAM

Extent and Distribution.—This type of soil is one of the most extensive, if not the most extensive, in the area surveyed, it covering an area of over 700 square miles. It is found in all of the counties included within the survey, and within Vilas and Oneida Counties it occurs in practically every township. The various tracts range in size from less than one square mile to 15 or 20 square miles. In Iron County the type is more limited and is confined to the southern half of the county, beginning in the vicinity of Mercer and extending in irregular scattered tracts to the southwest. This same general belt continues on into Price County where it is more extensive. It is confined largely to the territory within 5 or 6 miles of the South Fork of the Flambeau River, and runs as far southwest as where the Elk River flows into this branch of the Flambeau. The greater portion of this soil in Price County is found along the south side of the Flambeau. In Ashland and Rusk Counties only a few scattered tracts are found.

Description.—The surface soil of the Vilas sandy loam to an average depth of 12 inches consists of a brown or reddish-brown medium textured sandy loam. The surface few inches usually contain sufficient organic matter to impart a slightly darker color, but the total amount of vegetable matter present is small, and the structure is loose and open. The subsoil consists of a yellow or yellowish-brown light sandy loam which becomes lighter in color and coarser in texture with increased depth until below 16 to 20 inches the material usually consists of coarse sand and small stones, with only a very small percentage of silt and clay. Some gravel is found in places and bowlders are scattered more or less freely over the surface and through the body of the soil, but generally are not sufficiently numerous to interfere with agricultural development.

In texture this soil ranges from a loamy sand to a sandy loam, and there are some areas which in a detailed survey might be classed as gravelly sandy loam, but variations of this kind which were included

are limited and too irregular in occurrence for separate mapping at this time. Where the gravelly condition and the lighter texture extend over considerable areas the material was classed as Vilas gravelly loam. In Sections 29, 30, 4, 8, and 9 in Town 37, Range 9 E, Oneida County, the type is lighter in texture than usual. The same condition prevails in a belt beginning at Malvern and extending in a northeasterly direction along the east side of Pelican River, and beyond to a point two miles east of Starks. This material is too heavy for a sand, but is somewhat lighter than a typical sandy loam.

Along the south side of Town 35, Ranges 9 and 10 the Vilas sandy loam is heavier than typical, but the surface is quite rough and broken and the soil varies more than in some other sections, ranging from a sand to a silt loam within short distances. Taken as a whole, the material approaches more nearly a sandy loam than any other soil and was therefore included with that type.

Topography and Drainage.—The surface of this type varies from undulating to rolling with numerous limited tracts over which the topography is broken or rough. Where the rough and choppy tracts were of sufficient extent and gravelly they were classed as gravelly sandy loam. Over numerous tracts the surface is only gently rolling, and undulating tracts are not uncommon. Because of the uneven surface features and the loose character of the subsoil, there is usually no difficulty with the drainage of the type. Marshes are of frequent occurrence throughout the type, and along the margin of these where the land is low the natural drainage is frequently somewhat deficient. There are places where the drainage is excessive and where crops will suffer from lack of moisture. This is especially true over the crest of ridges where the gravelly material comes closer to the surface than usual.

Origin.—The material composing this type consists of glacial debris which was deposited chiefly in the form of ground moraine. The material was derived in part from the granite rocks underlying the region and in part from the sandstone rocks in Northern Michigan from which the material has been carried by glacial action. No calcareous rocks occur in this region and both soil and subsoil are found to be in an acid condition.

Native Vegetation.—The original timber was mostly large white pine with some Norway pine. This has all been cut and the pine stumps, with scattered birch stubs, are all that remain of the virgin timber. In some cases patches of hardwood timber are found on soil included with this type, especially on the heavier phase. The hardwood consists of maple, birch, some hemlock, and a little oak. These

grow chiefly in clumps in the pinery upon knolls of heavier soil, or on low areas where the water table is nearer the surface than usual The cut-over pinery has in many cases grown up to poplar and birch ten to thirty feet high, with much cherry, alder, or scrub oak brush and small pine. The ground is frequently covered with a thick growth of sweet fern.

*Agricultural Development.**—Probably less than 3 per cent of this type is under cultivation at the present time. Where farms have been developed, however, very fair results have in most cases been secured. The usual crops grown and yields reported are oats from 30 to 50 bushels, potatoes 150 to 250 bushels, hay 1 ton, and corn 35 to 50 bushels per acre. Corn will not always mature but the above yields of ripe corn are not at all uncommon. Excellent silage can be produced practically every year. Clover does well and failures to secure a good stand appear to be infrequent. Garden truck also thrives on this soil, though trucking has not been developed except in the home gardens.

VILAS SANDY LOAM—ROLLING PHASE

Extent and distribution.—This type of soil covers approximately 150 square miles of territory. The largest tracts of it occur in Town 39, Range 9, Town 41, Range 9 in the country west and northwest of Eagle River, and in Town 38, Range 7 and Town 40, Range 7 to the south of Wind Pudding Lake, and north of Arbor Vitae Lake in Town 40, Range 6, also south of Crab Lake in Town 43, Range 6. This soil is quite generally distributed over Vilas and the northern part of Oneida County. In Price County there is also a small amount of this soil. The largest tract begins a few miles south of Fifield and extends in a northeasterly direction in a series of irregular areas of limited extent.

Description.—Beneath 1 or 2 inches colored dark brown by organic matter, the surface of this soil consists of 8 to 10 inches of brown, or slightly reddish-brown, sandy loam or loamy sand. Beneath this is a subsoil of loamy sand which is generally quite gravelly and stony at 16 to 20 inches. The surface of the soil varies from a loamy sand to a sandy loam, and there are a few places where the amount of fine material makes it approach a fine sandy loam. Gravel appears upon the surface and scattered through the surface soil in numerous places to a sufficient extent to class the whole type as a gravelly soil. In a few places a rather heavy sandy loam was included

*For chemical composition and improvement see page 55.

with the type such as that to the east of Arbor Vitae Lake, where the soil is a good sandy loam but extremely rolling. Stones and bowlders are generally more numerous on this soil than on the Vilas sandy loam.

Topography and Drainage.—The surface of this type is very broken and choppy or uneven, consisting of a series of sharp knolls and ridges with deep depressions intervening. Small marshes are common in the depressions. On the tops of the highest ridges areas of 5 to 30 acres of more gentle topography are included with this type. The type resembles in surface features the Vilas stony sand, but the texture is somewhat heavier, and stones are not so plentiful, making it a somewhat better soil.

Excepting in the pot holes and depressions the drainage on this soil is good or even excessive, due to its irregular topography and the loose open gravelly subsoil. The rolling, rough surface and the gravelly nature are the chief characteristics of this type of soil.

Origin.—The material making up this type was largely ground from granitic and sandstone rocks and deposited by glacial ice. The rough topography is due to the fact that it was deposited near the margins of the glacier where greater amounts of debris were accumulated and where more movement of it took place. The material usually appears as lateral or recessional moraines, as kames and eskers, and in part as rough ground moraine. No rocks of a calcareous nature have entered into the formation of this type and both soil and subsoil are in an acid condition.

Native Vegetation.—The timber on this soil was mainly large white pine with a few Norway pine in places. On other places maple, birch, and a few black oak are found scattered as individual trees among the pine stumps, or in clumps upon small knolls or ridge tops of more nearly level or heavier soil. Poplar, birch, cherry, maple, oak, and pine from 8 to 30 feet high are found forming the second growth.

*Agricultural Development.**—But very little of this soil has ever been cultivated and little or no crop data are available. The topography makes the laying out and cultivation of fields difficult, and no farms of any size or extensive settlements are found upon this kind of soil.

On the whole, this type must be classed with soils of low agricultural value, because of its rough uneven topography. While the texture and water-holding capacity are generally sufficient to place it with fair agricultural types, the rough, choppy, and hilly surface

*For chemical composition and improvement see page 55.

makes this soil undesirable farming land, so long as equally good and better soil with better topography remains undeveloped.

PLAINFIELD SANDY LOAM

Extent and Distribution.—The Plainfield sandy loam occupies a total area of about 25 square miles and is distributed through four of the counties included in this area. The greater proportion of the type is found in Vilas County where it occurs near Rest, Harris, and Clear Lakes, with smaller patches in Section 31 (Town 40, Range 7), Section 26 (Town 40, Range 11), and Section 12 (Town 39, Range 10). In Iron County it occupies several small tracts in the vicinity of Mercer and near Springstead Lakes. In Price County it occurs just west of Phillips and east of the Caro Resort on Pike Lake, both areas being small. In Oneida County the largest tract, and one which is being improved, occurs in the immediate vicinity of Starks.

Description.—The surface soil of the Plainfield sandy loam to an average depth of 10 inches consists of a brown sandy loam which has somewhat of a grayish-brown appearance in cultivated fields when dry. The subsoil consists of a yellowish-brown sand or light sandy loam usually containing considerable gravelly material, especially below 20 to 24 inches. The gravel is well rounded and interbedded with layers of coarse, medium, and fine sand in the lower subsoil. In places, as about Springstead Lakes in Iron County and near Starks in Oneida County, small stones from 1 to 3 inches occur upon the surface over local areas. In connection with these stony patches a surface layer heavier than above described and a coarser sand subsoil at 18 to 20 inches is often found. No bowlders or large stones are found upon the type, and most of the soil is free from the smaller stones described above.

Topography and Drainage.—The surface of this type is level to very gently undulating, and because of the open porous character of the subsoil the natural drainage is excellent and usually somewhat excessive. Variations in topography occur chiefly in the vicinity of marshes, lakes, and streams, but these are not at all pronounced.

A few small tracts were found where the water table was close to the surface, and in such places the natural drainage was deficient, and a mottled condition had developed in the subsoil; such instances, however, are seldom found.

Origin.—The material from which this type has been derived occurs in the form of glacial out wash plains. There is no calcareous

material present and an acid condition prevails throughout both the surface and the subsoil.

Native Vegetation.—The native forests on this type included quite a wide range. Most of the type was covered with white, Norway, and some Jack pine, though there are a number of tracts where hemlock, birch, maple, and some basswood were found. Over most of the type the original timber has been removed and the present growth is poplar and birch, with some small pines. Where the hardwood was found birch, cherry, poplar, maple, and hemlock now form the second growth.

*Agricultural Development.**—The greater proportion of this soil is still unimproved, but at several points considerable progress has been made in its development. One of these is northeast of Eagle River, known as the Saltenberger district, in Vilas County and another is in the vicinity of Starks in Oneida County. Excellent crops of clover, oats, barley, and potatoes are grown. On the new land clover generally makes a catch with very little difficulty and produces two cuttings in a season. Potatoes yield from 100 to 200 bushels per acre, barley 25 bushels, and oats from 30 to 50 bushels per acre. Corn, while often injured by late spring and early fall frosts, generally ripens if seeded early enough in the spring. Excellent corn for silage can practically always be grown.

PLAINFIELD FINE SAND

Extent and Distribution.—The Plainfield fine sand is an important and extensive soil in this area. There are approximately 195 square miles, the greater proportion of which is confined to Vilas and the northern half of Oneida County. Extensive areas occur in th vicinity of Eagle River in Town 40, Range 10; Town 40, Range 9, near Clearwater Lake in Town 39, Range 10; and near Three Lakes in Town 38, Range 11. Extensive tracts are also found in the vicinity of Minocqua, Woodruff, Arbor Vitae, and about Lac du Flambeau. Areas of smaller extent are found all through Vilas and the adjoining portions of bordering counties. Only one small patch was found in Price County and this occurs near Pike Lake.

Description.—Beneath two inches of grayish loamy fine sand to sandy loam the surface soil is a compact brown to reddish-brown loamy fine sand or sandy loam becoming yellowish sand or fine sand at from 10 to 16 inches. In some cases the fine subsoil is deep, containing no coarser material; in others the subsoil contains small gravel stones, becoming quite gravelly at 20 to 24 inches. Where

*For chemical composition and improvement see page 55.

gravel is present, the sand grains are generally of medium to coarse texture.

The type contains material of two somewhat different combinations, one being that of a fine sand containing slightly more silt and clay particles in the surface soil than the Plainfield sand; the other, while having still more silt and clay, also has a larger number of sand grains of coarser texture giving the soil a light sandy loam texture. These two textures were found so intimately associated that no attempt was made to separate them. The two are, however, of relatively the same consistency and both have better water-holding capacity than has the Plainfield sand.

Topography and Drainage.—The surface of the Plainfield fine sand is generally level with some slight irregularities in topography bordering streams, lakes, or marshes, due to erosion of the plain, and giving a slightly undulating topography in such places. Other small irregularities consist of small bowl-shaped depressions or pits which occur singly or in groups, and break the evenness of the topography to a greater or less extent. Generally the groups of pits are small and do not affect the topography over more than one or two forty-acre tracts where they occur.

This soil, like the Plainfield sand, has good drainage because of its open texture and loose and sandy subsoil, but excessive drainage or drought does not so easily occur because of the greater amount of fine material—silt and clay, in the surface 8 to 12 inches. This greater amount of fine material perceptibly increases the water-holding capacity of the soil as compared with the Plainfield sand. The difference can be noted in a greater compactness of the surface of the fine sand and the numerous pools of water which remain in the roads often for several days after a hard shower.

Origin.—The Plainfield fine sand is of alluvial origin and the material was deposited in stratified layers by water issuing from beneath the glacial ice sheet, as was also the Plainfield sand, the only difference being that due to a slower movement of the water, a greater amount of silt and clay or fine sand was deposited on the surface where this fine sand type is mapped. The parent material came largely from the crystalline rocks of the region, but there may also be incorporated some material which was carried by glacial action from the sandstone region along the shore of Lake Superior.

Native Vegetation.—The original timber growth consisted of pine, the majority of it being white pine with occasionally a smaller amount of Norway or large Jack pine mixed in. An exception to this rule occurs in Town 38, Range 4 East, where the level fine sandy soil is not well drained. Here numerous cedar, hemlock, and tam-

arack occur, and the general water table is near the surface. Some birch and a few maple trees are also found.

The second growth on this type where the original pine has been removed is a thick stand of poplar and white birch 10 to 30 feet high, with a greater or less proportion of young white and Norway pine. In places the young pine growth predominates over the poplars. The ground growth consists of ferns, brakes, and sweet fern, with some grass. A fair grass sod is often found established on the virgin soil where pastured and where moisture conditions are favorable.

*Agricultural Development.**—While but a comparatively small part of this soil has been farmed as yet, the Plainfield fine sand has more farmers on it than any other soil in the region where the type is found. The clearings range from small patches of 3 to 5 acres to large well developed farms with 40 to 100 acres of cleared land.

The settlements about Eagle River and Clearwater, comprising about 140 clearings or farms with approximately 2000 acres of cleared land, arel argely on this kind of soil. The settlements about Woodruff and Minocqua, including about 75 clearings and farms with about 1500 acres cleared, are in large part on this soil.

The crops grown and yields reported are: potatoes 150 to 200 bushels; oats 30 to 40 bushels with yields as high as 56 in a few instances; barley 20 to 30 bushels; rye 20 bushels; peas 20 bushels; clover 2 tons in 2 cuttings, and corn about 40 bushels. Potatoes are well adapted to the soil and good yields are obtained. Oats also give good yields. Early varieties of corn while often retarded by a dry spell or a frost, mature well in most seasons if seeded early enough. Good silage can generally be secured. Clover does well and no great trouble in getting a good stand was noted, especially on new land.

VILAS FINE SAND

Extent and Distribution.—This is one of the types of minor importance since it is of very limited extent. Several small tracts are found south and east from Rhinelander in Oneida County and one area of about a square mile occurs about five miles southwest from Fifield in Price County.

Description.—The surface soil to a depth of about 8 inches consists of a gray or yellowish fine sand which contains only a very small amount of organic matter. The subsoil consists of a fine yellow sand to a depth of over 3 feet. In some cases a small amount of gravel may occur through the subsoil, but as a whole the type is quite uniform.

*For chemical composition and improvement see page 55.

VIEW OF FARM ON PLAINFIELD FINE SAND NEAR WOODRUFF.

Shows crops of clover and corn obtainable on this soil.

VIEW SHOWING SURFACE FEATURES OF VILAS SAND AND VILAS STONY SAND.

These types of soil have a low agricultural value and present conditions seldom favor their improvement.

Topography and Drainage.—The surface of this soil is undulating to gently rolling, and because of the loose open character of the soil material the natural drainage is excessive, and the type is inclined to be droughty; though this soils retains the moisture better than the Vilas sand or stony sand.

Origin.—The material forming this soil has doubtless been derived through glacial action from the underlying crystalline rocks, and also in part from sandstone formations far to the north, from which the glacial ice carried varying amounts of material. There is no limestone in the region and the soil is in an acid condition.

Native Vegetation.—The original timber consisted chiefly of white and Norway pine, with a small amount of hardwood and hemlock in places. All of the pine has been removed, and a second growth of poplar, birch, some pine, and sweet fern now covers the ground where the land is not cleared.

Agricultural Development.—Because of its limited extent this soil is of little agricultural importance. Probably half of the type is under cultivation and fair yields of the usual farm crops grown are secured. With careful management clover, small grains, potatoes, corn and alfalfa can be grown with profit.

CHEMICAL COMPOSITION AND FERTILITY OF MEDIUM SANDY SOILS

These soils have intermediate texture and hence have moderate water-holding capacity. They are not fine enough to be especially well adapted to grasses for pasture, though a fair quality of pasturage can be secured on the heavier phases of these soils. The more deeply rooted crops, such as clover, rye, corn, and potatoes, find sufficient moisture during average seasons and suffer from drought only during periods of relatively low rainfall.

This moderate wate-holding capacity permits these soils to dry off more quickly in the spring and become warmer than heavier soils, thus fitting them especially for such crops as corn, potatoes, and other truck crops requiring a warm quick soil. The water-holding capacity can be considerably improved by increasing the organic matter.

In chemical composition these soils are also of an intermediate character. The total phosphorus averages from 850 to 900 pounds in the surface 8 inches per acre. The total potassium of the surface 8 inches per acre is approximately 25,000 pounds or but little over one-half of that found in heavier soils such as the Kennan silt loam. The organic matter of these soils is also comparatively low, averaging from 2.5 to 3.0 per cent in the surface 8 inches and from 1 to 2

per cent in the second 8 inches. They have a correspondingly low nitrogen content averaging from 1000 to 1500 pounds in the surface 8 inches and from 500 to 800 pounds in the second 8 inches. This organic matter is largely in the form of leaf-mold and fine roots and is hence of an active character so that it decomposes quickly when the surface is first broken, furnishing a sufficient supply of nitrogen for a good growth of crops for a few years. But it is exhausted with comparative readiness and the most important point in the management of all of these soils is to follow methods which will maintain and increase the organic matter. In the virgin condition these soils are but slightly acid as a rule, but with continued cropping the acidity increases and for the best growth of clover and especially alfalfa, liming is essential. This use of lime not only makes the soil more suitable for the growth of alfalfa and clover, but assists in preventing the leaching of phosphorus and maintaining it in a form which is available for growing crops.

The management of these soils to maintain the fertility will depend to a considerable extent on the crops grown and on whether or not stock is maintained to which the produce of the farm is fed. When dairying or other live stock farming is practiced it will be less difficult to maintain the supply of the essential elements of plant food—phosphorus, potassium, and nitrogen. But even when stock is maintained, it is very probable that the moderate use of some form of phosphorus fertilizers will be found profitable, and some means for increasing the organic matter in addition to the use of the stable manure should be made use of as far as practicable. The growth of a crop of soybeans or clover occasionally all of which is to be plowed under as a green manuring crop will be found profitable in its effect on the succeeding crop of corn or grain.

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

The use of lime in some form and also the inoculation of the soil is of the utmost importance when alfalfa is to be grown and will be

found helpful on the older fields even for the growth of medium red or mammoth clover.

While the use of commercial fertilizers containing phosphorus and potassium is desirable in the management of these soils it must not be considered that this is an indication that they have less value than heavier soils which are relatively higher in these elements for the growth of potatoes and other special crops. The fact that these soils become dry and warm early in the season makes them less subject to local frosts, and the finer tilth which these fine sands and sandy loams develop fit them especially well for the growth of potatoes and some other root crops, since they are practically free from checking and cracking. The cost of these fertilizers is a comparatively small part of the total cost of growing these crops. For further suggestions on the management of these soils and for information regarding source and use of fertilizers consult Bulletins 204 and 230 of the Wisconsin Experiment Station.

CHAPTER V

GROUP OF SAND SOILS

VILAS SAND

Extent and Distribution.—The Vilas sand covers a total area of about 100 square miles and is confined chiefly to Vilas and Oneida Counties, with a few scattering areas in the southeastern part of Iron County. Areas covering 3 to 5 square miles occur in Town 42, Ranges 7 and 8, and in Town 40 Range 5 in Vilas County. In Town 37, Ranges 5, 6, 7, 8, and 9, in Oneida County there are also numerous tracts of this soil, and numerous smaller areas are scattered through the southern portion of the country.

Description.—The surface of the Vilas sand is generally a grayish-brown medium or fine sand. The surface 6 to 8 inches are underlain by light yellowish-brown medium to coarse sand containing some gravel. The deep subsoil contains considerable coarse sand and fine gravel. Not much gravel and very few stones are exposed on the surface.

Topography and Drainage.—The surface of this type varies from undulating to gently and moderately rolling. On account of the generally loose open structure of the soil the natural drainage is excessive and the droughty condition is indicated by its bare appearance and general lack of timber or other vegetation.

Origin.—The soil of this type consists of glacial debris which was ground from the granite rocks underlying this district and from sandstone rocks farther north. No calcareous material has entered into the formation of this type and both soil and subsoil are in an acid condition.

Native Vegetation.—Most of the Vilas sand has a rather bare open aspect with but very little timber on it. Where timber occurs, it consists of small clumps of Norway and Jack pine or a stunted growth of poplar, scrub oak, and birch from 3 to 5 feet in height. Sweet fern and blueberry bushes grow plentifully on this soil. Not much grass or sod is found.

*Agricultural Development.**—Very little of the soil has been farmed. Some attempts have been made, but in many cases an abandoned

*For chemical composition and improvement of this soil see page 63.

clearing has been the result. The lack of fire wood, the liability of crops to suffer from drought, and low yields due to the quick dissipation of the small amount of organic matter under cultivation, all tend to discourage any permanent settlement on this type of soil at present. Where efforts to work this soil have been made the crops grown have been the same as are being grown on other soils, but yields have been low. During years when the rainfall is well distributed very fair yields have frequently been obtained, but the undertaking is too uncertain to insure even moderate success. So long as there are large tracts of better soil available, it would be unwise to attempt the cultivation of this soil, especially when the farmer's means are limited. The type would afford some grazing during spring and early summer, but because of the droughty condition the grass dries up with the first continued dry spell of summer.

VILAS STONY SAND

Extent and Distribution.—The Vilas stony sand is an extensive type in this region, but it is one of the lowest in agricultural value. It is confined chiefly to Vilas and Oneida Counties, with a small amount scattered through the southern portion of Iron County. It is very closely associated with the Vilas sand, and the line between the two is not always sharply drawn.

Description.—The texture of this soil varies somewhat. Rough topography and stoniness are the chief characteristics. Usually there are 8 to 10 inches of brown medium loose sand to loamy sand, containing much gravel which increases in amount with depth. At 18 to 20 inches a medium yellowish-brown sand is found which continues to a depth of 40 inches or more. The deep subsoil also contains considerable gravel and coarse sand, and stones are common through the soil section. Bowlders large and small are scattered over the surface—in places very thickly. In fact, this type bears more stones and bowlders than any of the other types mapped. The soil resembles the Vilas sand in texture, but differs from it in topography and stoniness.

Topography and Drainage.—The surface of this type is very uneven, rolling, rough, and broken. It consists of a series of sharp, pointed and choppy knobs and ridges interspersed with numerous pot holes, marshes, and small ponds. Many of the slopes are so steep that modern farm machinery could not be used even if the texture of the soil indicated a good agricultural value. On account of the rough broken topography and the loose open character of the soil and subsoil, the natural drainage is excessive and the soil droughty.

Origin.—The material forming this soil is largely derived from granitic rocks on which it lies and from sandstone rocks to the north. No calcareous material occurs in the soil and both soil and subsoil are in an acid condition.

Native Vegetation.—Much of the Vilas stony sand is nearly bare cut-over Norway and white pine soil. It supports a growth of sweet fern, scattered Norway, Jack, and white pine, or a sparse second growth of poplar and white birch. In the portions of slightly heavier soil a heavier growth of poplar and birch is found, and scattered clumps of hardwood from 1 to 10 acres in extent are frequently found.

*Agricultural Development.**—Very little farming has been attempted upon any area mapped as stony sand, and little or no crop data is available. In most cases where the land has been cropped at all, it has been only as garden spots or portions fenced off for pasture. No extensive farming operations have ever been undertaken. Because of its loose open structure, its rough broken topography, low organic matter content, and droughty condition, this soil must be classed as having a low agricultural value, even though the texture in places would in itself indicate a somewhat better grade of material. The stony condition in itself would make farming operations difficult, as in most cases modern machinery could not be used to advantage. Because of these conditions no attempts should be made to improve this soil so long as there is better land available.

PLAINFIELD SAND

Extent and Distribution.—The Plainfield sand comprises a total area of approximately 190 square miles and is found in four of the counties making up the present survey. It usually occurs in large tracts, each of which generally contains several square miles. Large areas are found in Vilas County extending south from Sayner through Town 40, Range 8 to the Wisconsin River in northern Oneida County. More of this soil occurs between Conover and State Line in Town 41, Range 10; Town 42, Range 10; and Town 42, Range 9. It is found south of Crawling Stone Lake in Town 40, Range 5, west of Trout Lake in Town 41, Range 6, and Town 42, Range 6, about Bowlder Junction in Town 42, Range 7, and about Rest Lake in Town 42, Range 5 and Town 42, Range 4. In the southern part of Oneida County there is a very extensive area in Town 36, Ranges 5 and 6. The Tomahawk River flows through this tract. A tract several square miles in extent occurs in northeastern Price County in Town 40, Range 3 East. Smaller tracts of from ¼ square mile

*For chemical composition and fertility of this type see page 63.

to over one square mile are found scattered throughout the general region in which are found the larger areas of this soil.

Description.—The surface soil has from 1 to 2 inches of grayish medium to fine sand resting upon from 8 to 10 inches of medium brown or yellowish-brown sand. Yellow medium to fine sand is often found at 10 to 12 inches and this may extend to 40 inches or more, or may be followed by a medium coarse sandy layer containing varying amounts of gravel at 24 to 30 inches. Where the gravel layer is present it is underlain by a layer of coarse yellow sand. The type as a whole is stone free and is quite uniform. The chief variation is where the water table is closer than usual to the surface and more organic matter is present in the surface few inches than typical. Slight variations also occur in texture, but these are of small extent and not sufficient to justify the establishing of phases. North of Conover in local areas the texture is finer than typical, but the character of the vegetation and water-holding capacity does not differ from the Plainfield sand; therefore, no separation was made.

Topography and Drainage.—The surface features or topography of Plainfield sand consists of a level generally unbroken plain. Some variations occur in small areas where the plain is pitted—that is, having a group of bowl-shaped depressions. In other places broad gentle undulations occur, and about marshes, lakes, and along streams there are some irregularities, but in the largest areas the topography is a level plain.

Because of the open rather loose structure the natural drainage is good and often excessive. In some places the surface attains a certain compactness, but the general looseness of the subsoil permits the rapid percolation of all rainfall. The effect of this excessive drainage is seen in the quick drying of the soil and lack of water puddles after a heavy rain. The vegetation also shows the effect—the trees, if any, being drought-resisting varieties and the plant vegetation of a kind that requires a minimum amount of moisture. The difference in the resistance to drought between the Plainfield sand and Plainfield fine sand is noticeable in the vegetation, the latter generally bearing larger timber with a greater percentage of white pine, with plenty of poplar and birch appearing in the second growth.

An exception to this general state of excessive drainage is found on the areas bordering the Manitowish marshes between Powell and Manitowish. Here the type consists of bare flat sand areas but slightly elevated above the peat marshes where the water table is so near the surface that the soil is more or less continuously wet and

numerous wet grass grown swales and flats are scattered over the sand areas. These areas cover about 2 to 3 square miles of territory in Sections 8, 13, 15, 16, 17, and 21 in Town 42, Range 4 East. Another low poorly drained area is found in Oneida County in Sections 4 and 5 in Town 37, Range 8 East, where the water table comes from 1½ to 2 feet from the surface of the ground and the timber consists of hardwood and pine.

Origin.—The Plainfield sand has been deposited as outwash plains by water coming from beneath the glacial ice sheet. The material was doubtless largely derived from the granitic rocks upon which it lies, and in part also from the Keweenawan sandstone farther north. Being assorted by water from the melting glacier, the finer material was largely carried away, leaving the heavier sand grains deposited in horizontal layers. This horizontal stratification may be noted in almost any pit or road cut in this kind of soil. There is no calcareous material present and both soil and subsoil show varying degrees of acidity.

Native Vegetation.—The original timber growth on this soil consisted largely of Norway and Jack pine often of large size, with some white pine in places. Extensive areas appear to have had no timber on them for a long time past, as no stumps or other signs of timber are to be seen. Woodmen also report that when the timber of these plains was first cut, there were open areas bare of timber in some places. The second growth, where any has escaped the repeated fires, consists mainly of small Jack and Norway pine. Poplar and birch second growth is absent or meagre. The ground cover consists of sweet fern, brake, and blueberry bushes, with some short coarse buffalo grasses in places. In Sections 4 and 5, Town 37, Range 8 East, in Oneida County there is a somewhat heavier occurrence of this soil which is low lying and over which there was a mixture of hardwood and pine.

*Agricultural Development.**—Only a small proportion of this soil is cleared and under cultivation at the present time. The largest improved tract is in Oneida County in Town 30, Ranges 5 and 6. The yields reported from this region are corn from 20 to 40 bushels, rye from 10 to 15 bushels, buckwheat 15 to 18 bushels, hay about 1 ton, and potatoes from 100 to 150 bushels per acre and frequently more. Corn will not always mature, but is nearly always certain to provide silage.

*For chemical composition and improvement see page 63.

COLOMA SAND

Extent and Distribution.—This type occupies a total area of approximately 12 square miles and is all confined to the extreme northwestern portion of Iron County. Most of it occurs in one solid body and there are only a few detached areas. One of these is located at Gurney.

Description.—The surface soil of this type to an average depth of 8 inches consists of a yellowish-brown sand of medium texture. It is loose and open in structure, and contains only a very small amount of organic matter. The subsoil consists of a yellow or light yellow medium incoherent sand which becomes somewhat coarser with depth. There is no gravel on the surface and but very little in the soil or subsoil.

Topography and Drainage.—The surface varies from gently rolling to hilly, and because of the loose open character of the soil and subsoil the natural drainage is excessive and the soil droughty.

Origin.—The material forming this type consists of glacial debris which has been ground from the underlying Keweenawan sandstone by the action of glacial ice. There is no calcareous material present and both soil and subsoil are in an acid condition.

Native Vegetation.—The original timber growth consisted of white and Norway pine. All of this has been removed, except on the Indian Reservation. Fires have run over the country at various times, and now the region presents a rather desolate forsaken appearance.

Agricultural Development.—But little has been done in the way of improving this soil, and its development will doubtless be delayed until a larger proportion of the better soils in the region have been taken up. The type has a low agricultural value and will require very careful management to produce profitable crops from year to year.

CHEMICAL COMPOSITION AND FERTILITY OF COLOMA, VILAS, AND PLAINFIELD SANDS

In some respects sandy soils have advantages over heavier soils. They become drier and therefore warmer and can be worked earlier in the spring and more quickly after rains than heavier soils. These advantages are particularly important in regions of short growing seasons, but when the soil is too sandy it does not hold sufficient water from one rainfall to another to satisfy the needs of growing crops and they therefore suffer from drought. Moreover, some sandy soils are lower in their supply of the chemical elements

demanded by crops than heavier soils. When these two factors become too low they limit the profitable farming of these soils. In the mapping of the Soil Survey those soils which are classed as fine sands or sandy loams, have fairly good water-holding capacity and when their fertility is properly maintained their good qualities in regard to warmth and earliness can be taken advantage of, and they can be farmed with profit. But soils which are classified as sands, such as the Coloma, Vilas, and Plainfield sands, are so coarse as a rule that they do not have sufficient water-holding capacity and their use for the growth of staple crops is ordinarily unprofitable, unless unusual skill is used in their management. It must be kept distinctly in mind, however, that all types as mapped show some variation in texture or fineness of grain and that on small portions of soils mapped as sands a more detailed mapping would often show fine sands. This is particularly true in the case of sands mapped as Plainfield sand in Marinette County which was surveyed several years before the remainder of the area was mapped. The discussion of the composition and agricultural value of fine sands will be found on page 55. With very unimportant exceptions, the soils mapped as Coloma, Vilas, and Plainfield sands in this area are of a very sandy character and profitable farming will be possible on them only when they are managed with unusual care and the crops to which they are best adapted are grown. The chief factor limiting their agricultural use is that of water-holding capacity. This depends chiefly on the texture or fineness of grain and cannot be affected by any treatment it is practicable to give them. The water-holding capacity can be somewhat increased by increasing the amount of organic matter, but this is a comparatively slow process and the amount of organic matter it is practicable to develop and maintain in these soils will increase their water-holding capacity only to a limited extent.

The total content of the essential elements of plant food in these soils is moderate. The total phosphorus in the surface 8 inches per acre averages between 1000 and 1100 pounds and in the second 8 inches between 600 and 700 pounds. The total potassium in the surface 8 inches per acre is approximately 35,000 pounds in comparison with 50,000 or 55,000 pounds in the silt loam soils of that region. The total nitrogen content is between 1200 and 1400 pounds in the surface 8 inches per acre. When a sufficient supply of active organic matter is developed in these soils a portion of the phosphorus and potassium will undoubtedly be made available, but the use of fertilizers containing these elements in a more readily available form is desirable whenever these soils are farmed; especially is this true in

the case of garden or truck crops which make larger demands on the supplies of these elements than do the staple crops.

The starting point in the improvement of these soils is the development of active organic matter through the growth of legumes which are able to secure their nitrogen supply from the atmosphere. The growth of a good crop of mammoth clover or soybeans through the use of mineral fertilizers containing phosphorus and potassium is the best means of supplying this nitrogen and organic matter. This crop should be plowed under as a green manuring crop. Ordinarily on these soils clover should be sown without a nurse crop. It should also be put in a little deeper than on heavier soils and the drill should be followed by a roller, and finally the drag or corrugated roller should be used.

By the adoption of a rotation of crops including one year in four in which a legume crop is grown and the entire crop plowed under and the use of moderate amounts of commercial fertilizers containing phosphorus and potassium together with proper attention to cultivation to conserve moisture fair, crops can be grown during the remaining three years. When dairying or any other line of stock farming is followed so that most of the crops grown aside from the green manuring crop are fed, the fertility of this land can be maintained. This will permit the growth of potatoes or other truck crop for direct sale on approximately one-eighth of the land on the farm.*

* Extensive experiments have been carried on on Plainfield sand near Sparta. Information on these may be secured by writing to the Soils Department of the Wisconsin Experiment Station.

CHAPTER VI

GROUP OF POORLY DRAINED SOILS

PEAT

(With Included Areas of Muck)

Extent and Distribution.—Under this classification has been included all varieties of swamp and marsh land in this region whose surface soil is of organic origin. The total area covered by this class of land exceeds 600 square miles. Peat soils are well distributed throughout the area and occur in varying amounts in practically every township. It occurs as low lying areas bordering streams and lakes, in depressions and valleys between rolling ridges and hills where outlets are frequently lacking, or as wide extensive marshes which are wet the greater part of the year and have accumulated a surface covering of Peat in varying stages of decomposition.

The wooded marsh land occurs chiefly along streams and in smaller depressions in nearly every township, but the most extensive open peat marshes are confined to three or four localities. These most extensive tracts are known as the Thunder Lake or Three Lakes Marsh in Towns 38 and 39, Range 10 East; the Swamp Lake Marsh in Towns 38 and 39, Range 8 East; the Flambeau Marsh three miles north of Lac du Flambeau station in Towns 41 and 42, Range 5, and the Manitowish Marshes which cover extensive tracts bordering the Manitowish River and its tributaries in Town 41, Ranges 3 and 4, and in Towns 42 and 43, Range 4 East. Each of these marsh districts comprise from 15 to 25 square miles, each of low wet peaty lands. Smaller but important areas of Peat are found in all of the counties in the survey. The section in which the marshes are the least extensive is in the southwestern portion of the area in the southern part of Price and the eastern part of Rusk Counties where the Colby soils predominate.

Topography and Drainage.—All the marsh and swamp lands are necessarily nearly level. The drainage is poor due to the lack of a surface outlet or because of a dense subsoil layer which prevents the water from seeping away through the porous subsoil. Some of the large marshes have indications of once having been large lakes since

glacial times, which have found outlets more recently and have been partially or completely drained of their surface water. The Flambeau and Three Lakes Marshes appear to be of this origin, the lower lying portions of these marshes still containing large shallow lakes. The drainage conditions on all of the marshes are such that no agricultural development can be made until some system of drainage has been installed. After deep outlet ditches and laterals from 40 to 80 rods apart have been put in to remove the surface water the land can be cleared and broken during dry seasons. But in most cases either open ditches or tile will have to be put in every 10 to 20 rods to make the growing of hay safe and even closer to drain the land sufficiently for other crops.

Description.—The material composing this type consists of decaying vegetable matter in varying stages of decomposition, with which there has been accumulated varying amounts of mineral matter. The typical peat contains only a small amount of mineral matter and is often of a brown color and fibrous texture, though it may also be black and thoroughly decomposed. Around the margins of the large marshes and frequently making up the entire body of smaller marshes, the material contains sufficient mineral matter so that it could be properly classed as Muck. Such tracts, however, have a limited extent and in a general survey it was not considered practicable to attempt a separation. The mucky phase is also found along streams where it occurs in a narrow belt, usually wooded.

The typical Peat in the large marshes extends to a depth of 3 to 10 or more feet, and is often so loose that a pole can be shoved down to these depths. Over small tracts which might be classed as shallow peat, the depth ranges from 10 to 24 inches, but it was also impossible to separate these variations in a general survey. In a few of the large marshes some shallow peat was also found, especially in Vilas County. When the shallow peat is cultivated it is probable that the underlying material may become thoroughly mixed with the peaty covering and form a sandy or loamy Peat.

The underlying material varies greatly, depending largely upon the texture of the upland soils adjoining the marshes. In the regions where most of the soils are sandy, the material underlying the marshes is quite generally sandy, sometimes having a hard compact layer several inches thick which is often referred to as a hardpan. In regions where the upland soils are largely silt loams or loams, the material beneath the marshes is usually heavy.

Many of the grass marshes have been burned over repeatedly in dry years; others have been flooded by rising waters from adjacent streams and more or less mineral matter mixed with the peat. The

burning and addition of mineral matter has produced a finer, denser, and more decomposed surface soil which approaches a Muck in texture.

This sort of soil is found on the Haymeadow Creek Marshes near Conover, and also over parts of the marsh bordering Mud Creek just west of Powell in Town 42, Range 4, where a good heavy compact muck is found in places. The best marsh soils were generally found on the grassy marshes, being best where blue-joint grass was found, with somewhat less mineral matter and less depth where wire grass grew. Thinly wooded and blueberry marshes which have not been burned over usually have a covering of sphagnum moss and the peat from this source is coarse and stringy like excelsior and very raw. In some of the marshes small islands were found which were too limited in extent to be indicated on the map. Such a condition appears in Section 4, Town 36, Range 5 East, and Sections 32, 33, and 34 in Town 37, Range 5 East in Oneida County. A few other instances were observed where this same condition prevailed, though to a smaller extent.

As there is no calcareous rock formation in this region the adjacent upland soils are all acid, and consequently the waters coming into the marshes and the peaty material itself is always found to be acid. But this acidity in peat will in part be gradually removed by thorough drainage.

Native Vegetation.—Where protected from fire, partially due to their being lower and less often dry even in dry years, the open marshes bear sphagnum moss and patches of blueberry and cranberry bushes. Such marshes are generally partly wooded. Scattered clumps of stunted black spruce six to twelve feet high may be found with a dense growth of tamarack, cedar, alder, and spruce around the margin of the swamp. Other swamps are entirely covered with a dense growth of tamarack and cedar 20 to 60 feet high. The open marshes, where the Peat is not too deep and there is no moss, have often grown up to wire grass, which has a small round stem 16 to 20 inches high. Where the marsh soil is heavier and approaches a muck, blue-joint grass is apt to be found. This is a taller grass—2 to 3 feet high—with a feathery tassel, and it makes much better hay for feeding purposes than the wire grass.

Agricultural Development.—Very little of the Peat has been drained and put into farm crops. In Section 34, Town 42, Range 10, near Conover, a portion of a marsh was ditched, plowed, and seeded to timothy during a series of dry years and yielded fine crops of hay for several years. This marsh, however, has now gone back to wire grass and blue-joint due to a return of wet conditions. Buckwheat

has been grown on a part of the Three Lakes Marsh. The Three Lakes Marsh and the Swamp Lake Marsh contribute large quantities of wire grass. Farmers cut it for hay, and much is baled and shipped to grass rug and carpet concerns in Green Bay and Oshkosh. Large amounts are also obtained from the Flambeau Marsh.

Agricultural development on these marsh lands, however, cannot be developed to any proportions until drainage systems have been installed. Many of the marshes have sufficient fall so that their drainage would be possible. The larger ones, of course, would require a large expenditure, and the organization of extensive drainage districts. There are numerous small marshes which could be drained at comparatively small cost, and where the surrounding upland is improved these marshes should be drained.

CHEMICAL COMPOSITION AND FERTILITY OF PEAT

The chief difference between peat soils and upland soils consisting largely of earthy matter, is that they have relatively small amounts of the mineral elements phosphorus, potassium, calcium, and magnesium, and have extremely high amounts of nitrogen in the organic matter. The average per cent of phosphorus in the peats of this region so far analyzed is 0.135 per cent. This means that in an acre of soil to a depth of a foot there is approximately only 675 pounds or in 2 feet 1350 pounds in comparison with upland soils which have approximately twice these amounts. Moreover, the acid condition of these soils renders the phosphorus less available than in non-acid soil.

The deficiency of potassium in these soils is greater than that of phosphorus. They contain on the average 0.3 per cent of this element, while good upland clay loam soils average 2 per cent or over six times as much expressed in percentage. When the greater weight of the upland soils is taken into account it will be found that they contain in the upper two feet 120,000 pounds per acre, while the peat soils contain but 3000 pounds.

A large amount of organic matter in these soils gives them an extraordinary amount of nitrogen. They average 2.5 per cent of this element, while the upland silt loam soils of this region contain but about 0.12 per cent and this only in the surface 8 inches—the amount in deeper layers being much less.

As a result of this difference in the chemical composition the peat soils are very unbalanced. Their rational treatment requires the use of fertilizers containing especially the elements phosphorus and potassium. Of course, these elements are contained in relatively

small amounts in barnyard manure and good applications of manure will secure good yields of crops on peat soils, but manure contains large amounts of nitrogen not needed by the peat, so that when a farm includes upland soils as well as peat, the manure should be used on the upland soils and commercial fertilizers containing phosphorus and potassium used on the peat land.

On the deeper peats which are in a very raw and acid condition the use of lime in some form in addition to the commercial fertilizers will be found profitable. Occasionally a marsh is found on which on account of coldness and high acidity at first nitrification or the chemical change by which the nitrogen in the organic matter becomes available to crops does not take place readily and the use of a light application of composted stable manure to inoculate the soil with the proper organisms is very helpful. In this part of the state the chief crop grown on marsh land should be grass for hay.

WHITMAN SILT LOAM

Whitman silt loam is of very limited extent and of rather minor importance. It is confined to all lands chiefly associated with Colby soils, and is found most largely along stream courses or in depressions which are poorly drained. A number of small areas occur in the southern part of Price county where the Colby silt loam predominates. Probably the largest tracts are found in Oneida county, one occurring in the extreme southwestern corner and another in the southeastern portion of that county.

This type of soil is quite similar in texture and structure to the Colby silt loam, but it differs from that type in its topography position and by containing a larger amount of organic matter in the surface soil. The surface of this type to a depth of from 8 to 10 inches consists of a dark gray, brown or black heavy silt loam which is underlain by a bluish or drab strongly mottled silty clay loam which usually extends to a depth of over three feet. In some places the lower subsoil contains a sufficient amount of sand and fine gravel to impart a gritty feel. The dark color of the surface is due largely to the accumulation of organic matter. The amount of organic matter is quite variable which accounts for the variation in the color of the surface soil. In a number of places there was found a very thin covering of muck or peat over the surface of this type. Some of the areas mapped are somewhat stony. The area east of Pelican Lake in Oneida county is quite shallow the underlying rock outcrops in a number of places, and there are numerous large bowlders upon the surface.

The surface of the Whitman silt loam is level to very gently sloping, and because of its low position and the heavy character of the soil material, the natural drainage is very deficient. It is probable that all portions of this type will require artificial drainage before cultivated crops can be grown successfully.

The original timber on this land was quite similar to that on the Colby silt loam, but there is probably a somewhat larger amount of elm, with some ash and smaller amounts of maple and birch.

But very little of this type is under cultivation at present, and before agricultural operations can be successfully carried on it will be necessary to provide thorough drainage. Open ditches and tile drainage may both be used to advantage in reclaiming this soil. When thorough drainage has been established, this land will be adapted to a wide range of crops and will be fully equal in producing power to the Colby silt loam.

GENESEE SANDY LOAM

The surface soil of the Genesee sandy loam to an average depth of 10 inches consists of a gray sandy loam of medium texture, underlain by a drab or gray medium sand grading into stratified beds of sand and gravel. The subsoil is frequently mottled, but this mottling is the most common where a small amount of clay is mixed with the sand. The surface of the type is frequently covered with from 1 to 10 inches of peat or muck, and as a whole the type is subject to considerable variation.

The Genesee sandy loam is of very limited extent and does not occupy more than one square mile, all of which is within Price County. The largest area is found to the southeast of Fifield, within the flood plain of Sailor Creek. A small tract is also found in the northeastern portion of Price County about 2 miles west of Round Lake. The soil here is somewhat lighter in texture than typical. Another small area occurs near Phillips just west of Elk Lake within the flood plain of Elk River. The soil here is somewhat finer in texture than typical for a sandy loam.

As this soil is low, poorly drained, and subject to annual overflow it is not well adapted, in its present condition, to the production of cultivated crops. If cleared it could be used for pasture.

ROUGH STONY LAND

This classification includes land which is so rough, broken, or rocky that it is of little or no value as agricultural land. It has a total extent of about 10 square miles and is confined to the northern portion of Iron County, and forms a part of the Iron Range. The largest tract starts about 2½ miles northwest from Hurley and extends to the southwest as a narrow belt for about 10 miles. This tract is extremely rough and broken, and consists for the most part of huge rock outcrops. Between the rocks and along lower slopes there is often a thin covering of soil which would provide some pasture. The slopes are too steep, however, to permit the land to be cultivated and the soil is always shallow. In the vicinity of Kimball there are several smaller tracts where the surface is level to undulating and consists of a mass of broken rock. Sometimes there is a very thin covering of soil, but usually rocks are exposed over the greater portion of the surface.

The tree growth over the whole type is limited, and usually stunted, though where the soil is the deepest fair sized timber grew. The chief growth was maple and birch. Poplar forms most of the second growth.

Because of the extremely rocky nature of this material no attempts are made to cultivate it, and such land may be considered as non-agricultural.

CHAPTER VII.

AGRICULTURE AND CLIMATE

CROPS AND SYSTEMS OF FARMING

The staple crops for this region are timothy and clover for hay, oats, and potatoes. Wheat, barley, early varieties of corn, alfalfa, and root crops are grown to some extent. Since stock can be pastured on partly cleared land before it is practicable to use it for any other purpose, stock raising and especially the diary industry, is particularly adapted to that region. Potatoes is the most important special crop and is grown chiefly on the lighter soils such as the sandy loams and fine sandy loams. The maintenance of fertility on farms on which potato growing is the chief industry can best be accomplished through the maintenance of some stock and this also employs the farmer's time during the winter to advantage.

The following table shows the acreage of the most important crops as published in the United States Census Report for 1910.

County		Iron	Oneida	Price	Vilas
Approximate area in square miles		786	900	1241	907
Percentage of land improved		0.78	3.0	2.8	0.86
Hay and forage	Acres	1916	5860	12790	1547
	Yields in tone	2461	8040	18475	1747
Oats	Acres	311	2659	1450	550
	Yields in bushels	9044	74501	46033	15873
Barley	Acres	47	270	420	60
	Yields in bushels	636	5277	10471	1255
Wheat	Acres	88	83	65	36
	Yields in bushels	1537	1248	1165	517
Rye	Acres	11	155	128	41
	Yields in bushels	124	2278	2473	574
Corn	Acres	18	115	81	20
	Yields in bushels	747	2910	3357	831
Potatoes	Acres	201	1404	1059	332
	Yields in bushels	26408	163241	155654	39039
Peas	Acres	45	99	101	27
	Yields in bushels	572	1663	2228	641

Vegetables for home use are readily grown, including practically all kinds commonly grown in the state. Small fruit, including raspberries, blackberries, and strawberries do exceptionaly well throughout this region. Hardy varieties of apples, plums, and cherries can also be grown, although this cannot be considered a fruit section with the possible exception of the northern end of Iron County where the lake affects the climate favorably.

CLIMATE*

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

The distribution of rainfall over Wisconsin is remarkably uniform, the average yearly precipitation having a range of from 28 to 34 inches, while the mean for the state as a whole is 31 inches.

The local distribution of rainfall varies, however, from year to year in different sections. The variation is caused largely by the movement of cyclonic storms. The average rainfall for the entire state during the driest year was 21.4 inches, and for the wettest year 37 inches.

Of equal importance in agriculture to the total rainfall is its seasonal distribution, and in this respect Wisconsin is unusually fortunate, since about half of the total rainfall comes in May, June, July, and August, and nearly 70 per cent from April to September, inclusive. June has the heaviest rainfall, averaging 4.1 inches, while July averages 4 inches, and May 3.9 inches. The average rainfall for the State during winter is 3.9 inches, during spring 8.3 inches, during summer 11.4 inches, and during autumn 7.4 inches. The small winter precipitation in Wisconsin, mostly in the form of snow, on the other hand, causes virtually no leaching of fertility from the soil or erosion.

Based upon the factors of latitude, altitude, and lake influence, chiefly affecting temperature and the length of growing season, Wisconsin may be divided into eight climatic provinces. The area surveyed lies within two of these, known as the Superior Shore and the Northern Highland. By far the greater proportion of the region surveyed is included in the Northern Highland. This province covers most of the northern part of the state north of Marathon County,

*For further information on the climate of the State see Bul. 223 on the Climate of Wisconsin and Its Relation to Agriculture, from which this data has largely been taken.

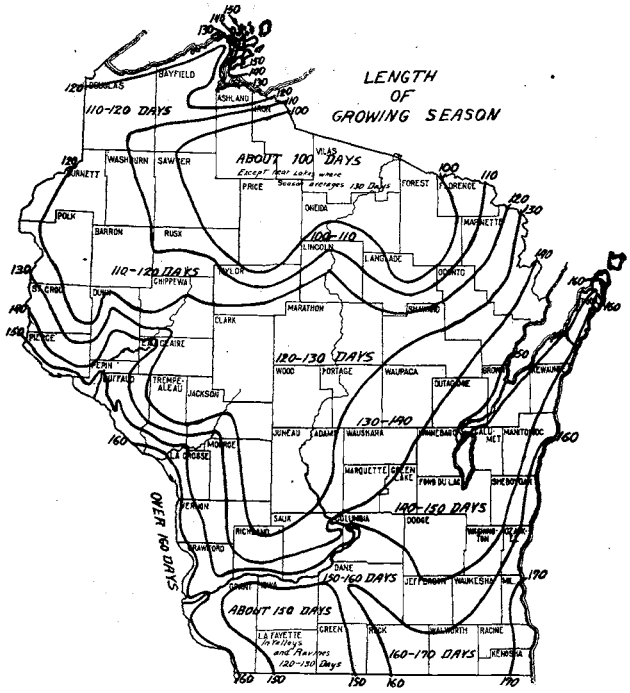


Fig. 2. Map showing length of growing season for corn.

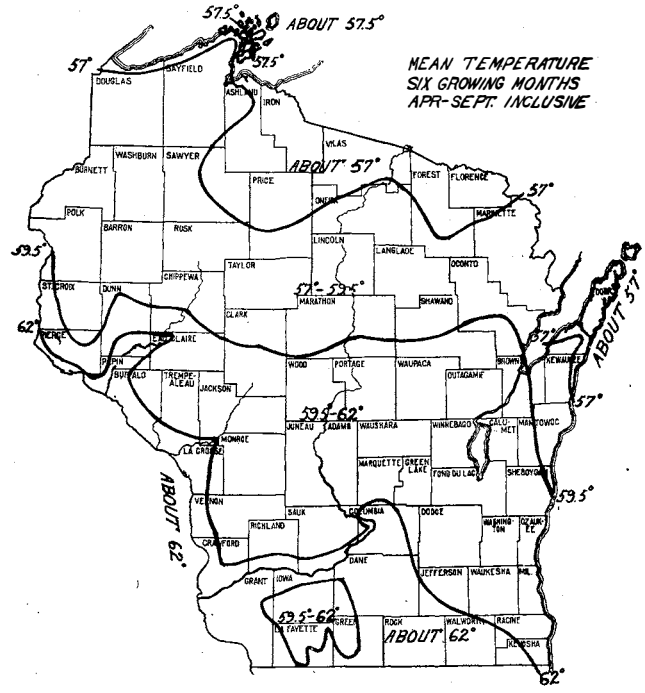


Fig. 3. Map showing average temperature for the six growing months April to September, inclusive. Note that the difference between the average temperature for the areas surveyed, and the southern portion of the State is only slight, varying from 2.5 to 5 degrees.

including the head waters of the Wolf, the Wisconsin, and the Chippewa Rivers, together with smaller streams flowing into Lake Superior and Lake Michigan. This region is characterized by a short growing season, cold winters, warm summer days, and cool summer nights.

The northeastern portion is cooler than the southern and western, the growing season averaging about 100 days in Vilas County. as compared with 130 days in Marathon and 120 days in Burnett County. Near the small lakes which abound in this portion of the state the growing season is lengthened several days. Away from these lakes, in these northern counties, light frosts are likely to occur upon low land in any month of the year.

The area surveyed borders Lake Superior for a distance of less than 10 miles, so that but a small proportion of this region falls within the Superior Shore Province. The climatic conditions, however, are noticeably different from those prevailing throughout the Northern Highland region. The Superior Shore consists of a narrow belt adjoining Lake Superior of unknown width, though it is unlikely that the lake influence extends farther inland than twenty-five miles and apparently, as a factor of horticultural value, this distance is considerably less. There also appear to be great variations within this belt.

Generally, on about four winter mornings, the temperature drops to 20° below zero or lower; while on an average of five days in summer it reaches 90° or more. The average length of the growing season varies. Immediately along the shore it is about 130 days, diminishing to about 115 days 10 miles inland.

FROST DATA

The following table gives average dates of killing frosts and approximate length of the growing season at various stations within and adjacent to the area surveyed.

Station	Length of Record Years	Average date of last killing frost in spring	Average date of first killing frost in fall	Approximate length of growing season Days
Ashland	16	May 14	Sept. 21	130
Butternut, Ashland County	15	June 4	Sept. 9	97
Prentice, Price County	17	June 6	Sept. 9	99
Koepenick, Langlade County	18	June 3	Sept. 17	106

There are a number of other stations throughout the survey, but weather records have been kept for only a short period of years. From the records available at several of these points the length of growing season appears to be approximately 122 days at Rhinelander, 114 days at Minoqua, 107 days at Big St. Germain Dam, and 95 days at Vudesare. Light summer frosts may occur any month during the summer throughout this portion of Wisconsin, especially on low land.

In general it may be said that the climatic conditions prevailing throughout this region are such as to encourage agricultural development. While corn does not mature every year, early varieties can be counted on for good silage. Grasses and clover make an excellent growth, and small grains and potatoes are profitable crops. Dairying and the raising of livestock are industries well adapted to northern Wisconsin. The climate is healthful, and while the winters are long and severe, the summers are especially delightful. The water supply is abundant and of very good quality. On account of the many beautiful lakes in this portion of the state, a large number of people are attracted to this region each year to spend the summer months.

SUMMARY

The area covered by the reconnoissance soil survey of north central Wisconsin includes Vilas, Oneida, Iron, Pierce and parts of Ashland and Rusk Counties. It comprises a total area of approximately 4230 square miles. The surface features are characteristic of a glacial region and the topography varies from level to rolling and hilly. The Penokee Iron Range which crosses the northern part of Iron County is the most conspicuous topographic feature in the area. The highest point on the range has an elevation above sea level of about 1800 feet while Lake Superior, which borders Iron County on the north, has an elevation of 602 feet. Streams within the area afford an excellent opportunity for water power development. The first settlement in the area was made about 1860. The first railroad entered the region in 1877. At present four extensive railway systems traverse the area and provide adequate transportation facilities. The population of the area surveyed was approximately 32,150 in 1910, or about 8 per square mile.

In the area covered by this survey 28 different types of soil were found and mapped. These range in texture from sands of low agricultural value to loams and silt loams of excellent agricultural value. A large proportion of this region is still undeveloped and tracts of considerable extent are still in virgin forest. The greater part of the land is fair to excellent in quality and susceptible of the highest agricultural development. This section is especially well adapted to general farming, dairying and stock raising, and it is along these lines that rapid development is being made.

This region is characterized by a rather short growing season, cold winters, warm summers, and cool summer-nights. Corn does not always mature, but silage of good quality can always be secured. Grasses, clover and small grains do especially well. An abundant supply of water of excellent quality is readily available in all parts of the area, and this region is one noted for its healthfulness.

KEEP THE MAP

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