WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

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

OF

SOUTH PART

OF

NORTH CENTRAL WISCONSIN

BY

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OF THE

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY

AND

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U. S. DEPARTMENT OF AGRICULTURE

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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 has been made of this area, and the new report and map covering Clark, Taylor, Lincoln, and Marathon Counties are included under this cover. This area is now known as the South Part of North Central Wisconsin.

Wood and Portage Counties have been surveyed in detail and separate reports and maps are now available for 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.

The fifth area, called the North Part of North Central Wisconsin, includes Iron, Vilas, Price, and Oneida Counties and the eastern portions of Ashland and Rusk Counties. Reports on this area are now available.

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 SOUTH PART OF NORTH CENTRAL WISCONSIN

CHAPTER I

GENERAL DESCRIPTION AND HISTORY OF THE AREA

Location and Boundaries—The area included in the survey of the South Part of North Central Wisconsin is located a little to the north of the center of the state. It is made up of four

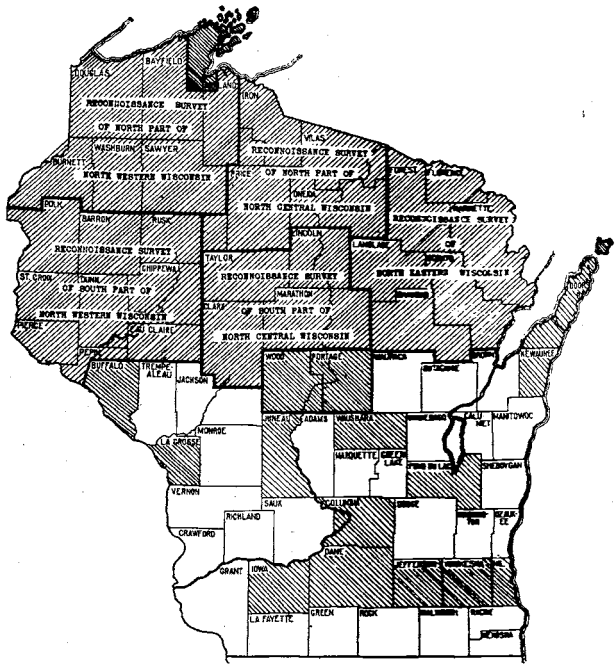

Fig. 1.—Sketch Map Showing Area Surveyed.

counties, Lincoln, Marathon, Taylor and Clark, and comprises an area of about 4,865 square miles or approximately 3,113,600 acres.

Topographic Features.—Within the region covered by this report there are two distinct types of topography. The portion of the area covered by the late Wisconsin Ice Sheet and occupying most of Taylor, Lincoln, and the eastern portion of Marathon Counties is characteristic of a glacial region. The surface varies from level to rolling and hilly, and there are numerous marshes, lakes and kettle holes. The most prominent feature of this Late Wisconsin Drift region is the broad and very broken belt of terminal moraine which extends across Taylor, Lincoln and eastern Marathon counties.

The portion of the area lying south of the terminal moraine may be divided into two sections—first that which is spoken of as the unglaciated region in central Marathon County, and second that which lies to the west in western Marathon and most of Clark Counties. Throughout this unglaciated region and also throughout the region of old glaciation to the west the surface consists chiefly of a broadly rolling country where the hill tops are rounded and the slopes are rather gentle. There are but few lakes and swamps.

Other conspicuous features of the topography are Rib Hill which is located about two miles to the southwest of Wausau, and the terrace formation along the Wisconsin River and its tributaries.

Rib Hill, about two miles to the southwest of Wausau is reputed to be the highest point in the state and has an elevation above sea level of 1940 feet. The water in the Black River below Dells Dam at a point three miles north of the south line of Clark County has an elevation of 784 feet, and this is about the lowest point in the county. It will thus be seen that there is an extreme difference of about 1000 feet in the elevation of the varions portions of the survey, though the major portion of the region will range from 1000 to 1600 feet above sea level.

Water Power.—Practically all of the streams in the area are swift flowing, and immense amounts of water power are available. Extensive water power developments have been made at Tomahawk, Merrill, Wausau, Schofield, Mosinee, and at several other points, but only a comparatively small proportion of the available water power has been developed. The elevation of the water in the Wisconsin River above the Tomahawk dam is 1,431 feet. The elevation near Dancy where the Little Eau Plaine joins the Wisconsin is 1,089 feet, so it is seen that between these

two points there is a fall of 342 feet in the Wisconsin River. The fall in the other rivers of the area is at about the same rate.

Settlement and Early History.—The first line of activity developed in the region covered by the present survey was by the American Fur Company which had a number of agents scattered through this section. Settlers who came into the region with the idea of locating did not appear until about 1840. During this year there was a small mill established at Big Bull Falls on the Wisconsin River. The first industry was, of course, the cutting of the pine timber, and for many years, lumbering was the most important industry followed.

In the early development of this region practically all the transportation was by boat on the Wisconsin and other large rivers. The first railroad was the Wisconsin Central which was completed through the area in 1873. In 1874 what is now the Chicago, Milwaukee & St. Paul was built to Wausau and extended to Merrill in 1881.

In 1855 the German immigrants started to come into the region, and agricultural development may be said to date from about this time, although the land actually placed under cultivation at that early date was very small. At present a large proportion of the population is German or of German descent, though most of these are probably American born. Quite extensive settlements of Scandinavians were also made at an early date, and of later years numerous Poles, Finlanders and other foreigners have taken up land in these counties. A considerable proportion of the inhabitants have also come from the southern counties and from other states.

Marathon and Clark counties were the first to be settled, and now a large part of the best land in these counties is improved and highly developed. In Lincoln and Taylor Counties there are still extensive areas of unimproved land, most of it being cut over, still there are large tracts of virgin forest in some sections. In these two counties the population is rather unevenly distributed, there being some townships in which practically no roads or settlers are found. The census of 1910 gave Marathon County a population of 55,054, Clark County 30,074, Lincoln County 19,064, and Taylor County 13,671, giving a total population of 117,833.

Chief Towns—Wausau, the largest city and the county seat of Marathon county has a population of 16,560. Merrill, the

next city in size is the county seat of Lincoln County and has a population of 8,689. Medford, the county seat of Taylor County, has a population of 2,050, and Neillsville, the county seat of Clark County has a population of 1,957. Tomahawk in the northern part of Lincoln County has a ppoulation of 2,626. In 1910 there were only three cities in the area having a population of over 2,500, so that it is seen that by far the greater proportion of the population is rural, although there are very many small towns with populations of from 300 to 1,200.

Transportation Facilities.—Nearly all portions of the area surveyed are well supplied with railroad facilities. Lines belonging to three of the largest railway companies in the state traverse the area. These are the Chicago, Milwaukee & St. Paul, the Minneapolis, St. Paul & Saulte Ste. Marie, and the Chicago and Northwestern.

Markets.—The cities and logging camps within the area surveyed afford a market for a considerable portion of farm produce. A larger proportion, however, is shipped to outside points. Dairy products probably make up the largest proportion of the output of the farms, and butter and cheese are shipped to markets in various parts of the country, much of it, however, passing through Chicago firms. Quantities of hay are shipped to Milwaukee and other points, and the shipping facilities are such that excellent markets are within easy access of all portions of the region covered by this survey.

Public roads and Schools.—The wagon roads throughout the settled portions of the area are usually in fair condition. Many of the main roads have been improved under the new state highway improvement law, and these are all in excellent condition, having been crowned with gravel or crushed rock. Where the country is nearly level and the drainage somewhat poor, the side roads are sometimes in rather poor condition, and in the spring when the frost is coming out of the ground they are at times nearly impassable. When the roads have dried, they are in very good condition.

The rural school buildings throughout the area will average somewhat better than through the southern part of the state. In some sections several districts have been combined and the children are all carried to and from school in a public conveyance. Rural free delivery routes reach nearly all of the people. The rural telephone is in common use and many of the farms are furnished with this convenience.

ORIGIN AND GENERAL NATURE OF SOILS †

Most of this region, in common with all of northern and eastern Wisconsin, owes the general character of its surface to glacial action. Two very distinct periods of glaciation occur. The older drift*, which was probably deposited by three separate ice sheets, is confined largely to Clark and Marathon Counties. One of the most important characteristics of this old drift formation is the compact character of the subsoil, and the comparatively level or gently rolling nature of the surface.

In the central portion of Marathon County there is a considerable area which is usually spoken of as an unglaciated region and in which the soils are largely of residual origin. Over this section, however, it is not uncommon to find a few glacial boulders and other evidences which indicate that this region was influenced to a very slight extent by glacial action. Throughout this region as well as throughout the region of the old drift sheets there are but few marshes and lakes, the topography is level to gently rolling, and in places the natural drainage is deficient.

The material which was deposited by the Late Wisconsin Ice Sheet occupies the greater portion of Taylor, Lincoln, and † eastern and southeastern portions of Marathon Counties. For the most part the topography throughout this region is more or less rolling and hilly and much more irregular than in the region of the older glacial drift. Lakes, swamps, kettle holes, and sharp ridges are common, and the stream channels have not been as well established as in the older sections. The soils are of a much more variable character than is the case of the old drift regions, and stones and bowlders are much more plentiful.

The glacial drift has been derived largely from the underlying geological formations of which several are represented. Throughout Lincoln, Taylor and most of Marathon and along the eastern and northern sides of Clark County, crystalline rocks, chiefly granites and dark colored rocks make up the underlying formation, so that most of the soils of the area have been derived largely

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† As this report is intended chiefly for agricultural readers no attempt is made except in a very general way to discuss the Geology of the region.

* See Weidman —"Geology of North Central Wisconsin."

from granitic rocks. On Rib Hill and on Mosinee Hill quartzite is the surface rock. Throughout the greater part of Clark County and over isolated areas in Marathon and Taylor Counties, Potsdam sandstone forms the surface rock. Over most of Clark County, however, this formation has been covered by early glacial material from the north and so has not contributed very extensively to the soil formation in such places. The sandy soils in southern and western Clark County have been derived largely from this Potsdam sandstone.

In the survey of this area the soils have been classified into twelve series and thirty soil types, all of which have certain characteristics by which they can be readily recognized.

The Colby series is the most extensive and includes light colored upland timbered soils in the glaciated region where the underlying material is extremely compact and usually heavy. The subsoil and sometimes the surface soil is mottled to a marked degree. Due to the rather level surface and the heavy character of the subsoil the natural drainage is often deficient, and the internal drainage is nearly always deficient. Only one type, the Colby silt, loam was mapped.

The Kennan series includes light colored upland soils in the glaciated region where the material has been derived largely from the underlying crystalline rocks. The surface soil is predominatingly heavy and the subsoil is quite gravelly and porous. The types mapped belonging to this series are the silt loam, loam and fine sandy loam.

The Vilas series embraces all glacial soils which have been derived largely from crystalline rocks and which are lighter in texture than a fine sandy loam. Four types, the sandy loam, fine sand, sand and gravelly sand were mapped.

The Marathon series includes light colored upland timbered soils in the crystalline rock region where the material, especially the subsoil, is largely of residual origin. The silt loam, gravelly silt loam, fine sandy loam and sandy loam were mapped as belonging to this series.

The Antigo series includes light colored timbered soils of alluvial origin where the material has been deposited in the form of outwash plains, stream terraces, or filled in valleys. The upland material has come from the crystalline rock formation and in some instances there has been incorporated with this a small

amount of material from sandstone rocks. Only two types of this series, the silt loam and fine sandy loam were recognized.

The Plainfield series includes light colored soils of alluvial origin which have been deposited as outwash plains, stream terraces, or filled in valleys. The upland matrial has come entirely or nearly so from sandstone, and in this respect differs from the Antigo series. The types of this series are sandy loam, fine sand, sand and gravelly sand.

The Knox series which is of very small extent consists of light colored upland soils in the unglaciated region where the soil has been derived largely from loessial material. Only one type, the silt loam, was mapped.

The Vesper series consists of light colored material where the subsoils have been derived largely from the weathering of sandstone, while the surface material consists chiefly of a loess-like deposit which is very high in silt and clay. The characteristic feature of this series is that the surface soils are heavy, while the underlying material is sand or sandstone rock. Only one type, the silt loam was recognized.

The Boone series consists of light colored unpland timbered soils in the unglaciated region where the material has been derived largely from the wearthing of the Potsdam sandstone. The fine sand only was mapped.

The Auburn series includes light colored upland soils where the material composing the subsoil is largely residual from sandstone, and in places from shale associated with the sandstone. The soil is in part loessial and in part from Pre-Wisconsin glacial material. These materials have become intermixed in places so that a considerable range in texture is found. Auburn loam and fine sandy loam were mapped in this survey.

The Whitman series consists of dark brown to black low-lying material which has been derived largely from crystalline rocks. In physiographic position it is comparable to the Clyde soils and may be largely alluvial or it may occur as poorly drained depressions or old lake beds. The silt loam was the only type mapped in this series.

The Genesee series consists of light colored timbered soils of alluvial origin largely within the glaciated region. It is seldom that material lighter in texture than a fine sandy loam occurs in this series, however, a small area of sand was mapped.

The Dunning series consists of dark colored low-lying light

textured soils in non-calcareous regions. In most cases the material has been derived from the underlying sandstone. In the surface there is usually an accumulation of varying amounts of organic matter which gives the dark color. Its position is comparable to that of the Clyde, but it differs in that both soil and subsoil show varying degrees of acidity. The fine sand is the only type mapped of this series.

The peat mapped in this area consists of decaying vegetable matter in varying stages of decomposition. A large proportion of it is of a brownish color and quite raw and fibrous.

The following table gives the name and actual and relative extent of each soil type mapped.

Area of Different Soils.

Soil	Acres	Per cent
Colby silt loam	556,928	44.8
Rolling phase	779,968	
Kennan silt loam	169,856	8.1
Rolling phase	68,992	
Kennan fine sandy loam, rolling phase	264,512	8.8
Marathon silt loam	188,160	6.2
Peat	142,848	5.4
Shallow phase	17,216	
Auburn fine sandy loam	71,040	2.4
Whitman silt loam	96,256	3.2
Auburn loam	76,608	2.6
Marathon fine sandy loam	70,656	2.4
Vesper fine sandy loam	68,544	2.3
Vilas fine sand	54,080	1.8
Boone fine sand	46,208	1.5
Plainfield sand	44,928	1.5
Antigo silt loam	36,160	1.2
Genesee silt loam	35,008	1.2
Plainfield gravelly sand	30,208	1.0
Vilas gravelly sandy loam	22,656	.7
Plainfield fine sand	22,464	.7
Colby loam	20,416	.7
Dunning fine sand	18,944	.6
Antigo fine sandy loam	18,880	.6
Vilas sandy loam	5,824	.2
Vesper silt loam	14,336	.5
Marathon sandy loam	12,800	.4
Plainfield sandy loam	10,752	.4
Marathon gravelly silt loam	5,632	.2
Genesee sand	6,208	.2
Knox silt loam	4,864	.2
Rough stony land	2,240	.1
Vilas sand	1,408	.1
Total	2,985,600	

SOIL CLASSIFICATION

Many of the most important qualities of the soil depend on the relative amounts of different sized grains present in the soil. 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
Medium sand soil ..	3	14	20	38	12	8	5
Fine sand soil	0	2	14	49	20	11	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 the 30 types of soil are classified into five groups—(1) a group of heavy soils, (2) a group of merium 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

Colby Silt Loam

Extent and distribution. The Colby silt loam, including the rolling phase, is the most extensive type of soil within the region surveyed, covering a total area of more than 2000 square miles. It is found in all four of the counties, but is most extensively developed in Marathon and Clark Counties. It is found in all portions of Clark County except along the western and southern borders. In Marathon County its greatest extent is in the western and northern portions of the county. In Taylor County it occurs in the western and northwestern parts and also in the southern and southeastern sections, especially in the vicinity of Medford. In Lincoln County it is confined chiefly to the western and southwestern parts. Throughout its entire extent it is closely associated with the rolling phase and the line between the typical soil and this phase is an arbitrary one and often difficult to establish because of the gradual change from one class of topography to the other.

Description. The surface soil of the Colby silt loam to an average depth of about 10 inches consists of a heavy gray or grayish brown silt loam which has a very smooth velvety feel due to the presence of a very large amount of silt. When this soil is dry it has a gray ashen appearance. In some cases the surface has a larger accumulation of organic matter than typical and in such places the soil is brown or dark brown in color. In some instances the lower portion of the soil section is slightly mottled.

The subsoil of this type consists of a heavy silt loam of a grayish or yellowish color which gradually becomes heavier with depth, grading into a silty clay loam or clay loam at about 14 or 16 inches below the surface. This heavy material which is extremely compact extends to a depth of about 30 or 36 inches where it is common to find varying amounts of fine and medium

sand and sometimes angular or rounded gravel mixed with the material. This gritty clay loam, as it may be called, frequently extends to great depth, though the underlying rock may be found at a depth of 4 feet or more. The most characteristic feature of the subsoil is the fact that it is strongly mottled. Colorings of yellow, blue, gray, red, and rusty brown are very common. In a number of instances the deep subsoil was found to consist of a red clay, and a reddish cast is frequently found to prevail through a large portion of the soil section. The structure of the subsoil of this type is rather peculiar. The proportions of silt and clay to the amounts of coarses material are such that it is very impervious to the passage of water and when dry it appears to be sufficiently elastic so that it does not crack as is the case with many heavy clay soils. This peculiarity makes the type more difficult to handle than many soils having as much or more silty and clay material present.

As a type the texture, structure, and color of the soil are remarkably uniform. There are a few variations, however, chiefly in regard to its depth, which are worthy of note. In a few instances it was found that sandstone rock was encountered in the subsoil at a depth of from 18 inches to 3 feet. In some sections this sandstone had weathered into a sand and in some cuts it was noticed that this material outcropped. Wherever this condition was found to prevail over tracts sufficiently large to map, the material was classed as Vesper silt loam. There are a number of instances, however, where the areas were of very small extent and could not be indicated on a general soil map. Some stones may be found upon the surface but never in such numbers as on the Kennan silt loam. Large tracts are free from stones or nearly so.

In Marathon County to the east and northeast of Wausau and immediately south of Glandon there is considerable land mapped as Colby silt loam but which differs from that in being within the unglaciated region, the subsoil is largely residual, and stones are very scarce. The subsoil, however, is mottled and impervious making the drainage conditions similar to those of the Colby silt loam.

Topography and drainage. The surface of the Colby silt loam is level or very gently undulating and because of the surface features and the extremely heavy character of the soil and subsoil the natural surface and under drainage are both quite deficient.

Wherever the slope was sufficient so that the surface drainage conditions were considered fair to good the type was classed with the rolling phase. Over some of the lower places where the surface is level over large tracts a semi-marshy condition prevails where the land has not been cleared and placed under cultivation. In spring and early summer a few inches of water sometimes stands in such places for a considerable period of time. In a few instances a sufficient amount of organic matter has accumulated to give the soil a rather dark color and where this condition is the most pronounced the material has been mapped with the Whitman series. When these flat semi-marsh tracts are cleared and placed under cultivation the drainage conditions improve to a marked degree even without the installation of extensive drainage systems. The type as a whole, however, is cold and backward in the spring and the planting of crops is frequently delayed because of the soggy condition of the land.

Origin. The material forming the Colby silt loam is derived from at least two sources and probably three. The greater part of the type lies within the section which was traversed by the Pre-Wisconsn ice sheets and some of the material was brought to its present position through the action of one or more glaciers. The underlying rock throughout this region consists of crystalline material—largely granite, and it is from this source that most of the material came. The extremely silty surface appears to be partly of loessial origin and forms an extensive blanket over a large amount of north central Wisconsin. In a number of cases the deep subsoil appears to be partly residual, having been derived directly through the weathering of the underlying rock. The portions of the type which occur in northern Taylor and northwestern Lincoln Counties lie within the belt of country traversed by the Late Wisconsin Ice Sheet and may have been influenced to a limited extent by this last period of glaciation, though it seems probable that most of the material of glacial origin was deposited by earlier ice sheets. There is no limestone rock in the region covered by the present survey and varying degrees of acidity have developed in both soil and subsoil; in many cases an extremely acid condition prevails, while in other cases the acidity is only slight.

Native vegetation. The original timber growth on the Colby silt loam consisted chiefly of hardwood, white pine and hemlock. Of the hardwoods maple, birch, basswood, elm, and ash, and

VIEW OF THE ROLLING PHASE OF COLBY SILT LOAM

The Colby silt loam soils occupy over a million and a quarter acres or 44.8 per cent of the four counties included in this report. The dairy industry is highly developed, and a large number of highly improved, prosperous farms are found upon this soil. There are also considerable areas which are still unimproved.

sometimes oak, were found—the ash and elm being confined to the sections which were most poorly drained. Scattered throughout the hardwood white and Norway pine were found. In a number of instances large tracts were found over which the predominant growth was pine. In other sections the hardwood was most plentiful and the pine was almost entirely lacking. All of the pine has been removed, but large tracts of hardwood and hemlock still remain. Over the cut-over land which has not been improved there is often a rather dense second growth of popple and birch.

Present agricultural development. While a considerable amount of the Colby silt loam is now under cultivation, there are also extensive areas which have not been cleared. The type is naturally a productive soil and its virgin fertility may be considered fair to good. The greatest difficulty in its development is the question of drainage and the poor drainage conditions which prevail have retarded the development of this class of land. The chief type of agriculture which is followed consists of general farming and dairying to which the land is well adapted. This soil is especially well adapted to grasses, and it always supplies excellent grazing. Because of the fertile condition of the virgin soil clover usually does very well on new land in spite of the fact that the soil is usually strongly acid. After the land has been cultivated for a number of years and some of this fertility removed there seems to be more difficulty in growing clover successfully. Timothy and alsike clover grow very well, but alfalfa cannot be grown successfully without the use of some form of lime. Small grains such as oats and barley give very satisfactory yields when fair drainage is supplied. Corn is grown, and with drainage fair yields are secured. The crop can usually be matured, though it may sometimes be damaged by early fall frosts. It can always be matured sufficiently for silage. In the improvement of this soil there are two points which should be given careful consideration. The first is that of thorough drainage and the second is that of thorough cultivation. The surface drainage may be greatly improved by plowing fields in narrow strips having dead furrows at intervals of every 2 or 3 rods and running with the slope. These may connect along the margins of the field with open ditches which will supply an outlet. This type of drainage is often sufficient so that all kinds of crops common to the region can be successfully grown and while the

land is new and the amount of capital available somewhat limited, this may be considered as probably the best system to install.

Tile drainage on this soil is less effective than on most other heavy soils of the state, because of the heavy impervious nature of the subsoil. In most cases it is necessary that tile should be placed from 3 to 4 rods apart, which makes the tiling of this soil expensive. However, experiments have shown that for certain crops such as potatoes and corn, this expense for thorough tile drainage is a good profitable investment, so that farmers having this class of land could well afford to plan on draining a portion of their farm, leaving the remainder for those crops which do not require such thorough drainage.

Cultivation of this soil is not difficult and as soon as moisture conditions permit getting on the land a good mellow seed bed can be secured readily.

A rotation of crops which appears to be well suited to this land consists of small grains with which clover and timothy may be seeded and hay cut for two years after which the land may be plowed for corn to be followed again by small grain crops.

Most of the general farm crops, with the exception of clover and alfalfa, make good growths on this acid soil and such legumes as soybeans and serradella can be grown successfully under acid conditions so that it is possible to carry on a system of farming without the use of lime.

However, as this soil is kept under continual cultivation and the fertility is somewhat reduced, the need for the use of lime will gradually become apparent, so that ultimately it will be found profitable for farmers on this soil to lime the greater part of their land for the growth of the general farm crops, as well as for the best growth of clover and alfalfa.*

Colby Silt Loam—Rolling Phase

Extent and distribution. The rolling phase of the Colby silt loam is very closely associated with the typical soil and is confined to approximately the same portions of the area. The largest tracts occur in western and northern Marathon County,

*For a discussion of the chemical composition and improvement of this soil see page 40.

southern and western Lincoln County, throughout Clark County with the exception of the western and southwestern portions, and throughout the eastern and southeastern portions of Taylor County. There are also a few small areas in the northwestern portion of Taylor County in the vicinity of Jump River. This phase differs from the level Colby soil chiefly in topography and as the change from one to the other is often very gradual the line separating them is usually an arbitrary one. Small tracts of the level soil are often included with the rolling phase and the converse is also true in many cases.

Description. The rolling phase of the Colby silt loam to an average depth of 8 or 10 inches consists of a heavy gray or grayish brown silt loam which has an extremely smooth feel. The content of silt is extremely high, but the amount of organic matter present is rather low. When the soil is dry it has a gray ashen appearance, but this color gradually becomes darker with an increased moisture content. Where there are accumulations of organic matter, which is frequently the case in low-lying places, the color is frequently a dark brown. The subsoil of this phase consists of a heavy silt loam of a grayish or yellowish color which grades into a silty clay loam or clay loam at about 14 inches. This heavy compact material extends to a depth of about 30 inches where it is common to find incorporated with it varying amounts of medium sand and fine angular or rounded gravel which gives it a gritty feel. This gritty material usually extends to a great depth, though in a few cases the underlying rock was found within 4 or 5 feet of the surface. Both soil and subsoil of this phase are extremely uniform and in texture, color, and structure the phase is very similar to the typical soil. It differs somewhat in that the lower portion of the subsoil is seldom mottled and the upper portion of the subsoil is not as strongly mottled as the typical soil, but in the lower depth the mottling is practically the same and is usually quite pronounced. As in the typical soil a heavy red clay is sometimes found in the lower subsoil and a reddish cast frequently prevails throughout the subsoil section. The peculiar structure which is characteristic of the level Colby soil is also characteristic of this phase, but it is not so objectionable in this case because of the more uneven character of the surface.

In a very few instances it was found that small areas of this

phase were underlain by Potsdam sandstone which sometimes came within reach of the auger and in road cuts fragments of sandstone rock were sometimes seen; such areas, however, were of limited extent and seldom of sufficient size to be indicated. The underlying formation throughout this region is almost entirely of crystalline rocks.

Some stones and a few boulders are frequently found scattered over the surface of this phase, though they are seldom present in sufficient amounts to interfere with the cultivation of the soil. These stones are usually rounded, indicating glacial origin, though along the border of the phase adjacent to the soils of the Marathon series there are frequently some angular pieces of rock found upon the surface. In no place over this soil are the stones as plentiful as on the soils of the Kennan series. Many extensive tracts are practically stone-free.

Topography and drainage. The surface of the rolling phase of the Colby silt loam varies from very gently rolling to rolling. The type always has a more pronounced slope than the level phase and was separated on this basis. There is always sufficient slope so that surface water will be readily carried off. Because of this difference the phase has a somewhat higher agricultural value. In spite of the fact that the surface drainage of this phase is fair to good, the heavy character of the subsoil makes the movement of water through the soil very sluggish so that in low places between slopes and even on some of the slopes themselves the installation of tile drains will doubtless be found profitable.

Origin. The material forming the rolling phase of the Colby silt loam has practically the same origin as the level soil, having been derived in part through glacial action and in part from the deposition of loess-like material. The deep subsoil may also be in part residual, having been derived in part from the underlying crystalline rocks. As there is no limestone in this section an acid condition has developed in both soil and subsoil and this is frequently very marked.

Native vegetation. The original timber growth on the phase is very similar to that found on the typical soil, except that there is a smaller amount of elm and ash, since these trees are found more extensively on the poorly drained land. Maple and birch formed the greater part of the original growth, but there

was also considerable hemlock and over some tracts white pine was the predominant growth. Over the northermost portion of the type there is still a heavy forest growth. Where the land has been cut over and not improved or grazed there is often a second growth of popple and birch springing up.

Present agricultural value. A larger proportion of the phase is under cultivation and more highly improved than is the case with the level soil. This is probably due to the fact that it has better drainage, it can be worked earlier in the spring, and better yields can usually be secured. This is a very good general farming soil and the dairy industry is highly developed upon it. It is naturally a productive soil and its virgin fertility may be considered good. It is especially well adapted to grasses, and clover makes an excellent growth on new land even though the soil is acid. After fields have been cultivated for a number of years the clover does not make quite as good a growth as at first, so that liming may ultimately be necessary.

The chief crops grown consist of timothy and clover, oats, barley, a small amount of wheat, corn, and potatoes. The small grains do very well on this soil, and corn also makes a very satisfactory growth, though there is some danger of early fall frosts.*

KENNAN SILT LOAM

Extent and distribution. The Kennan silt loam is one of the important soil types of the region surveyed, from the standpoint of its agricultural possibilities, though in area it is not as extensive as several other types of soil. The most extensive tracts of the typical soil occur in eastern Marathon County, and western, central, and southeastern Lincoln County, smaller tracts are also found in various parts of Taylor County, and in the extreme northwestern corner of Clark County.†

Description.—The surface soil of the Kennan silt loam to an average depth of 10 inches consists of a brown or grayish-brown friable silt loam in the surface few inches of which there is sufficient organic matter to impart a dark brown color to the virgin

*For a discussion of the chemical composition and improvement of this soil see page 40.

† The area of Marathon silt loam along Pine river due east from Merrill should have been included with the Kennan silt loam.

soil. The subsoil consists of a yellow or light yellowish-brown silt loam which usually becomes somewhat heavier with depth until a depth of from 20 to 30 inches is reached where a lighter textured material is encountered. This may consist of a fine sandy loam, sandy loam, or a sandy clay loam, with which there is usually varying amounts of small gravel stones. The line between the silty covering and the coarser textured subsoil is usually quite sharp, and in cuts the abrupt change can be readily seen. The surface material is comparatively free from gravel, while in the deep subsoil it is quite plentiful. Bowlders occur upon the surface in a rather irregular manner, there being numerous areas which are stone free. It is seldom that stones and bowlders are ever sufficiently numerous over any extensive tract to retard or discourage agricultural development.

Some variations occur in this type, chiefly in the depth of the silty covering over the coarser textured material. In a few instances the underlying sandy material outcrops or comes to within several inches of the surface, while in other sections the silty covering extends to a depth of over 3 feet. Small areas of fine sandy loam were sometimes included with this soil, but because of the small extent of all of these variations they could not be indicated separately on a general soil map.

This soil works up readily when placed under cultivation and no difficulty is experienced in securing a good seed bed.

Topography and drainage.—The surface of this type ranges from undulating to gently rolling. In some portions of Lincoln County some tracts which were rolling were included with the type. Because of the usual surface features and the underlying coarse material the natural surface and under drainage are good. Peat marshes are quite commonly found associated with this soil along the borders of some of these where the surface is nearly level, and low, the natural drainage is sometimes deficient, but such conditions cover comparatively small areas.

Origin.—The material forming the Kennan silt loam appears to have been derived from two distinct sources. The underlying material has doubtless come from the underlying crystalline rocks through the action of glacial ice, in some places the subsoil appears to be residual from the underlying rocks. The surface silty covering appears to be in part at least of loesial origin, forming a part of an extensive silty loess-like blanket which covers very extensive areas in northcentral Wisconsin.

There is no limestone present in this region, and an acid condition has developed in both soil and subsoil.

Native vegetation.—The native timber growth on this soil consisted of maple, birch, hemlock, with smaller amounts of basswood, oak and a little elm. Mixed with the hardwood there are also varying amounts of white and some Norway pine. All of the pine has been cut but there is still considerable hardwood and hemlock standing. Where the land has been cut over the present growth consists chiefly of popple and birch brush.

Present agricultural development.—Only a comparatively small percentage of this type is cleared and under cultivation, but with its rolling phase, it gives promise of becoming one of the most highly improved soils in the area. Much of this land is still owned in large tracts by lumbering companies and individuals, and its development along the line of agriculture is thus somewhat retarded. Regions where development has taken place on this soil are found north of Hatley, and to the north and south of Norrie in eastern Marathon County, east of Merrill and in the vicinity of Irma in Lincoln County. In Taylor County there is a considerable settlement on the rolling phase in the vicinity of Lublin.

The chief crops grown are hay, oats, potatoes, corn, and various root crops. Potatoes do very well and seem to be especially suited to the soil and climate. Yields range from 150 to 200 bushels per acre, and often higher. Oats yield about 50 bushels and hay from 2 to 3 tons per acre. Clover and all kinds of grasses suited to the climate do remarkably well, and along old tote roads, and about all the old lumber camps there is always a rank growth of clover and grasses. Peas are grown to some extent and give good yields. Barley, wheat and sugar beets thrive but are not grown to any extent in this new country. Corn will mature about 3 or 4 years out of 5. Corn for silage can always be counted on. The type is well adapted to general farming and dairying and it is along these lines that development is being made.

Because of the fact that agricultural development on this soil is comparatively new no very definite system of crop rotations has been worked out. The virgin soil is strong and productive and the question of maintaining its fertility has not received serious consideration. The greatest problem is getting the land

cleared and ready for the plow. The cost of removing the stones is sometimes equal to the cost of removing the stumps, though it is not necessary that either should be removed from any large proportion of a farm at first. Usually a tract sufficiently extensive for growing the desired cultivated crops is carefully cleared as rapidly as possible and the remainder brushed and gradually seeded. Excellent grazing is thus afforded and after a few years the hardwood and hemlock stumps will be sufficiently decayed to be taken out readily. As long as the land is used for grazing the stones which may be present are no serious handicap. Probably as much as 40 percent of the type is stone free, or the stones and boulders are present in the surface in such small numbers that they do not interfere with agricultural development nor detract from the agricultural value of the soil.*

Cut-over land of this type ranges in value from $12 to $25 per acre depending chiefly upon its location. Partly improved farms are valued at $35 to $50 or $60 per acre depending upon the amount of clearing, buildings, location, etc.

Kennan Silt Loam, Rolling Phase

Extent and distribution.—The rolling phase of Kennan silt loam is confined almost entirely to Taylor County, though a small amount is found in the extreme northwestern corner of Clark County. It occurs chiefly in the morainic belt which crosses Taylor County form the northeast to the southwest, and comprises a total area of approximately 95 square miles. The major portion of this type is in three separate areas—one in the extreme southwestern portion of Taylor County west of Lublin and south of Polly—one several miles to the northeast from Perkinstown, and the third in the extreme northeastern corner of the county.

Description.—The surface soil of this phase to an average depth of 8–10 inches consists of a brown or light brown, mellow silt loam which has a fair amount of organic matter in the virgin soil. The subsoil consists of a yellowish, or yellowish-brown silt loam grading into a heavy silt loam or silty clay loam, and at a depth of from 16 to 24 inches it passes into coarser textured ma-

*For a discussion of the chemical composition and improvement of this soil see page 40.

VIEW OF LEVEL COLBY SILT LOAM NEAR SPENCER

There are over half million acres of this class of land in the four counties covered by this report. It is a heavy soil adapted to grasses, small grains and hay. Dairying is the leading industry.

TYPICAL VIEW OF KENNAN SILT LOAM WEST OF MERRILL

With its rolling phase this type includes over 25,000 acres of excellent, cut-over hardwood land, only a small portion of which is improved. It is an excellent soil and has great possibilities.

terial consisting of a fine sandy loam, sandy loam, or gravelly loam. Beds of sand or fine sand may also be encountered in the subsoil in places. The phase is quite similar to the typical soil, except that the covering of silty material is thinner and more irregular in the rolling phase. On many of the hill tops, and steep slopes the underlying gravelly and sandy material outcrops over small tracts, while along the lower slopes there is sometimes a deep accumulation of silt which reaches below the depth of the auger. Stones and bowlders occur upon the surface and mixed with the soil, but their occurrence is not uniform, and there are numerous tracts which are stone free. Stones are seldom present in sufficient numbers to retard or discourage agricultural development. The chief point of difference between this phase and the typical soil is a difference in topography.

Topography and drainage.—The surface of this phase varies from rolling to rough and broken, and a considerable proportion is steep enough so that modern farm machinery could be used only with difficulty or not at all. Pot holes, in which small areas of peat may be found, and lakes and ponds are quite numerous. On some of the ridge tops there is frequently a small amount of nearly level land, while in other places the ridge top is very narrow. Because of the uneven character of the surface and the loose open structure of the deep subsoil the natural surface, and the underdrainage are excellent, and somewhat excessive. When cleared many of the steeper slopes will be subject to erosion and it will be necessary to follow special methods to prevent destructive washing of the hillside land.

Origin.—The material forming this soil has been derived largely from the glacial debris deposited as a terminal moraine by the Late Wisconsin Ice Sheet. Practically all of the gravel and much of the fine material in the subsoil has come from the underlying crystalline rock formation, having been ground up and transported short distances by action of the ice. The silty covering may be in part of loessial origin, having been brought to its present position by the action of wind. There is no limestone in the region and an acid condition has developed in both soil and subsoil.

Native vegetation.—The original timber growth as on the typical soil consists of maple, birch, hemlock, with a mixture of white and some Norway pine. Much of the land has been cut

over but there is still considerable hardwood, and hemlock timber standing.

*Present agricultural development.**—The greatest amount of development on this phase is confined to the tract west of Lublin. By far the greater proportion is unimproved. It is adapted to the same crops as the typical soil, though its cultivation is somewhat more difficult because of its rougher surface. Where cultivated the crops grown and yields are about the same, and the same methods should be used for its higher development. This class of land is well suited to the development of the sheep raising industry.

Marathon Silt Loam

Extent and distribution.—The Marathon silt loam is confined entirely to Marathon County and is one of the important soils of the region surveyed, both from its extent and from the development which has taken place upon it. It covers a total area of approximately 290 square miles and occurs in an almost continuous body, near the center of which the city of Wausau is located. East of the Wisconsin river this type extends nearly to Hogarty and is confined largely to the north of the Eau Claire river. On the west side of the Wisconsin river the type extends to a point about 6 miles west of Marathon City and south to the Little Eau Plaine river. The continuity of the type is broken by tracts of Colby silt loam, and by a few areas of Marathon gravelly silt loam, and by a few sandy soils along the streams traversing the region.†

Description.—The surface soil of this type to an average depth of 10 or 12 inches consists of a yellowish-brown, friable silt loam in the surface few inches of which there is sufficient organic matter to impart a somewhat darker color to the soil. The subsoil consists of a yellow silt loam. With increased depth the texture gradually changes to a silty clay loam which extends to an average depth of 30 or 36 inches, beneath which yellow sandy clay, clay loam or fine sandy loam may be encountered. This type of soil very seldom has the heavy compact layer in the sub-

*For a discussion of the chemical composition and improvement of this soil see page 40.

† The area of Marathon silt loam along Pine river due east from Merrill should have been included with Kennan silt loam.

soil which is characteristic of the Colby soils, the angular gravel and small amount of other rather coarse material is scattered through the subsoil making it somewhat more open and permitting a more rapid movement of water through the soil section.

In texture and general surface characteristics this type is uniform over large areas, but there is some variation in the depth of the extremely silty covering forming the surface soil. In the vicinity of Halder and for several miles in all directions the soil is not as deep as elsewhere, and in addition is underlain by a bed of angular gravel known as arkose.

Much of the type north of Marathon City, north of Wausau, and between Sunset and Glandon contains disintegrated particles of the bed rock scattered through the lower subsoil. Along ridge tops, and on some of the steep slopes the bed rock often outcrops and is frequently encountered at a depth of from 2 to 3 feet.

Along the western border of this soil type is a long strip of land varying from one to four miles in width and which is about 22 miles long. This has been included with the Marathon silt loam but differs from the typical soil in being just outside of the unglaciated area. A few rounded bowlders on the surface indicate that there has been some glacial action over it, but this was undoubtedly very slight and not sufficient to materially change the character of the soil. This strip may be considered as an intermediate soil between the Colby and Marathon silt loams, but it resembles the Marathon in its important characteristics much more than it does the Colby and is therefore mapped as Marathon silt loam.

Glacial bowlders are found to a very limited extent, though most of the type is practically free from them. In some places angular rock fragments are found upon the surface and mixed with the soil.

This type is very similar in texture and agriculture value to the Kennan silt loam. It differs somewhat from this type by having a slightly heavier subsoil. It also differs from the Kennan in the origin of the subsoil, but agriculturally this is not important.

Topography and drainage.—The surface of this type over the greater portion of its extent is rolling, with some areas which

are gently rolling. The hills and ridges are usually broad, with long slopes. While there are some slopes too steep to be readily cultivated, modern farm machinery can be readily used on nearly all of this soil. Because of the uneven topography, and the coarse material in the deep subsoil the natural surface and underdrainage are excellent. Where the beds of angular gravel occur the drainage is frequently excessive.

Origin.—The surface of this type is frequently loess-like in appearance, and may have been deposited in part by wind action. The subsoil is largely residual, having been formed by the disintegration of the underlying rocks, which are chiefly coarse grained granite. While a few glacial bowlders are sometimes found, the glacial action over this region was so slight as to have no appreciable influence on the formation of the soil.

No limestone has entered into the formation of this soil and both the soil and subsoil show varying degrees of acidity.

Native vegetation.—The original timber growth on this soil consisted chiefly of hardwood with maple as the predominant growth. Birch was quite plentiful in places and hemlock formed an important part of the growth. Some pine was found and in places it made up a large proportion of the tree growth. Most of the best timber has been cut, but there are still some rather extensive tracts of hardwood and hemlock, and numerous woodlots on the improved farms.

Present agricultural development.—The Marathon silt loam is an excellent general farming soil, and includes the best extensive tracts of land tributary to the city of Wausau. It is important not only because of the development which has taken place upon it up to the present time, but also because of its total extent. Its future development is a very important economic factor in the continued growth of Wausau. This class of land is well adapted to all of the general farm crops adapted to the climatic conditions prevailing in this region. Hay, small grains, root crops, potatoes, and corn for all do well. The region is especially well suited to grasses, and although acid, clover makes a rank growth on new land.*

*For chemical composition and improvement of this soil see page 40.

MARATHON GRAVELLY SILT LOAM

Extent and distribution.—This type of soil is not extensive, but is distinct from all other types which have thus far been mapped. It covers a total area of approximately 9 square miles and most of it occurs from 3 to 9 miles south and southeast from Marathon City in Marathon County. A few other scattered areas occur throughout the region which is covered with Marathon silt loam with which this type is always associated.

Description.—The surface soil of the Marathon gravelly silt loam to an average depth of 10 inches consists of a brown or dark brown silt loam which has an accumulation of a fair amount of organic matter in the surface 2 or 3 inches. Where fields have been cultivated this organic matter has been more thoroughly mixed with the surface section. The subsoil consists of a yellowish brown or light brown gravelly silt loam in which the gravel consists of angular fragments of granitic rock. At from 18 to 30 inches a gravel bed is usually encountered which consists of a mass of angular rock fragments varying in size from smaller than a pea to the size of about a hickory nut. The underlying granitic rock is usually encountered at a depth of from 3 to 6 feet, although on some of the hill tops and sharp ridges the underlying rock outcrops or comes to within 1 to 2 feet of the surface.

This type is quite variable in that the covering of silt over the angular gravel may range from a depth of only a few inches to 2 or 2½ feet. In a number of places the angular gravel is turned up by the plow so that the gravel forms a conspicuous feature in cultivated fields. As a whole, the silt covering is sufficiently shallow so as to make the type quite different in this respect from the Marathon silt loam.

Topography and drainage. The surface of this type is rolling and frequently consists of a series of rather sharp ridges. The natural drainage is always sufficient and often excessive, the subsoil being quite loose and open because of the high content of angular gravel.

Origin.—The material forming this type appears to have been derived from two sources. The extremely silty material forming the surface soil has a loess-like appearance and may have been deposited in part by wind action. The gravelly portion

of the type has undoubtedly been derived from the disintegrating of the underlying rock which is a coarse grained granite. It is probable that where the beds of gravel have outcropped on the higher elevations some of this material has been washed down and deposited over the silt on the lower slopes and in this way has become mixed with the soil section in various sections. It is also probable that in some cases the gravel has worked up into the silty covering. There is no indication of limestone rock in this region and both the soil and subsoil are found to show varying degrees of acidity.

Native vegtation. This is a hardwood soil and the original timber growth consisted chiefly of maple with some birch and a considerable amount of hemlock. There was also a small amount of pine scattered through the original forests.

Present agricultural development.—A small proportion of this type has been placed under cultivation and in most cases satisfactory crops are being raised. Where the silt covering over the gravel is shallow the type is inclined to be somewhat droughty. Portions of the type which are the most rolling are not well suited to cultivated crops, but can be used to advantage for grazing purposes. All of the general farm crops adapted to this region can be raised successfully on this type where the topography will permit.*

Vesper Silt Loam

Extent and distribution.—The Vesper silt loam is an unimportant and inextensive type, confined entirely to Clark County and accupying a total area of approximately 15 square miles. This soil is found in two distinct localities—one in the extreme southeastern corner of Clark County and the other about 5 miles to the southwest from Greenwood.

Description.—The surface soil of this type to an average depth of about 10 inches consists of a grayish-brown or dark brown silt loam in which the amount of organic matter is somewhat variable. The subsoil consists of a gray, drab, or sometimes yellowish heavy silt loam which may be mottled with brown, red, green or bluish coloring, and which at a depth of about 20 inches grades quite abruptly into sandy material. This may con-

* See page 40 for chemical composition and improvement of this soil.

sist of sand, fine sand, or medium or fine sandy loam. In some instances the underlying sandstone rock is encountered within the 3 foot section. In a few instances the underlying sandy material was found to be exposed at the surface.

The subsoil of the area near Greenwood is usually not quite as heavy as the subsoil of the other tract. While the type as a whole is quite variable, none of the variations were of sufficient extent or importance to be indicated separately.

Topography and drainage.—The surface of this soil is level to very gently undulating, and because of its low position, and the heavy character of the soil, the drainage is poor. The soil on account of this is cold and backward in the spring.

Origin.—The material forming this soil is from two distinct sources. The underlying sandy material has been derived from the weathering of the underlying Potsdam sandstone, while the silty covering may be in part residual from shale associated with the sandstone, or it may possibly owe its origin partly to glacial action. The region in which this soil occurs was influenced only to a very limited extent by glacial action, as it occurs along the border of the driftless area. The ice sheet which advanced to about this point was of Pre-Wisconsin age. The absence of limestone has permitted to development of a strongly acid condition in both soil and subsoil.

Native vegetation.—The original timber growth contained some ash, elm, and other moisture loving trees, and on the portions best dained some maple and birch. At present where not cleared the growth is largely small birch brush, poplar, and alder.

*Present agricultural development.**—A small proportion of the type has been cleared and placed under cultivation, but because of the poor natural drainage conditions the yields secured are usually not satisfactory. The tract southwest from Greenwood appears to have a somewhat higher agricultural value than that in the southeastern part of Clark County, although no larger proportion of it is under cultivation. In its present condition the soil is probably better adapted to the growing of timothy and alsike clover and to grazing than to any other line of farming.

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* See page 40 for chemical composition and improvement of this soil.

Antigo Silt Loam

Extent and distribution.—The Antigo silt loam is confined almost entirely to the eastern portions of Lincoln and Marathon Counties. It is not an extensive type, but it is one of the best soils in the area surveyed.

Description.—The surface of this type to an average depth of about 12 inches consists of a yellowish brown silt loam which is very smooth and friable. In the surface 2 or 3 inches there is a considerable amount of organic matter which has imparted a somewhat darker color than is found in the remainder of the soil section. Below 12 inches the soil is a yellow or drab silt loam which is frequently mottled. At a depth of about 2 feet a fine sandy loam or sandy loam is usually encountered. This is often of a yellowish color, though it is frequently mottled with red, brown, and drab. In a few places this lower depth was found to be a sandy clay loam. At a depth of 30 to 36 inches stratified beds of fine and medium sand are usually found.

This type is subject to numerous variations, especially in the depth of the silty covering over the underlying sand. This depth has an extreme variation of from about 10 inches to 4 or 5 feet, though these extremes are rarely found, the average depth of the silt being about 24 inches. The deepest silt covering was found in rather large areas in Towns 31, 32, and 33 North, Ranges 7 and 8 East. Over most of these tracts the silt extended to a depth of about 30 inches. In Towns 26, 27, and 28 North, Range 10 East, the underlying sandy material usually came to within 20 or 24 inches of the surface.

Topography.—The surface of this soil is level and where the silty covering extends to a depth of 2 feet or more the natural drainage is somewhat deficient. This is especially true where the type is adjacent to streams and on a rather low terrace. Where it is well elevated the underlying sand and gravel affords excellent drainage. When improved it will probably be found desirable to tile drain certain portions of this soil.

Origin.—The Antigo silt loam is of alluvial origin and has been derived largely from crystalline rocks. The silty covering over the sand was deposited in waters which were flowing at a much lower rate of speed than the waters which deposited the sand and gravel. It is possible that some of the fine material

may have been blown into quiet waters by the wind and then settled, thus giving a surface soil which has a somewhat loess-like appearance.

Native vegetation.—This is a hardwood soil and the original timber growth consisted chiefly of maple and birch, with a considerable amount of hemlock and smaller amounts of white and Norway pine. All of the pine has been removed, but there is still a considerable amount of hardwood and hemlock standing.

*Present agricultural development.**—This type of soil is recognized as one of the best in the area, though it is of comparatively small extent. Its freedom from stones and bowlders makes it much more desirable than some of the rolling country and the sandy subsoil makes it comparatively easy to remove stumps. It is a soil which may be worked readily and no difficulty is found in draining the land. It is well adapted to the general farm crops grown in this section and it is a soil which is certain to reach a very high state of development. The crops grown at present consist of clover and timothy, small grains, corn, and potatoes, all of which give very fair yields.

Knox Silt Loam

Extent and distribution.—The Knox silt loam occupies a total area of only about 6 square miles and is confined entirely to an almost unbroken tract in the extreme southwestern corner of Clark county in the immediate vicinity of Humbird.

Description.—The surface of this type to an average depth of about 8 inches consists of a light to dark brown smooth, friable silt loam. This is underlain by a yellow, buff, or yellowish-brown silt loam which gradually changes to a silty clay loam. At about 28 or 30 inches there is usually an abrupt change into a reddish, gritty, sandy clay loam. At a depth of 3 feet the underlying sandstone, or sand from this rock is frequently encountered, although the heavy material usually extends to a depth of over 36 inches. While this soil is associated with, and frequently grades into, boone fine sandy loam, as a type it is very uniform. The surface of this soil is stone free.

Topography and drainage.—The surface of this type is quite rolling, and because of this, and the underlying sandstone for-

* See page 40 for chemical composition and improvement of this soil.

mation the natural surface and underdrainage is always good. There are some rather steep slopes upon which erosion is apt to take place if the surface is not protected.

Origin.—The surface soil of this type is undoubtedly of loessial origin while the deep subsoil has doubtless come in part from the disintegration of the underlying sandstone. The sand particles have become mixed with the loessial material giving the gritty feel to the deep subsoil.

Native vegetation.—The original timber growth consisted chiefly of hardwood. Most of this has been cut, but on the steeper slopes there is still some timber.

Present agricultural development.—The greater proportion of this type is in farms and improved. It is a good general farming soil and well adapted to all of the usual crops grown in this region. Small grains, corn, hay, and root crops give satisfactory yields.

Chemical Composition and Fertility of Heavy Soils

The heavy soils of the Colby, Kennan, Marathon, Antigo, Vesper and Knox series have a good supply of the mineral elements, phosporous and potassium.

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 phosphorous 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.

The element potassium exists in very much larger amounts in these soils than does the element phosphorous—in fact they contain on the average over 40,000 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.

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.

Since all of these soils were formed from rocks not containing lime carbonate they are essentially all acid. The degree of acidity varies and to correct this condition will require from 2 to 4 tons of ground limestone per acre. In some cases it would require even more than this to completely correct the acidity. A slight degree of acidity does not interfere to any marked extent with the growth of clover while the soil is comparatively new and the fertility high, but does reduce the yield as the fertility is reduced by further cropping. Even in the virgin condition on this soil acidity does interfere with the growth of alfalfa. Acidity is also a condition unfavorable to the maintenance of a good supply of readily available phosphorus in the soil, and thus all crops are directly or indirectly influenced to some degree by acidity. 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. They should also 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 soils are well adapted to a wide range of crops, including corn, root crops, grasses and small grain. The Colby silt loam requires more care as to its drainage and cultivation than do the other soils, but its supply of essential plant food elements is as high as that of any of the others. All of these heavy soils are well adapted to the developmentof the dairy industry on account of their unusual fitness for the growing of hay and pasture.

CHAPTER III

GROUP OF MEDIUM HEAVY SOILS

Auburn Loam

Extent and Distribution.—The Auburn loam is confined largely to Clark county. Several small tracts are also found in Lincoln and Taylor counties. While not extensive as compared with the Colby soils, it nevertheless contains some of the finest agricultural land in the present survey. It occurs chiefly in a north and south belt along and mostly to the west of the Black river, beginning at a point four miles south of Neillsville and extending north for twenty miles to within several miles of Greenwood, where it swings to the northwest, crossing the county line about five miles south of the Soo Railroad. This belt is nearly continuous and varies in width from two to six miles.

Description.—The surface soil of the Auburn loam to an average depth of 10 to 12 inches consists of a mellow, brown or light brown loam or silt loam, in which there is usually a large percentage of fine and very fine sand. The subsoil consists of a lighter colored yellowish loam or silt loam, extending to a depth of from 24 to 30 inches where there is usually an abrupt change into material much lighter in texture and which consists of fine sandy loam, sandy loam, sand, or gravelly material. Frequently a mass of rather finely broken sandstone will be encountered in the subsoil, and in a few instances this was found to outcrop on the slopes. Glacial gravel is frequently present in the subsoil, and gravel beds are not uncommon. The surface soil while usually a loam, sometimes contains sufficient fine and very fine sand to justify calling the type a fine sandy loam, but such variations could not be separated out in a general survey.

Topography and Drainage.—The surface of this type ranges from gently rolling to steeply rolling, with the major portion which could be classed as rolling. Because of the irregular sur-

face, and the open nature of the subsoil the natural surface drainage is excellent and the under-drainage is good. There are very few slopes which are considered too steep to be utilized, and even the steepest land is of value for grazing. On by far the greater portion of the type modern farm machinery is being used. A little damage from erosion frequently results when the slopes are left without a crop covering them, but because of the open nature of the subsoil the amount of run-off water is reduced to the minimum.

Origin.—The material forming this soil appears to have been derived from several sources. The type is pactically all underlain by the Potsdam sandstone, from which the sandy material in the subsoil is largely derived. Dr. Samuel Weidman, who has studied the geology of this region very carefully, indicates that the belt of country of which most of this type forms a part, is a terminal moraine of one of the early ice sheets. The frequent deposits of glacial gravel indicate that at least a portion of the material has been influenced to some extent by glacial action. It is also possible that some of the material, especially that which is extremely silty has been brought to its present position by the action of the wind. There is no limestone present in this region, and an acid condition has developed in the soil.

Native vegetation.—The original timber growth consisted of maple, birch, hemlock, with a considerable stand of white and some Norway pine especially along the Black River. All of the pine has been removed, and also all of the best hardwood and hemlock.

Present agricultural development.—*A very large proportion of this soil is cleared and under cultivation, and it is considered to be one of the best types in the region. Because of its higher content of fine and very fine sand, it is easier to cultivate than the Colby soils, and because of its mellow soil and loose open subsoil the drainage is also much better. Most of this class of land is highly improved, and devoted to general farming and dairying. Corn, small grains, clover, and timothy and root crops are the chief crops grown, and very satisfactory yields are obtained.

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*See page 54 for chemical composition and improvement of this soil.

VIEW OF IMPROVED FARM ON AUBURN LOAM IN CLARK COUNTY

While of comparatively small extent this is one of the most desirable soils within the area surveyed. Most of it is devoted to general farming and dairying and is highly improved.

A GOOD ROAD THROUGH WILD LAND IN MARATHON COUNTY

Throughout this region there are many miles of gravel and macadam roads which extend through the unimproved as well as through the improved sections. They are of vital importance to the new settler.

KENNAN FINE SANDY LOAM

Rolling Phase

Extent and distribution.—The Kennan fine sandy loam is one of the most extensive soil types in the region surveyed. It is found in all four of the counties. In Clark County it is quite limited in extent and is confined to the extreme northwestern corner. In Taylor County it forms an extensive belt from 3 to 10 miles in width extending from the southwestern corner in a northeast direction to the extreme northeastern corner of the county. In Lincoln County it occupies large areas in the central and northeastern portions, while in Marathon County it is confined to the southeastern corner of the county. Throughout its extent it is associated with Kennan silt loam, and in Lincoln County especially it is quite closely associated with Vilas fine sand as well as Kennan silt loam. Throughout the areas indicated it occurs in rather extensive tracts with smaller outlying areas mixed in with other types.

Description.—The surface soil of the Kennan fine sandy loam to an average depth of about 10 inches consists of a light brown or yellowish brown rather compact fine sandy loam with which there is a fair amount of organic matter incorporated. The surface soil of cultivated fields when thoroughly dry is rather of a grayish color, but becomes somewhat darker as the content of moisture increases. The subsoil consists of a fine sandy loam to sandy loam which becomes somewhat coarser in texture and somewhat lighter in color with increased depth. In a number of cases the deep subsoil below 24 inches was found to consist of sand or sand and gravel. There is present upon the surface and mixed with the soil varying amounts of gravel, the amount of which usually increases with depth. In some places the deep subsoil was so gravelly that it was found difficult to bore. The type in places is stony, the stones ranging in size from a few inches to several feet in diameter.

There are a number of variations in this soil and one which is quite common is in the color of the subsoil. In many places this consists of a reddish brown sandy loam or fine sandy loam instead of yellowish material. The texture of the subsoil is also somewhat variable and there are places where loam or silt loam is found making up the bulk of the underlying ma-

terial at a depth of 20 to 30 inches. In a few places the surface soil was also found to consist of a silt loam. The type as a whole may be considered as intermediate between the Kennan silt loam on the one hand and the Vilas sand and fine sand on the other, so that gradations between these limits are frequently found. Associated with this type are also a number of small marshy tracts occupying kettle-like depressions. All of these variations, however, were of such small extent that they could not be indicated on a general soil map. In a detailed soil survey it is probable that most of these variations could be indicated.

This soil has a rather loose friable structure and because of this it is easily cultivated and so far as the soil itself is concerned, it works readily into a mellow seed bed.

Topography and drainage.—The topography of the Kennan fine sandy loam is quite variable, but for the most part it is from rolling to broken and hilly. Most of this consists of a series of knolls and ridges, with intervening kettle holes and narrow valleys in which small marshy tracts and lakes are numerous. It is distinctly a morainic country and is confined almost entirely to the terminal moraine which marks the farthest point of advance of the Late Wisconsin Ice Sheet. Associated with this morainic belt are numerous small areas where the surface is undulating or only gently rolling. But because of the small and irregular extent of such areas no topographic separation was made in this type. In Sections 19 and 20 in Township 31 North, Range 1 West small patches of this character are found which were large enough to separate. Most of this type as found in Taylor and Lincoln Counties is quite broken. The portion which is found in the southeastern part of Marathon County has a less broken topography and may be described as from gently rolling to rolling.

Because of the surface features and the loose open character of the subsoil both the natural surface and under drainage are excellent, and sometimes excessive.

Origin.—The type owes its origin to the weathering of glacial till which was deposited over the crystalline rocks and it consists of material which was derived largely from this geological formation from the grinding action of the ice and the subsequent weathering. The greater proportion of the type occurs within

the terminal morainic belt of the Late Wisconsin Ice Sheet. Some of it is probably resessional moraine, and a portion of it may be considered as ground moraine. It may be that a small proportion of the sandy material incorporated with this type has had its origin in part from sandstone formations to the north, having been carried to its present position by ice action. There is no limestone material in this region and its absence has permitted the development of an acid condition both in the soil and subsoil.

Native vegetation.—The forest growth over this type consisted mainly of hemlock, maple, and birch with which there was a considerable mixture of white and Norway pine. Hemlock was the predominant tree growth and immense quantities of tan bark have been taken from this type of soil. On some of the lower portions of the type some elm was found and on some of the ridges basswood and oak also occurred. By far the greater proportion of the timber has been removed, though in some places there is still considerable hemlock and maple standing. Much of the type has been burned over by forest fires, leaving it in a very desolate looking condition. Where fires have not recently destroyed the second growth there is often a rather heavy growth of popple and birch.

Present agricultural development.—While quite a number of farms have been started on this soil, by far the greater proportion of the Kennan fine sandy loam is undeveloped. In Taylor County there is some settlement east of Lublin in Township 30, Range 3 West; also in the vicinity of Perkinstown and along the Soo Railroad between Whittlesey and the north line of Taylor County. In the south eastern portion of Marathon County there are also a number of small settlements. Some settlement has been made in Lincoln County on this type, but no large areas have been cleared. In some instances farms have been in operation on this type for 20 years, but the amount of clearing which has been done is limited. The soil in itself is of good quality and produces excellent yields. Heavy crops of clover, timothy, oats, barley, and rye are grown and excellent yields of potatoes and corn are secured. Corn is more certain to mature than on the heavier soils such as the Colby silt loam. Because of the extremely rough character of this soil, however, it has not been developed to a great extent and this roughness will have a ten-

dency to retard development in the future, because there are many portions which are so steep that modern farm machinery cannot well be used. In the improvement of this soil the type of farming followed should be modified somewhat from that which is followed on other soils of the region. In many places there are small areas of gently rolling land surrounded by the rougher portions of the type. If these less rolling areas are selected for cultivated fields and the remainder of the farm used largely for grazing purposes, this type may be profitably improved. This type is well adapted to grasses and will supply a large amount of excellent grazing so that the dairy industry could be well developed, and the soil is probably better adapted to the raising of sheep than any other type in the area, and this industry is one which could well be considered for extensive development on this class of land.*

The selling price of land of this character is somewhat variable, but will average from about 10 to 15 dollars per acre, depending on location, topography, stoniness, etc.

Antigo Fine Sandy Loam

Extent and distribution.—Antigo fine sandy loam is fairly well distributed throughout Lincoln County and the eastern half of Marathon County. The largest tract of about eight square miles is found in the southeastern corner of Marathon County.

Description.—The surface soil of the Antigo fine sandy loam to an average depth of about 10 inches consists of a brown fine sandy loam. In the surface 2 or 3 inches there is an accumulation of organic matter in the virgin soil which makes it somewhat darker than the remainder of the soil section. The surface soil is usually underlain by a yellow sand or fine sand extending to a depth of from 18 to 24 inches. Below this depth the soil is somewhat lighter in color and it varies in texture from a fine to medium sand. Throughout the soil section a small amount of gravel may be found and in a few localities a gravel bed was encountered at a depth of about 3 feet. The type is practically stone free.

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* See page 54 for chemical composition and improvement of this soil.

This type is subject to some variation and small patches of fine sand, medium sand, and sandy loam may be found, but none of these are of sufficient extent to indicate separately. In a few localities the subsoil was found to be somewhat heavier than usual and to contain an appreciable amount of silt and clay. In some low places the surface soil was found to be quite dark in color and sometimes to approach a silt loam in texture.

Topography and drainage. The surface of this type is level and the drainage is fair to good, but there are a few places where the ground water is sufficiently close to the surface so that in the improving of this soil drainage will be needed.

Origin.—This type of soil is of alluvial origin and occurs as stream terraces or outwash plains. The parent material has been derived from crystalline rocks and carried to its present position through the action of water. There is no limestone in this region and all of this type is now found to be in an acid condition.

Native vegetation.—The original timber growth consisted of mixed pine and hardwood. In some localities the hardwood predominated, while in other sections the pine was the most extensive tree growth. Considerable hemlock was also found in places. All of the pine has been removed, but some of this type is still covered by hardwood and hemlock timber.

Present agricultural development.—A portion of this type has been placed under cultivation and where farmed very fair yields have been obtained. It may be considered very well adapted to the general farm crops which are grown in the region, and especially well adapted to trucking crops, though because of its location the trucking industry has not been developed. It is well adapted to potatoes and in order to secure the best returns a rotation consisting of one year small grain, one year clover, and one year potatoes should be followed.*

Colby Loam

Extent and distribution.—This type of soil is confined extirely to Marathon County and occupies a total area of about 23 square miles. The most important tracts are found in the vicinity of Ringle and about 8 miles east of Mosinee.

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*For chemical composition and improvement of this soil see page 54.

Description.—This type is extremely variable, ranging in texture from a silt loam to a fine sandy loam, but because of numerous changes in texture within short distances, and because the major portion appears to approach more nearly to a loam than to any other type it was all included under the head of Colby loam, though a detail survey would doubtless be able to separate several types.

In general it may be said that the surface of this type to an average depth of about 12 inches consists of a brown or dark brown loam, which frequently becomes yellowish or reddish-brown within a few inches of the surface. The subsoil usually consists of a reddish-yellow sandy clay loam which frequently becomes heavier with depth, and is mottled with drab, brown and yellow. In a few instances the subsoil was found to contain considerable mica and some chlorite. At a depth of 4 feet the decomposed mica and chlorite schist was found. South of Ringle the subsoil contained considerable angular granitic gravel and where this was the case there was no mottling of the subsoil, doubtless because of better drainage. None of the variations found were of sufficient extent to be indicated on a general soil map of this kind.

Topography and drainage.—The surface of this type is flat to very gently undulating and the natural surface drainage as well as the under drainage, is deficient. Where the type approaches a silt loam the drainage is always poorer than where the texture is somewhat lighter.

Origin.—The subsoil of the Colby loam has doubtless all been derived from the disintegration of the underlying crystalline rocks, which are usually granite. Much of the surface soil has also had the same origin. Field tests indicate that both soil and subsoil of this type show varying degrees of acidity.

Native vegetation.—The original timber growth consisted of hardwood, mostly maple, and hemlock. The greater part of the merchantable timber has been removed and the land left in "slashing."

Present agricultural development.—But very little of this type has been placed under cultivation. Before farming operation can be carried on successfully from year to year it will be necessary to provide more thorough drainage than prevails at present. When the land is cleared the drainage is greatly im-

proved, but in the higher development of land of this character the use of tile drains will be found profitable, and often necessary.

When thoroughly drained this will make a good, productive soil. While the land is new clover will make a rank growth, but after crops have been grown for a time the use of lime will be beneficial. For alfalfa growing liming will be necessary. By removing the brush this type will afford excellent grazing without any additional labor.*

Marathon Fine Sandy Loam

Extent and distribution.—The Marathon fine sandy loam occupies a total area of about 3 townships. It is confined entirely to Marathon County, and is found east of the Wisconsin river between the Eau Claire river and the south county line. It is practically all found within 12 miles of the Wisconsin river. Only a few scattered tracts are found outside of the region indicated.

Description.—The surface soil of this type to an average depth of about 12 inches consists of a brown or rather dark brown fine sandy loam in the first few inches of which there is sufficient organic matter to give it a somewhat darker color than the remainder of the surface section. The subsoil consists of a yellowish-brown fine sandy loam which usually becomes lighter in color and texture until a yellow fine sand is often encountered at depths ranging from 14 inches to 3 feet. The lower portion of the 3 foot section is frequently a fine sandy loam, and in a few places a sandy clay loam was found in the lower subsoil.

Local variations in texture were noted both in the soil and subsoil, and ranges from fine sand to loam were observed, but none of these variations were of sufficient extent to be indicated on a general soil map.

Topography and drainage.—The topography over the major portion of the type is gently rolling to rolling, with some nearly level tracts and the natural drainage is usually good. An exception to this was found about 7 miles east of Schofield, where the surface is nearly level, rather low lying, and the drainage

*For chemical composition and improvement of this soil see page 54.

quite deficient. The subsoil of this phase shows mottlings of red, yellow and drab, and is quite compact. The subsoil is here frequently heavier than typical, due to larger amounts of clay, and in places possibly to a ferruginous cementing material. On this poorly drained phase bowlders are quite plentiful.

Origin.—This type of soil has been derived largely from the disintegration of the underlying crystalline rocks, and the variations in texture appear to be due largely to the variations in the texture of the rock from which derived. While this is considered to be a residual soil, the region has doubtless been traversed by glacial ice, but the influence of the ice sheet appears to be very slight. The rounded bowlders were transported by the ice, and it is possible that some of the soil material itself may also have been carried short distances by the ice. There is no limestone present in this region, and both soil and subsoil are found to show varying degrees of acidity.

Native vegetation.—The original timber growth consisted largely of hemlock and maple, with which there was varying amounts of pine. There is still considerable hardwood and hemlock standing.

Present agrciultural development.—Only a small proportion of this type has been cleared and placed under cultivation. Most of the development which has taken place occurs southeast of Schofield, and east of Mosinee. Along the main road due east of Mosinee for 8 or 9 miles a large number of 20 and 40 acre tracts are being developed into farms largely by foreigners who have been located on the land by a larger lumber and land company operating in this locality. This type of soil is well adapted to general farming and all crops adapted to this region give satisfactory yields. Small grains, hay, potatoes, and roots are the chief crops now grown.*

Auburn Fine Sandy Loam

Extent and distribution.—The Auburn fine sandy loam is confined to the western and southern portions of Clark County, the most extensive area occupying from 5 to 16 miles west and northwest of Greenwood. In this tract there is over 50 square miles.

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*See page 54 for chemical composition and improvement of this soil.

The type is quite closely associated with Boone fine sand and also with the Auburn loam, and it may be considered as an intermediate type between these two.

Description.—The surface soil of Auburn fine sandy loam to an average depth of 8 or 10 inches consists of a light brown fine sandy loam which is usually underlain by a yellow or yellowish brown fine sandy loam. In places the subsoil has a somewhat reddish appearance, this condition usually being found close to the sandstone mounds where the soil is rather shallow and where the underlying rock has a reddish cast.

The type is subject to considerable variation and in a number of places the surface may approach a loam in texture, while the subsoil frequently consists of a heavy fine sandy loam or sandy clay loam. This heavy phase is found chiefly in the northern extension of the type northwest of Greenwood.

There are a few areas of limited extent which approach the Boone fine sand type in texture. The subsoil in a number of places is found to grade into a fine sand at a depth of from 2 to 3 feet, while in a few places the bed rock may be encountered at about the same depth.

Topography and drainage.—The surface of Auburn fine sandy loam is usually gently rolling to rolling, so that the natural drainage is good; in some places it is excessive. Associated with the type are a number of large mounds or hills where the underlying rocks outcrop to such an extent as to justify calling such places rough stony land.

Origin.—This type of soil has been derived chiefly through the weathering of the underlying sandstone formation. The region in which this soil is found appears to have been influenced to a very slight degree by glacial action, but this has not been sufficient to materially change the character of the soil material. A very few small glacial bowlders are found scattered over the type and a very small amount of gravel mostly consisting of crystalline rocks was also seen. No limestone formations occur in this region and practically all of the type is found to be in an acid condition.

Native vegetation.—The major portion of the type as it occurs northwest of Greenwood supported a good growth of hardwood and hemlock timber with which there was mixed a small amount of pine. The southern areas which are somewhat lighter

in texture supported a larger proportion of pine timber. By far the greater proportion of the timber growth has been removed.

Present agricultural development.—Only a comparatively small proportion of the type has been cleared and put under cultivation, but where improved it is proving to be a very fair soil. All of the general farm crops which are grown in this region give satisfactory yields, especially over that portion of the type lying to the northwest of Greenwood which is somewhat heavier than the remainder of the type. The chief crops grown consist of small grains, corn, and hay.

Chemical Composition and Fertility of Loams and Fine Sandy Loams

These soils are only a little more open in texture than the silt 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, phosphorous and potassium, is nearly if not quite as large in the Kennan and Marathon fine sandy loams as the Kennan silt loam. 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 orgainc 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 actvie 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 phosphorous 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 phosphorous 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 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.—The Vilas sandy loam is of very limited extent and is confined to the northeastern part of Lincoln County and to the eastern and northern portions of Marathon County. The most extensive tract, of several square miles, occurs in the vicinity of Granite Heights.

Description.—The surface soil of this type to an average depth of about 10 inches consists of a brown or grayish brown sandy loam of medium texture with which there is incorporated a small amount of organic matter. The subsoil consists of a yellowish brown or rather rusty colored sandy loam which contains a rather high percentage of fine sand. With increased depth the soil becomes more of a sandy nature and the deep subsoil usually consists of a yellow or slightly yellowish red sand. There is a small amount of gravel scattered through the soil section and a small amount may appear upon the surface in places. The type is quite similar to the Vilas gravelly sand type, but contains somewhat more fine material and a smaller amount of gravel. The type is subject to some variation, but none of the variations were of sufficient extent to separate on the general soil map.

Topography and drainage. The surface of this soil is rolling to hilly. Kettle basins, kames, and small marshy tracts are quite common. There are a few level and undulating tracts included with the rougher country but these could not be indicated separately. Because of the surface features and the open nature of the sub soil the natural drainage is sufficient and usually excessive.

Origin.—In origin the material composing this soil has been derived from glacial material which has been deposited chiefly in the form of recessional moraines. The greater proportion of the material has doubtlessly been derived from the underlying

crytalline rocks, though it is possible that sandstone formations far to the north have contributed to its formation also. There is no limestone found in this region and an acid condition has developed in both the soil and subsoil.

Native vegetation. The original timber growth consisted chiefly of pine with which there was mixed a considerable amount of hemlock and also a small amount of hardwood consisting chiefly of maple with some birch. All of the pine has been cut, but there is still some hemlock and hardwood standing.

Present agricultural development.—Only a very small amount of this type has been placed under cultivation. Because of its rather rough character and somewhat droughty condition its agricultural value is rather low and while it can be farmed successfully, the production of profitable crops upon it will require careful management. So long as there are extensive areas of much better land which can be secured at a reasonable price, it would not be advisable to urge the improvement of this class of land at the present time.*

Marathon Sandy Loam

Extent and distribution.—This type of soil is of comparatively small extent. The largest tract is found within a triangle formed by Moon, Dancy and Mosinee. Smaller areas occur between Marathon City and Wausau, to the northwest of Ringle, and about 5 miles southeast from Rothschild. None of this soil is found outside of Marathon County.

Description.—The surface soil to an average depth of 10 inches consists of a brown or grayish-brown sandy loam of medium texture. Below 10 inches the material becomes a yellowish, or sometimes a reddish-brown sandy loam or sand, carrying a high percentage of angular gravel. At a depth of 2 to 3 feet this usually grades into a bed of angular gravel consisting entirely of disintegrated crystalline rock. Sometimes the underlying crystalline rock (usually granite) comes to within 3 feet of the surface.

The type is quite variable and includes small areas of loam, silt loam and fine sandy loam, all of which were of too limited

* See page 64 for chemical composition and improvement of this soil.

extent to be shown on a general soil map. In a few instances small spots of sand and fine sand were included with the type.

Topography and drainage.—The surface of this type is usually rolling, and on account of this and the underlying gravelly material the natural surface and under drainage is excellent, and sometimes somewhat excessive.

Origin.—This soil has had its origin from the disintegration of the underlying crystalline rocks, which are usually granite, or granite gneiss. The gravel present consists of small angular fragments of this rock which are being slowly transformed into soil. Gravel beds making up of this material are known as arkose. No limestone material has entered into the formation of this soil and both soil and subsoil show varying degrees of acidity.

While this soil is considered to be of residual origin it is known that this region was traversed by glacial ice, but its action was slight. The few rounded bowlders seen here and there were brought to their present position by the ice, but beyond this the glacier seems to have had but little influence.

Native vegetation.—The original timber growth consisted chiefly of hardwood and hemlock, and the greater proportion of this has been cut. Some pine was mixed through the hardwood, but this has all been removed.

Present agricultural development.—But very little of this soil is under cultivation at the present time. In its agricultural value it is very similar to the Marathon fine sandy loam, differing from that type chiefly by being underlain by angular garvel. Where cultivated fair yields of most of the general farm crops common to the region are secured.*

Vilas Fine Sand

Extent and distribution.—This type occupies a total area of about 30 square miles and is confined to the northern part of Lincoln County along both sides of the Tomahawk River north of Tomahawk, and between the Tomahawk and Wisconsin Rivers.

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* See page 64 for chemical composition and improvement of this soil.

Description.—The surface soil of this type to a depth of about 6 inches consists of a brown or grayish-brown fine sand which grades into a reddish or rusty brown fine sand and then at from 12 to 18 inches into a yellow fine sand which extends to a depth far below the reach of the auger. There is present in soil and subsoil sufficient clay to give the material a slightly loamy feel. A small amount of gravel is frequently found scattered through the soil section. The type is subject to some variation and includes small patches of fine sandy loam, sandy loam and gravelly sand, some of which could be mapped separately in a detail survey. Stones and bowlders frequently occur.

Topography and drainage.—The surface of Vilas fine sand is for the most part rolling, broken and hilly, consisting largely of moraines in which kettle basins, kames and sharp ridges are quite common, small marshes abound. An exception to this topography is found to the northeast and northwest from Tomahawk, where the surface is nearly level, approaching the Merrimac fine sand, but has numerous bowlders upon the surface in places. Because of the surface features and structure of the material this type has excellent drainage, and is often droughty.

Origin.—The material forming this soil has been derived largely from the underlying crystalline rocks by glacial action. It seems probable that in addition some material from sandstone formations to the north may have been carried down and mixed with the crystalline rock debris by glacial action. There is no limestone present in this region and soil and subsoil are acid.

Native vegetation.—The original timber growth was largely pine, though there were areas over which some hemlock and frequently some hardwood grew. Birch and popple brush and sweetfern largely make up the present growth.

Present agricultural development.—A small percentage of this soil is under cultivation, and it has a producing power somewhat higher than the Vilas gravelly sand and sand types, but it is lower in value than the fine sandy loam. Where not too rough and broken it can be farmed profitably but it requires careful management. The crops grown consist chiefly of small grains, potatoes, hay and a small amount of corn. Fair yields are usually secured. Difficulty may be experienced in getting clover started, as the soil is acid. Where clover cannot be grown without lining the soil, such legumes are soy beans or serradella may

be successfully grown. A rotation consisting of a small grain, followed by clover, followed by potatoes usually gives good results on this class of land.*

Plainfield Sandy Loam

Extent and distribution.—The Plainfield sandy loam is a type of minor importance and is confined almost entirely to Marathon County. The principal tracts occur along the Little Eau Claire River about 4 miles west of Bevent and another tract is found about 2 miles northeast of Hogarty. Other small patches occur along Trap River east of Trap City and along the Wisconsin River south of Merrill.

Description.—The surface soil of the Plainfield sandy loam to an average depth of about 8 or 10 inches consists of a brown medium sandy loam in the surface few inches of which there is a small amount of organic matter. The subsoil usually consists of a reddish brown or rusty sandy loam which at a depth of about 2 feet grades into a gravelly sand of a rather reddish color. At a depth of about 3 feet it is quite common to find the material of a more yellowish cast. The lower portion of the subsoil is usually stratified and lenses of gravel and coarse and fine sand are quite common. In a few places a small amount of sandy clay or clay loam was found at a depth of about 30 inches, but this condition was unusual.

The type as a whole is subject to some variation. The tract which occurs near Bevent is somewhat heavier than usual and contains patches which approach a loam in texture. In other places the texture was found to approach that of a fine sand or fine sandy loam, but none of these variations were of sufficient importance to indicate on the soil map.

Topography and drainage.—The surface soil of this type is level and occurs as river terraces. Its position is somewhat lower as a rule than that of the Plainfield sand and gravelly sand and because of this fact the natural drainage is sometimes deficient. The ground water level frequently comes within 3 feet of the surface, and where this is the case the type is rather wet especially in the spring and early summer. Where the type oc-

* See page 64 for chemical composition and improvement of this soil.

cupies a second terrace the drainage is very fair and sometimes excessive.

Origin.—This type has the same origin as the other types of the Plainfield series, having been deposited by stream action when the waters were at a much higher level than at present. The material forming this soil has been derived largely from the underlying crystalline rocks which consist largely of granite.

Native vegetation.—The predominant growth on this soil consisted of white and Norway pine, all of which has been removed.

Present agricultural development.—Only a small proportion of this type has been placed under cultivation. It has an agricultural value somewhat above that of the Painfield sand and gravelly sand, but it is not as good a soil as the Antigo fine sandy loam. Most of the general farm crops of the region are being grown upon it to a limited extent, but the yields are rather low and the type as a whole under present conditions must be classed as a soil of rather low agricultural value.*

PLAINFIELD FINE SAND

Extent and distribution.—The Plainfield fine sand is not an extensive type, but it is found in three of the four counties included in the present survey. One of the largest areas is found in the northern part of Lincoln County extending to the northeast from Tomahawk along the Wisconsin River. In Marathon County there is an area of considerable size extending for about 7 miles to the southwest of Bevent along Plover River. At Knowlton in the southern part of Marathon County there is another tract of several square miles along the Wisconsin River. In Clark County there are several small patches along the Black River in the southern part of the county and also scattered areas along the Wolf River in the northwestern portion of Clark County.

Description.—The surface soil of the Plainfield fine sand to an average depth of about 8 inches consists of a brown or yellowish fine sand in the surface inch or two of which there is sufficient organic matter to give the material a dark brown color. The surface soil is underlain by a brown, reddish brown, or

* See page 64 for chemical composition and improvement of this soil.

rusty fine sand which usually grades into a yellow fine sand at about 18 or 20 inches below the surface. This yellow fine sand may extend to a depth of 3 feet or more, though a number of places were found where the brownish or rusty color extended to the depth of the auger. Throughout the soil section there is a very small amount of silt or clay which is sufficient to make the soil stick together when wet. In a few places a small amount of gravel was found scattered through the soil and in the deep subsoil.

Gravel beds, however, were not found. In a few instances a very compact layer of reddish fine sand was found at a depth of about 8 inches which seemed to be cemeted together by a ferriferous material. This condition, however, seemed to be of very limited extent. In such places the surface was usually a whitish or gray fine sand and the drainage was much more defective than usual.

Topography and drainage.—The surface of this type of soil is level to very gently sloping. Because of the loose character of the soil and subsoil the natural drainage is thorough and usually excessive except in such localities where the type is low and the ground water rather near the surface which is sometimes the case.

Origin.—The Plainfield fine sand occurs chiefly as a terrace formation, though in some cases it probably consists of outwash material. The terraces are always sufficiently above the level of the streams along which they occur to be free from flooding and some of the terraces have an elevation of 20 to 30 feet above the present flood plain. The upland material from which this soil has been derived is the crystalline rock formation which prevails throughout this region. There is no limestone material in this region and both the soil and subsoil of this type are found to be in an acid condition.

Native vegetation.—The original timber growth consisted largely of white and Norway pine, all of which has been removed. The present growth consists of a few small pine trees with a ground covering chiefly of sweet fern, some birch, and a small amount of popple.

Present agricultural development.—But very little of this type has been cleared and placed under cultivation. Its agricul-

tural value is slightly higher than that of the Painfield sand, but it will require careful management to produce profitable crops.*

Boone Fine Sand

Extent and distribution.—This type of soil occupies a total area of about 40 square miles and is practically all found west of Black River and in the southwestern fourth of Clark County. There are only a few scattered areas outside of the above region in the southern part of Clark County. The largest occurrence of this type consists of about 30 square miles and lies immediately south of Mentor and Tioga and to the east and northeast of Humbird.

Description.—The surface soil of the Boone fine sand to an average depth of about 8 inches consists of a fine brownish or yellowish sand which contains only a small amount of organic matter. The subsoil consists of a yellow fine sand which extends to an average depth of 3 feet or more. In a few places the subsoil was found to consist of a nearly white fine sand. The underlying sandstone rock may be encountered anywhere below a depth of 2 feet, and there are a few places where the underlying rock outcrops. Around Mentor and to the south of Tioga some gravel was found scattered about the surface and mixed with the soil. This gravel is largely of crystalline rock material. The soil in this region appears to have a somewhat higher agricultural value than where no gravel is present. The occurrence of the gravel, however, was not sufficiently uniform or extensive to warrant a separation on this basis.

Topography and drainage.—The surface of this soil is usually undulating to gently rolling and in a few instances rolling. Because of the uneven surface and the loose open character of both the soil and subsoil the natural drainage is excessive and the type is subject to drought for a large portion of each growing season. Along the south fork of the Eau Claire River and also along Hay Creek there is a narrow strip of this type which has a nearly level surface and over this portion of the type the water table comes much closer to the surface than usual so that a droughty condition would seldom prevail over this phase.

* See page 64 for chemical composition and improvement of this soil.

Origin.—This type has been derived from the weathering of the underlying Potsdam sandstone and is considered to be a residual soil. As in the case of the fine sandy loam, this type may have been influenced to a very slight extent by glacial action, as is indicated by the presence of glacial gravel; this influence, however, has been so slight as to have no appreciable effect. The type has, therefore, been included with the Boone series. There is no limestone present in this region and both the soil and subsoil are found to be in an acid condition.

Native vegetation.—The original timber growth on this type consisted chiefly of white and Norway pine, all of which has been removed. The growth at present consists chiefly of scrub oak, a small amount of second growth pine, and an undergrowth of sweet fern.

Present agricultural development. Only a small proportion of this type has been put under cultivation. Where fields have been cleared the chief crops grown consist of corn, rye, potatoes, and clover, but the yields of all of these crops are rather low and the type as a whole may be considered as having a low agricultural value.

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 the average seasons and suffer from drought only during periods of relatively low rainfall.

This moderate water-holding capacity permits these soils to dry off more quickly in the spring and to become warmer than heavier soils, thus fitting them especially for such crops as corn, potatoes, and other 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 phosphorous 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 form 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 phosphorous 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—phoshhorous, pottassium, 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 phosphorous 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 phosphorous 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 phosphorous 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

This soil occupies a total area of only about 2 square miles and is confined to the northeastern part of Lincoln County where it joins larger tracts of similar soil in Oneida County to the north.

The surface consists of a brown or grayish brown medium to fine sand to a depth of 3 to 4 inches where it passes into reddish-yellow or rusty sand which becomes a yellow sand below 2 feet. This loose, open sand extends to a great depth. The soil is similar to the gravelly sand of this series, but differs from that by being practically free from gravel.

The surface is undulating to gently rolling, and the natural drainage is excessive.

The soil has been derived by glacial action from the underlying crystalline rocks and from sandstone formations far to the north. The absence of limestone has permitted the development of an acid condition in both soil and subsoil.

The original timber growth consisted chiefly of pine, though there was some hemlock and a very small amount of hardwood. All the best timber has been cut.

This soil is all cut over but still unimproved. It has a rather low agricultural value and to produce profitable crops will require careful management. So long as there are large tracts of better land available, it is doubtful if, under present conditions, the improvement of this land should be encouraged.*

VILAS GRAVELLY SANDY LOAM

The Vilas gravelly sandy loam covers a total area of approximately 30 square miles and is confined to a nearly continuous body in the northeastern part of Lincoln County in the vicinity

* Chemical composition and improvement discussed on page 72.

of Long, Bass, and Pine Lakes. It may be considered as one of the unimportant types.

The surface material to a depth of about 3 inches consists of a gray or light brown gravelly sand or fine sand which then passes into a reddish, brownish-red, or rusty colored sand or fine sand having a loose open structure, grading at about 18 inches into a yellow or yellowish-red sand of about the same texture, which extends to a depth far below the reach of the soil auger. Gravel varying in size from that of a pea to that of an apple, is found all through the soil section. Bowlders frequently occur upon the surface.

The type is somewhat variable, frequently containing small patches of sandy loam or fine sandy loam, especially along some of the lower slopes. The surface of this soil is decidedly broken in topography and geologically would be classed as a recessional moraine. Hummocks, kettle basins, kames, eskers, and sloughs are numerous. Many small lakes dot the landscape, and small tamarack and cedar swamps are plentiful. Because of the uneven surface and the open character of the material the drainage is excessive and the soil is droughty.

The material composing this soil has been derived from the glacial debris deposited by the Late Wisconsin Ice Sheet. This came largely from the underlying crystalline rocks, though it is probable that sandstone formations may have contributed to its origin also. An acid condition has developed.

The present growth is largely hemlock with some birch. Originally there was also considerable pine.

This soil has not been improved and because of its rough surface, loose open structure, and droughty condition it has a low agricultural value. To produce profitable crops will require careful management, and the improvement of this class of land is not encouraged under present conditions, when there is so much land of much better quality readily available.*

Plainfield Sand

Extent and distribution. The principal areas of Plainfield sand are found in Marathon County in the valley of the Wisconsin River in the vicinities of Dancy, Mosinee, Granite

* Chemical composition and improvement discussed on page 72.

VIEW OF PLAINFIELD SAND IN THE WISCONSIN RIVER VALLEY

The loose, open character of this soil makes the drainage excessive, and its natural fertility is low. With proper cultivation, lime and fertilizers, however, profitable crops can be grown. This view shows an excellent crop of clover hay.

TYPICAL SURFACE FEATURES OF PLAINFIELD SAND

While potatoes are extensively grown on this soil, they are not as well adapted to sand soils as to sandy loam and fine sandy loam soils. Corn responds more readily to improved methods on the sand than potatoes, and therefore more corn and less potatoes should be grown on these extremely sandy soils.

Heights, Wausau, Merrill, and to the north of Tomahawk. Other areas occur west of Dancy along the Big and Little Eau Plaine Rivers, between Wausau and Marathon, along Big Rib River, and also along Plover River near Bevent. One tract is found immediately east of Humbird and another occurs along both sides of the Black River in the southern part of Clark county.

Description. The surface soil of Plainfield sand to an average depth of about 10 inches consists of a brown medium sand in the surface 2 or 3 inches of which there is sufficient organic matter to make the color somewhat darker than the remainder of the soil section. This is undelain by a reddish brown sand which is loose and open in structure and which may contain considerable gravel. This material extends to a depth of over 3 feet. The lower section is usually stratified and consists of layers of fine and medium sand and gravel.

The type is subject to considerable variation, though most of the variations are of too small extent to be indicated on a general soil map. In the vicinity of Bevent the subsoil is usually a loose yellow sand, in place of a reddish brown sand, and there is a much higher content of fine sand in this locality than elsewhere. The underlying beds of gravel which occur in various places are sometimes found within 12 inches of the surface and occasionally gravelly spots will be found at the surface, so that in such places the type could be properly termed a gravelly sand.

Topography and drainage.—This soil occurs as terraces along the various streams and the surface is flat or very gently sloping. Along the Wisconsin River and some of the other streams there are often two and sometimes three distinct terraces. The difference in elevation between these terraces ranges from a few feet to over 20 feet. While the texture of the soil on the various terraces is uniform, the drainage conditions vary somewhat—the higher lying soil having better drainage than the lowest terarces. Over the type as a whole the drainage is very thorough and frequently excessive and there are only a few places where the water level is sufficiently close to the surface to make the drainage deficient. The lowest portions of the type have been indicated by marsh symbols.

Origin.—The Plainfield sand is of alluvial origin, having been deposited by the Wisconsin River and its tributaries when these streams were flowing at a much higher level than at present. These streams all traverse a region of crystalline rocks and it is this class of material which has contributed largely to the formation of this type of soil. There is no limestone in this region and practically the whole of this type is now found to be in an acid condition.

Native vegetation.—The original timber growth consisted almost entirely of pine. In most places white and Norway pine was the predominant growth, while in others Jack pine was quite plentiful. All of the pine timber of any value has been removed.

Present agricultural development.—Only a small proportion of the Plainfield sand is under cultivation. Because of the small amount of organic matter present and also the limited amounts of the mineral plant food elements found in this type it must be considered as a soil of rather low agricultural value. Where it is under cultivation at the present time the crops grown consist chiefly of rye, potatoes, some oats, and a small amount of corn and some hay. Because of the acid condition of the soil it is difficult to get clover started. Profitable crops can be grown only when the very best of methods are followed.*

Plainfield Gravelly Sand

Extent and distribution.—The Plainfield gravelly sand is confined almost entirely to Marathon County and occupies a total area of about one township. By far the greater proportion of this soil occurs along the Eau Claire River east of Schofield and along the Wisconsin River between Schofield and Mosinee. A few other much smaller tracts occur on terraces along some of the other streams traversing Marathon County.

Description.—The surface soil of this type to an average depth of about 8 inches consists of a brown or dark brown gravelly sand which is quite loose and open in texture. In the surface inch or two of the virgin soil there is usually a fair amount of organic matter which gives it a somewhat darker color. This

* For chemical composition and improvement see page 72.

largely disappears after cultivation for a few years. The subsoil consists of a reddish brown gravelly sand which is very loose and open in structure, but which usually contains sufficient silt and clay so that when moist the material will stick together slightly. The gravel present ranges in size from a pea to about the size of a hen's egg. The lower portion of the soil section is usally stratified and a bed of gravel is sometimes found at a depth of about 3 feet.

Included with this type are numerous small areas of Plainfield sand which differs from the gravelly sand only in that it does not contain gravel. It was found in a number of cases and where these two types bordered each other the line between them was an arbitrary one. There are also a few places where the texture of the soil is somewhat finer than usual, but none of these variations were of sufficient extent to indicate on this general map.

Topography and drainage.—The surface of this soil is level and because of the loose open structure of the material the natural drainage is excessive. This is true in all cases except where the type occupies a position lower than usual and where the ground water comes within 3 feet of the surface which is rarely the case.

Origin.—The Plainfield gravelly sand occurs chiefly as river terraces, though it may also occur as outwash plains. There are several different terraces and in a number of places three distinct levels are noticeable. These range in elevation from 4 or 5 to about 20 feet or more above the pesent flood plains of the streams along which they occur. The material forming this soil has been derived from the crystalline rocks which form the underlying formation throughout this region. No limestone formations occur in this section of the state and both soil and subsoil are found to be in an acid condition.

Native vegetation.—The original timber growth consisted largely of white and Norway pine, though in some instances Jack pine was often growing on this soil. All the timber of any value has been removed. At the present time there is a small amount of popple, some birch, and a considerable amount of sweet fern growing on this type.

Present agricultural development.—Because of the loose open character of this material the soil is droughty and has a low

agricultural value. The amount of organic matter is small and the type is deficient in mineral plant food elements. Only a small proportion of the Plainfield gravelly sand has been placed under cultivation. Unless special lines of treatment are followed the yields secured are low.

Chemical Composition and Fertility of 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 periods. But when the soil is too sandy it does not hold sufficient water from one rainfall to another to satisfy the needs of the growing crops and they therefore suffer from drought. Moreover, most 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 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 grian and that on small portions of soils mapped as sands a more detailed mapping would show fine sands. With very unimportant exceptions, the soils mapped as 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 phosphorous 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 25,000 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 considerable portion of the phosphorous 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.

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. The use of a complete commercial fertilizer will often be found pofitable. This crop should be plowed under as a green manuring crop.

A rotation which experiments have demonstrated to be well adapted to sand soils consists of rye, clover and corn. Best results in securing a stand of clover are usually secured by seeding with rye which may be disked and harrowed in and seeded to clover in the spring. Where the fertility of the land is low, the entire clover crop should be plowed under. Where the fertility of the sand is fair, the first cutting of clover may be saved for hay, and the second plowed under as a green manuring crop. As these sands are acid best results with clover cannot be secured without the use of lime. By using corn in the rotation instead of potatoes there will be a considerable increase in the acreage of corn, which will make possible the use of silage for summer

feeding. This in turn will reduce the number of acres devoted to pasturing and this is especially desirable on sand soil because of the fact that the sand does not produce good pasture. The supply of stable manure on these soils is always limited, and the use of commercial fertilizers may frequently be found advisable for general farm crops.

While considerable acreage of this soil is devoted each year to growing potatoes for home use and on a commercial scale, careful field tests have demonstrated that increased yields of corn can be secured much more readily on this soil than can increased yields of potatoes. In other words, potatoes do not respond well to the improvement of this soil, while corn responds readily to improved methods of cultivation and fertilization on sand. It will be desirable therefore to reduce the acreage of potatoes on sand soil as much as possible and to increase the acreage of corn. The potatoes are better adapted to sandy loams, and fine sands, and fine sandy loams, all of which have more fine material than the extremely sandy soils.*

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

CHAPTER VI

GROUP OF POORLY DRAINED AND MISCELLANEOUS SOILS

PEAT[1]

Extent and Distribution.—Areas of Peat are distributed throughout all four counties, but are most extensive in the glaciated regions in southeastern Marathon, nothern, central, and southwestern Lincoln, and northern Taylor County. In the region spoken of as unglaciated very extensive areas are found where no Peat marshes occur. The most extensive tracts of Peat are found southwest of Mosinee Hill and from 7 to 12 miles west of Dancy along the Little Eau Plaine River. In Clark County areas of Peat are found in the southern and western portions.

Description.—The material mapped as Peat consists of vegetable matter in various stages of decomposition. Much of the material is still in a raw fibrous condition, showing plainly the remains of vegetable growth from which derived. This raw fibrous material is of a brown color, but the more thoroughly decomposed it becomes the darker is the color. That which is well decayed is usually black or very dark brown. Small quantities of mineral matter may be incorporated with the organic matter, but when this becomes sufficient to change the texture appreciably, the material is classed as Muck. In the extensive areas of Peat little mineral matter is found, except about the margins, where there is frequently sufficient inorganic matter present to form Muck. Because of their limited extent, however, the areas of muck have been included with the Peat.

The depth of Peat is variable and ranges from 10 inches to over 20 feet. In practically all of the swamps where the area is a square mile or more in extent the Peat is over 3 feet deep. In

[1] See Bul. No. 205, Univ. of Wis. Exp. Sta., on the Development of Marsh Soils.

many of the smaller patches there is a margin of several rods where the underlying material can be reached at 12 to 20 inches, while in the center of the marsh it will be over 3 feet below the surface. In some of these places, however, the entire tract is shallow and where the depth of the Peat was less than 18 inches the material was mapped as Shallow Peat.

In the large swamps and marshes where the material is still raw there is very little difference between the character of the surface material and that several feet below the surface. Where conditions have favored rapid decomposition the material in the surface soil is frequently considerably darker than at lower depths. A profile section of such material may consist of from 8 to 16 inches of black, fairly well decomposed organic matter, underlain by a brown, or light-brown, raw, fibrous material extending to a depth of from 3 to 20 feet.

The material underlying the Peat is variable and ranges from sand to silt loam or clay loam. In general it may be stated that the texture of the underlying material is determined largely by the texture of the upland soil in the vicinity of the Peat areas. Throughout the areas of silt loam the underlying material is usually heavy and of a light-gray or bluish color. Throughout the sandy portions of the area practically always the Peat is underlain by a grayish or nearly white fine to medium sand, and in some instances there is considerable gravel mived with the sand.

Topography and drainage.—The surface of practically all of the Peat areas is level or has only a very gentle slope toward the water course along which it occurs. This slope is nowhere sufficient to drain the excess moisture from the Peat without the use of open ditches. Most of the Peat areas are wet for the greater part of the year and there is often a few inches of water over the surface in the spring, when most of the heavy rains occur. There are a large number of the Peat marshes which are on a sufficient slope to enable them to be successfully drained. In fact, it seems very probable that far the greater proportion of the Peat in the area is so situated as to permit of drainage. Up to the present time, however, only a very small proportion of it has been reclaimed. Along Little Eau Plaine River a drainage district has been established to reclaim a large tract of marsh land. Other drainage projects are now being developed

but the total area of Peat land actually producing crops is very small. On a few individual farms small patches of Peat have been reclaimed, but by far the greater proportion is unimproved.

Native vegetation.—The vegetation on the areas of Peat consists chiefly of tamarack, cedar, and spruce. There are a number of marshes which at present either do not support any timber or have only a scattering growth of spruce or tamarack. In most of these places the original timber has been completely destroyed by fire, though there are a few marshes which it seems were always treeless. On some of the open marshes there is now a growth of coarse grass which is cut for hay, though in the majority of cases the vegetation consists of sphagnum moss, cranberry vines, and other moisture-loving plants.

The underlying formation consists of sandstone or crystalline rocks and the upland soils are made up entirely of noncalcareous material. The Peat is practically all acid.

PEAT

Shallow phase

The total area of Shallow Peat is very limited. It is most extensively found in southern and western Clark County, and in scattered areas in the eastern half of Marathon County, with a few small tracts in other portions of the survey.

The material composing Shallow Peat consists of decaying vegetable matter in varying stages of decomposition, with which there may be mixed varying amounts of mineral matter. In some instances there is sufficient mineral matter to make the material a true muck, but because of its small extent a separation on this basis could not well be made in a general survey. In some places the Peat is raw and fibrous, while in others it is fairly well decomposed. The chief point of difference between the Shallow Peat and the typical peat is that the Shallow Peat never extends to a depth of over 18 inches. The underlying material is variable. In regions where the upland soils the heavy the subsoil of the Shallow Peat is usually a silt loam or clay loam, quite strongly mottled. Where the uplands are sandy the material is usually light—a sand or sandy loam, or in some cases a fine sand. The depth of the peat is variable and may range from 6 or 8 inches to 18 inches. In Clark County this

phase includes a few low sandy islands which were too small to be indicated on the map.

The surface features are the same as typical Peat and the phase occupies similar positions, though usually of smaller extent. Because of the low flat position the natural drainage is very deficient.

The origin of the Peaty portion of this phase is the same as the deep Peat, but the subsoil is residual in the sandstone country in southern and western Clark County, and glacial or residual from crystalline rocks over the remainder of the area. All of the Peat is in an acid condition.

The native vegetation varied. There was some tamarack in places, alder in others, and frequently some ash and elm trees. Some of the marshes were open and supported a heavy growth of coarse marsh grasses.

The cutting of marsh hay is about the only use to which this soil is being put at the present time, aside from supplying some grazing. In its present condition it has a low agricultural value, and before it can be farmed successfully it will be necessary to thoroughly drain it.

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 phosphorous, potassium, calcium, and magnesium, and have extremely high amounts of nitrogen in the organic matter. The average per cent of phosphorous 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 two feet 1350 pounds in comparison with upland soils which have approximately twice these amounts. Moreover, the acid condition of these soils renders the phosphorous less available than in non-acid soil.

The deficiency of potassium in these soils is greater than that of phosphorous. They contain on the average 0.3 per cent of potassium, while good upland clay loam soils average two 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 3,000 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 eight 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 phosphorous and potassium. 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 phosphorous 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.

Frosts on Marsh Land.—It is well known that frosts frequently occur on marsh land when there is no frost on higher land. This is partly because the cold air which forms on the surface of all the ground at night tends to flow down and collect in low places, but it is also the result of the fact that the loose, spongy soil of peat marshes does not conduct the heat received from the sun during the day downward. In consequence of this, the lower layers of soil do not become warmed in peat marshes as they do in other earthy soils and the little heat left in the surface inch or two of soil is rapidly lost at night by radiation, so that the freezing point is frequently reached on such soil when it would not be on more earthy soils such as sandy

loam or clay loam which would conduct the heat downward better during the day and so keep warm farther into the night.

This difficulty with peat marshes can be overcome to a certain extent by heavy rolling which, by compacting the soil, permits the heat to be conducted downward more readily. It will also to a certain extent become less in time, as the peat decomposes and takes on more of the character of muck. Nevertheless, it must always be expected that marsh land will be more subject to late Spring frosts and early Fall frosts than high land. It may be stated as a general guide, that the occurrence of killing frosts is as liable on marsh land at any given point as it is on upland soil having good air drainage about 150 miles farther north; in other words, the marshes of Dane County are as liable to have a frost which will kill corn as early as are the upland regions of Shawano, Marathon, or Clark Counties. The marsh land regions of the area surveyed are liable to have frost two weeks or more earlier than the hill tops of the same latitude.

Crops and System of Farming on Marsh Lands.—Since the growth of corn and potatoes to which these marsh lands would otherwise be well adapted, is limited in this section on account of the danger from frost, the best staple crops for this land are grasses for hay and pasture, hardy root crops, and rye, and to a less extent oats. When properly fertilized and limed, clover, alfalfa, and other legumes can also be grown. On fairly well drained marsh land not too raw, good pasture can also be developed. The compacting of the soil resulting from the use of this land as pasture is also a great benefit to it. When peat land is placed under cultivation a heavy roller should be classed along with implements necessary to its successful management.

On account of the crops to which this land is adapted and its use as a pasture, marsh lands can be used for dairying or stock raising to good advantage.

Certain special crops, such as cabbage, onions, buckwheat, and rape, are well adapted to such lands when well drained and fertilized.*

*For more complete discussion of the management of marsh soils see bulletin on this subject by the Agricultural Experiment Station.

WHITMAN SILT LOAM

Extent and distribution.—The Whitman silt loam is not an extensive soil, but it is found rather widely distributed throughout practically all portions of the area surveyed. Tracts which have been mapped usually range in size from 40 acres to 2 or 3 square miles, though there are a few areas which are somewhat larger than this.

Description.—The surface soil of the Whitman silt loam to an average depth of about 10 or 12 inches consists of a dark gray to black silt loam which usually contains a large amount of organic matter. This high organic matter content accounts largely for the dark color of the soil. The subsoil consists of a heavy gray silt loam which with increased depth gradually becomes somewhat heavier until at about 20 inches the material is a silty clay loam or clay loam which is usually strongly mottled with red, yellow, and brown. The subsoil is quite compact and the heavy material usually extends to a depth of over 3 feet.

In texture and structure the soil section is variable, and in many places the color of the surface soil is considerbaly lighter than the average. In a few places the subsoil was found to consist of asandy clay at a depth below 2 feet. In a few instances beds of stratified sand were found in the lower subsoil. Such variations, however, were of too limited extent to be indicated in a general survey. In general it may be said that the lighter colored phase is confined to Clark and Taylor Counties and the western part of Marathon County, although in these same regions the dark phase may also occur. The portion having the lightest textured subsoil occurs in regions where the upland contains more or less sandy material.

In a few instances, especially in Marathon and Lincoln Counties, isolated sections were found upon which stones and bowlders were very plentiful; these areas, however, were very small and symbols were used to indicate their location.

Topography and drainage.—The surface of the Whitman silt loam is level or very gently sloping. It usually occurs as narrow strips along the flood plains of streams or as rather small depressed areas in the upland. It occupies a position similar to the Clyde soils. There are a number of tracts where the surface is flat and where the soil is very similar in position to the

Colby silt loam, except that it is a trifle lower, making the drainage somewhat more deficient. Because of the heavy character of the material and its low position the natural drainage of this entire type is very poor.

Origin.—The material composing the Whitman silt loam has probably been derived from several sources. A large amount of the surface material is probably of the same origin as the Colby and Marathon soils. In some places where the material occurs in the flood plains of streams it is undoubtedly of alluvial origin. It may be that in a few instances it is a lacustrine deposit. Possibly some of the material has been influenced to a greater or lesser extent by glacial action. Litmus tests in the field indicate that both the soil and subsoil are strongly acid.

Native vegetation. The timber growth on the Whitman silt loam is made up of a great variety of trees. Ash and elm are quite common in some places, especially where the drainage is the most deficient. Over the better drained portions some birch, maple, and hemlock were also seen. Over some portions of the type no large timber has developed, but there is a dense growth of willows or alder. In a few instances a heavy growth of marsh grass was noted.

Present agricultural development.—On account of its low position and very poor drainage, but very little of this type of land has been improved. In a few instances small fields have been cleared and placed under cultivation, but because of its wet condition in the spring it is very difficult to put in cultivated crops. Some marsh hay is cut from this land in a few places and this is the most important crop which the type produces at the present time.

Chemical composition and fertility.—This soil is well supplied with mineral plant food elements and also with nitrogen and organic matter. From the standpoint of plant food which it contains it is doubtless the best balanced soil in the area. When this land has been supplied with good drainage the soil will prove to be very productive and well adapted to general farming. Without drainage it is doubtful if it can be utilized except for cutting hay and use as pasture.

VESPER FINE SANDY LOAM

Extent and distribution.—The Vesper fine sandy loam is confined almost entirely to the southwestern and southern parts of Clark County. One belt extends about 6 miles north and south from Columbia and has a width of from 1 to 5 miles. Another belt extends from the Black River east along the south Clark County line to within 2 miles of the southeast corner of this county. This belt has a width of from 2 to 5 miles. There are a few other scattered areas located in the same general regions. About 8 miles east of Knowlton in Marathon County there are 2 or 3 small tracts of this soil which amount to something less than one square mile.

Description.—The surface soil to an average depth of about 10 inches consists of a gray or yellowish fine sandy loam in the surface few inches of which there is a small amount of organic matter. The texture of the surface soil is somewhat variable and over limited areas may range from a fine sand to that of a loam or even a sandy clay loam. The subsoil of this type is also quite variable, but usually consists of a yellow or whitish fine sandy loam grading into light colored clay loam or sandy clay loam. Beneath the surface soil it is quite common to find a layer of gray or nearly white sand which may extend to a depth of 18 or 20 inches where a whitish or bluish clay is encountered. This clay or clay loam may have a depth of from 1 inch to 10 or 12 inches or sometimes more, and is frequently very plastic and impervious. This may grade into another layer of fine sand or it may rest immediately upon broken fragments of shaly sandstone rock. Rock fragments are very often found through the soil section and in some places the underlying sandstone comes within 18 inches or 2 feet of the surface. Under practically all of the type the sandstone can be reached within 3 or 4 feet of the surface. In many places small fragments of the underlying shaly rock appear on the surface. The color of the heavy material underlying this soil is extremely variable and may be gray, yellow, or nearly red, and frequently it is strongly mottled.

Topography and drainage.—The surface of this phase varies from flat to very gently undulating and the natural drainage is deficient. An exception to this is found on a few gentle slopes and low elevations where drainage is sometimes sufficient. The

poor drainage is due to two causes. The position of the type is usually rather low so that the ground water would be quite near the surface. In addition to this the underlying rock and beds of heavy material are sufficiently close to the surface to hold up any water which may fall upon the surface. During the spring and early summer the soil is extremely wet. After it has had sufficient time to thoroughly dry it up it is subject to drought because the moisture from underneath cannot readily reach the surface owing to the impervious layer in the subsoil.

Origin.—In origin this soil has been derived from the weathering of the underlying formation which consists of Potsdam sandstone. This sandstone formation has associated with it a rather shaly formation and it is from this source, it is thought, that the heavier portions of the type have been derived, while the fine sand has doubtless come from the disintegration of the sandstone itself.

Native vegetation.—The original timber growth over the main portion of this phase consisted chiefly of white and some Norway pine. This, however, has all been removed and there is now a second growth of popple and smaller brush including birch, gall berry, etc. On the small areas in Marathon County the present growth consists chiefly of small scrub red oak.

Present agricultural development.—Only a very small proportion of this type has been cleared and placed under cultivation. In a few places where fields have been cleared the land has been cultivated for a few years and then allowed to remain idle because of the low yields secured.

Chemical composition and fertility.—The surface soil as indicated is usually deficient in organic matter and nitrogen, and it has also been found to be deficient in the mineral plant food elements, especially phosphorous. These factors combined with the deficient drainage give this type in its present condition a rather low agricultural value.

In the improvement of this soil the first step should be supplying thorough drainage. When this has been provided the organic matter should be increased and in order that clover or alfalfa can be grown the soil should be limed, for it is all in an acid condition. The use of some mineral fertilizers would be desirable and possibly necessary, especially where stable manure is not obtainable. Such crops as timothy and alsike clover can

be raised successfully without the use of lime. When thorough drainage has been provided and a larger amount of organic matter supplied to the soil along with mineral fertilizers fair crops of corn and small grains can be grown. The system of farming best adapted to this class of land is one which will make possible the use of a considerable portion of it for pasture. It should provide very good grazing when cleared and sufficiently drained.

Genessee Silt Loam

Extent and distribution.—The Genesee silt loam is a type of minor importance. In Marathon County a small area is found east of Dancy along the Wisconsin River, and other tracts occur along the Little Eau Plaine river. A number of small tracts are found in Clark and Taylor Counties, especially along the Black River and along the south fork of the Eau Claire river.

Description.—The material composing this type of soil is extremely variable in texture and might well be classed as meadow land. A soil section which is probably the most common consists of a light brown silt loam extending to a depth of about 12 inches. The subsoil consists of a yellow or yellowish brown silt loam which at a depth of 18 or 20 inches usually grades into a a yellowish fine sandy loam or fine sand and gravel. In some instances the depth of the silty material was much greater than this and it was frequently found to extend to a depth of 3 feet or more. In such cases the subsoil was usually mottled. In a number of other cases the sandy layer in the subsoil was found to come much closer to the surface and in a few instances the surface soil was found to consist of a fine sandy loam. In general it may be said that the heaviest phase of this type is confined to the region where the upland soils consist largely of silt loam, while the sandy phase occurs in regions where the upland soils are inclined to be of a sandy nature. Probably the most extensive tract of the sandy phase is found along the south fork of the Eau Claire river and its tributaries in the western part of Clark County.

Topography and drainage.—This type occurs chiefly as narrow strips adjacent to streams and is almost always first bottom land subject to frequent overflow. Because of its low position the natural drainage is poor. In some instances where the bot-

tome land is a quarter of a mile wide it might be possible to drain some of this land. In most cases, however, where the bottoms are narrow it will be difficult to install drainage systems without lowering the bed of the stream along which it occurs. There are a few cases where the surface of this type is somewhat higher than usual and this condition is found adjacent to the upland. In such places the drainage is sometimes sufficient to permit the growing of cultivated crops. In Taylor County this type includes a number of areas which are commonly referred to as "beaver meadows" over which the poor drainage is largely due to the construction of dams by beavers.

Origin.—The material forming the Genesee silt loam is largely of alluvial origin and has been derived from the glacial, or residual material covering the region throughout which this type is found. The portion of the type adjacent to the highland may in some instances be partly colluvial. There is no limestone in this region and because of its absence an acid condition has developed to a marked degree in both the soil and subsoil of this type.

Native vegetation.—The original timber growth on this soil is varied, but consists largely of ash and elm. In a number of cases there is no growth of large trees but a dense growth of alder and willows. In some cases the only growth is coarse marsh grass.

Present agricultural development.—None of this type has been placed under cultivation chiefly because of its extremely poor drainage. In some instances marsh hay is being cut, but this is practically the only use which is being made of the type aside from its supplying a small amount of pasture.

Genesee Sand

Extent and distribution.—The Genesee sand is of limited extent. It is confined to Lincoln and Marathon Counties. The principal developments of this soil occur in the flood plains of the Wisconsin, Eau Claire, Big and Little Rib, and Little Eau Plaine Rivers in Marathon County. A number of small narrow bands of this type are found in the flood plains of many of the streams, but are often too small to be indicated on the soil map.

Description.—The surface soil of this type consists of a brown or light brown loose open sand extending to a depth of about 8 inches. The subsoil consists of a yellow or yellowish brown medium sand which is very loose and open in structure. This extends to a depth of 3 feet or more and in the deep subsoil it is common to find lenses of coarse sand and gravel.

The texture of this soil is quite variable and in a number of places small areas were found which could be classed as a sandy loam or a fine sandy loam had they been of sufficient extent.

Topography and drainage. The surface of this type is level or has a very gentle slope toward the stream along which it occurs. It is found as first bottom land and is subject to overflow. The natural drainage, therefore, for the greater part of the year is poor. When the streams are low, however, during dry seasons this soil dries out quickly.

Native vegetation.—On the better drained portions of the type some pine originally grew, while on the wettest portions willows and other water-loving trees and brush are frequently seen. Some portions of the type do not support any timber growth.

Present agricultural development.—But very little of this type has been placed under cultivation because of its low value and also because of the fact that most of it is subject to overflow. The type is deficient in organic matter and also in the mineral plant food elements. It is considered as having a low agricultural value and in order that crops may be successfully grown it will require very careful management. Because of the dangers of flooding in connection with its low fertility, it would not be advisable to attempt the improvement of this soil at the present time.

Dunning Sand

This is one of the inextensive and unimportant types of soil mapped in the present survey. It is confined chiefly to the southern and southwestern portions of Clark County where it is closely associated with the Vesper fine sandy loam. A few small patches occur in Marathon and Lincoln counties.

The surface soil of Dunning sand to an average depth of about 6 inches consists of a dark gray or nearly black medium to fine sand, containing considerable organic matter, especially in the first few inches. The subsoil is quite variable but usually

consists of an almost white medium or fine sand. Lenses of clay an inch or more in thickness are frequently found in the subsoil. The color of the surface is also variable, the most uniform characteristic of the type being its low set condition, and low present value.

The surface of this soil is generally flat, but in some instances it may extend some distance up a gentle slope where seepage keeps the ground wet. Both soil and subsoil are in a waterlogged condition much of the time and uniformily poor drainage is a characteristic of the type.

In origin the material forming this soil has been derived chiefly from the Potsdam sandstone. That found in Marathon and Lincoln Counties is partly from granite rocks. The dark color is due to the growth and partial decay of waterloving plants, but this accumulation has not been sufficient to make a Muck of Peat. In a few places where the type is adjacent to streams it may be partly alluvial.

The original timber growth was largely white pine but the present growth is largely scrubby alder, popple, mixed with gall berries, wintergreen, etc.

In its present condition this type has a low value, and but very little of it has been placed under cultivation. Drainage will improve this soil somewhat, but because of its low content of plant food it will require very careful management to produce profitable crops over a period of years. Money and labor can be expended to much better advantage on almost any of the other soils of the area.

Rough Stony Land

The material mapped as Rough stony land consists of a series of rock outcrops which take up such a large proportion of the surface that it is impossible to grow cultivated crops, and the land has no value for agricultural purposes beyond supplying a limited amount of grazing. While there is some soil between the outcrops, it is usually shallow, and in places sandy.

Rough stony land occurs in two portions of the area—one to the southwest from Wausau including Rib Hill and Mosinee Hill in Marathon County, and the other in western and southwestern Clark County, including North, Middle and South Mound, and several other tracts north of Humbird.

The Rock outcrop occurs as the highest portions of large hills, and on Rib Hill an elevation of 1940 feet is reached which is the highest point in the state. In all cases where Rock outcrop has been mapped it is the highest portion of the region and a conspicuous feature of the landscape.

The rock formation on Rib and Mosinee Hills consists of quartzite, while the bluffs in western Clark County are made up of Potsdam sandstone. Where sandstone prevails the intervening small areas of soil are sandy. Where the quartzite rocks are found the soil is usually a silt loam.

The only agricultural use being made of any of this land is for grazing, and only a very small amount is used for this purpose. It is very steep and broken, and rocky and in many places it would be difficult for stock to travel over it. It may be considered as non-agricultural land, and as having a lower value than any of the other portions of the area surveyed.

CHAPTER VII

AGRICULTURE AND CLIMATE

General Agriculture

The most reliable records available indicate that the first farming operations in the area surveyed were undertaken by a settler in what is now Berlin Town, Marathon County, in 1856. At that time the total population of Marathon County was about 500, but these early settlers were engaged in other industries than farming. The following year a number of families, some coming from Germany, settled in the region for the purpose of farming. Farming operations were begun about the same time in Clark County, but in neither of these counties was agriculture important prior to the close of the Civil War.

It was thought at first that the winters were too long and the summers too short for farming, but it was soon demonstrated that good crops could be grown in almost all parts of the area. Many of the early farmers were obliged to cut the timber and burn the logs, as the hardwood was of little value, only the pine being handled by the mills. It was a common practice in the early days, and is at the present time in the less developed sections, for farmers to work in the logging camps and mills during the winter months and to cultivate their fields and clear additional land in the summer. The farming methods originally followed were crude, but the virgin soil was very productive, and heavy yields were often obtained with little attention given to seed selection or cultivation.

Between 1870 and 1880 a large number of new farms were taken up in Marathon and Clark Counties; and, according to the census of 1880, there were 1,705 farms in Marathon County and 1,556 in Clark in that year. At this time comparatively few farms were operated in Taylor and Lincoln Counties. After 1880 agriculture developed rapidly, especially in Clark and

Marathon Counties, and at the pesent time large sections of these two counties are as thickly settled and as highly developed as many of the leading farming districts of southern Wisconsin. In Taylor and Lincoln Counties, however, there are large tracts of cut-over land in which no settlements have been made, and also extensive tracts of virgin forest of hardwood and hemlock.

The crops grown most extensively by the early settlers were hay, oats, and potatoes and other root crops. Oats and hay early became important sources of income, as the lumbermen required large quantities of feed for their stock. Wheat was grown to some extent in the older communities for a number of years, but the small grains have never attained as much importance here as in older sections of the State, chiefly because the oldest agricultural communities here had just become well established when grain growing elsewhere was at its height. With the decline in grain production more general farming was practiced, and dairying came to occupy an important place. Hay was often cut 5 to 10 years on the same field, and when the yields were no longer profitable the field was plowed for other crops. Little thought was given to crop rotation in the early days.

The following table, compiled from U. S. Census reports, shows the growth of the area surveyed in population and agricultural development since 1880.

Increase in Population and Agricultural Development

	Marathon	Clark	Taylor	Lincoln
Per cent of land area in farms:				
1890	27.76	23.82	10.34	11.00
1900	44.50	41.80	16.30	17.10
1910	53.60	52.80	21.50	21.60
Total number of farms:				
1880	1,705	1,566	266	153
1890	2,789	2,086	752	504
1900	4,276	3,456	1,168	924
1910	5,080	4,196	1,582	1,119
Total population:				
1880	17,121	10,715	2,311	2,011
1890	30,369	17,708	6,731	11,008
1900	43,256	25,848	11,262	16,269
1910	55,054	30,074	13,641	19,064
Value of all dairy produce exclusive of home use:				
1880	.....	.....	.....	.....
1890	.....	.....	.....	.....
1900	$136,058.00	$188,979.00	$26,598.00	$29,411.00
1910	883,816.00	1,171,341.00	240,383.00	138,753.00
Av. value of farm property per acre:				
1900	$14.29	$19.57	$10.88	$10.57
1910	29.35	34.68	23.31	21.67

The growth of the dairy industry, during the past 20 years, especially in Clark and Marathon Counties, has been marvelous. In Clark County alone the value of dairy products sold, as reported by the census, increased from $188,979.00 in 1900 to $1,171,340.00 in 1910. At present it is estimated that the yearly value of dairy products is close to $2,500,000. With this rapid growth in dairying has also come an increase in the acreage of

hay, corn, and small grain, and also a very substantial increase in land values

Chief Crops Grown.—The crops most extensively grown, in about the order of acreage devoted to each, are hay, oats, barley, corn, potatoes, rye, and wheat. There are more than twice as many acres in hay in the area as there are in any other one crop. The average yield of all kinds of hay is about 1½ tons per acre, but clover and timothy frequently yield from 2 to 3 tons per acre on the best soils. The Colby silt loam is the best hay and grass land in the area. On the Kennan and Marathon silt loams good yields of hay are also secured. The light sandy types are not well adapted to hay crops and yields are small. Some clover seed is grown, mostly medium red. The soils in this region show varying degrees of acidity so that alfalfa cannot be successfully grown without liming the soil. Inoculation is also necessary. The acreage given to alfalfa is very small.

Oats are grown more extensively than any other grain crop, in fact the acreage of oats is greater than the combined acreage devoted to all other grains. The average yield for the entire area in 1909 was approximately 30 bushels per acre. Yields on the light sandy soils are small, but on the silt loams and fine sandy loam types yields of 50 bushels per acre are common and 70 to 80 bushels per acre are frequently reported. Much of the oats is fed to stock on the farms, but on most farms the crop is also a direct source of income.

Barley is the second grain crop in importance and in 1909 there were 12,244 acres in Marathon County, and 9,063 acres in Clark, with 1,510 acres in Taylor, and 1,178 acres in Lincoln. The average yield that year was about 25 bushels per acre. Most of the crop is grown on silt loam types and some on fine sandy loam, on both of which it does very well. On the lighter soils yields are low. On the best fields yields of 35 to 50 bushels are not uncommon.

Corn is the third grain crop in the area from the standpoint of acreage. Yields of 40 to 50 bushels per acre are not uncommon and higher yields are sometimes reported. Large amounts are grown for silage in Clark and Marathon Counties; it is safe to say that the acreage put into the silo is larger than that which is allowed to mature. As dairying develops the number of silos also greatly increases and the acreage devoted to corn is ex-

tended. Golden Glow, Silver King, and Wisconsin No. 8 are dent varieties that are successfully grown in addition to the native yellow dent corn of mixed breeding. Flint corn is also grown. Loams and heavy fine sandy loams make the best corn land for this region, since these warm up earlier than heavier types. Level portions of Colby silt loam and Antigo silt loam are rather "cold" and "late."

Rye is grown in all four counties, but only to a rather limited extent. Yields average about 18 bushels per acre. It is grown mostly on the sandy soils and does better on such types than any of the other small grains.

Wheat has never been extensively grown in this region, but it can be raised successfully. In 1909 the yield from 1878 acres in Marathon County was about 15 bushels per acre. In Clark County there were 1116 acres devoted to the crop during the same year.

Potato growing has not been extensively developed on a commercial scale within the area except at a few points. The sandy types of soil within the valley of the Wisconsin River and its tributaries produce most of the potatoes. On the heavy soils such as the Colby silt loam potatoes are grown chiefly for home use. Average yields are largest where the bulk of the crop is grown on sandy soils. The varieties grown most extensively are Early Ohio, Triumph, Hebron, Early Rose, Rural New Yorker, and Burbank. Efforts are being made to encourage the growing of fewer varieties and purer strains in order to secure more uniformity in market and seed stock.

Peas are grown chiefly for seed, though not to a great extent. In 1909 there were 1,699 acres in Marathon County and less than 400 acres in any of the other three counties. The crop does well on many of the soils and could be profitably grown to a greater extent. Yields usually range from 15 to 20 bushels.

Buckwheat is frequently grown and with success, but the acreage is not large. Yields usually range from 15 to 18 bushels per acre.

While beans could be grown successfully in many portions of the area, the acreage devoted to this crop is small. They are grown chiefly on the sandy soils.

The following table, compiled from the Thirteenth Census,

gives the acreage production in 1909 of various general farm crops in each of the four counties surveyed.

Approximate Acreage and Production of Chief Crops by Counties

	Marathon	Clark	Taylor	Lincoln
Approximate land area in square miles ..	1,554	1,218	991	902
Number of farms	5,080	4,196	1,582	1,119
Hay and forage:				
Acres	69,596	60,239	18,239	13,678
Tons	102,477	104,261	27,951	17,909
Corn:				
Acres	3,742	8,833	214	275
Bushels	131,419	264,560	7,587	7,944
Oats:				
Acres	38,085	24,455	3,507	5,087
Bushels	1,058,750	809,770	112,960	168,328
Barley:				
Acres	12,244	9,063	1,510	1,178
Bushels	312,449	234,002	40,620	27,294
Potatoes:				
Acres	6,856	2,992	1,193	1,477
Bushels	649,764	336,540	170,356	199,890
Rye:				
Acres	3,985	2,972	523	297
Bushels	62,194	59,378	10,955	5,282
Peas (dry):				
Acres	1,699	376	196	257
Bushels	26,795	7,729	4,479	4,105
Wheat:				
Acres	1,878	1,116	70	107
Bushels	29,493	20,625	1,536	1,952

Special Crops.—There are a few special crops and truck crops grown within the area, though no one line of intensive agriculture has become highly developed in this part of Wisconsin. Sugar beets can be grown successfully, though the present

acreage is very small. Kennan silt loam and the well drained areas of the Colby silt loam and Antigo silt loam are well adapted to this crop.

Ginseng is grown by quite a number in various parts of the area, but the total acreage is small. One of the gardens at Wausau has the reputation of being the largest in the United States. All gardens are artificially shaded and great care and patience are necessary in growing this crop. The salable products from this plant are the dried roots, dry seed, and germinated seed, though the dry roots constitute the main product. The dry roots bring from 4 to 7 dollars per pound on the local markets. It requires 18 months for the seed to germinate and it is about 5 years from the time the seed is planted until the roots are large enough to be marketed.

Fruit and Truck Crops.—The trucking industry is not extensively developed in any part of the area, though in the vicinity of many of the towns small tracts are devoted to special crops. Apples are grown more extensively than other tree fruits, but these are raised only in small home orchards, there being no commercial orchards in the area. In 1909 Clark and Marathon Counties produced a total of 33,824 bushels of apples. Most home orchards are found on the Kennan silt loam and well drained Colby silt loam, though there are numerous farms upon which no apple trees are found. Strawberries are raised in all parts of the area for home use chiefly. Raspberries and black berries grow wild throughout the survey and can be profitably rasied commercially, but this line has not been taken up to any extent.

Stock Raising.—The raising of beef cattle has not reached any extensive proportions in this part of Wisconsin, although on many farms some stock is fattened for market. Excellent pasture is afforded, especially on the heavier types of soil, and in addition to the profits derived from selling cattle, their grazing assists in the clearing of the new land, which is a very important factor. Beef cattle can be kept over winter with profit, and it is believed that they can be profitably fattened in all the counties. Horses are not extensively raised for the market, but many farmers raise their own work stock. Hogs are kept, chiefly in conjunction with dairying, but the number is not as great as in sections where corn is more sure to mature. Sheep are raised

even in smaller numbers than are hogs. Some poultry is kept on practically all the farms, and the products sold figure materially in the income from the farm. A few farmers keep bees, and some place small quantities of honey on the market each year.

The following table, compiled from the 1910 census, gives a fair idea of the distribution and value of live stock, poultry and bees.

Distribution and Value of Livestock

	Marathon	Clark	Taylor	Lincoln
Cattle:				
Number	59,089	54,481	13,630	9,112
Value	$1,180,617	$1,365,408	$291,367	$173,841
Horses:				
Number	11,866	11,071	2,803	2,398
Value	$1,337,972	$1,160,380	$320,291	$279,064
Hogs:				
Number	18,079	16,611	2,706	3,478
Value	$115,347	$128,181	$22,806	$23,938
Sheep:				
Number	24,232	12,400	1,730	3,882
Value	$64,012	$50,918	$4,775	$10,789
Poultry, all kinds:				
Number	149,799	128,474	34,027	31,562
Value	$57,211	$52,881	$14,655	$12,361
Colonies of bees:				
Number	2,066	2,166	329	538
Value	$9,046	$7,845	$1,534	$2,178

Dairying.—Dairying is the most important branch of agriculture followed at the present time in the area surveyed, and the one which gives the greatest promise of the most extensive growth as the undeveloped portions of the region are settled up. Animals of Holstein breeding are more plentiful than cattle of other breeds. While the majority are grades, the number of pure breds is quite rapidly increasing. Pure bred sires are

most commonly used and the standard is constantly being raised. In 1909 the value of dairy products for the whole area amounted to the sum of $2,434,290. At present the annual output doubtless exceeds $3,000,000. In 1913 there were 84 cheese factories and 17 creamies in Marathon County and 71 cheese factories and 24 creameries in Clark County. The cheese factories are constantly increasing in numbers, while the creameries are decreasing, especially in the older settled regions. The silo is in common use and the numbers are rapidly increasing.

The following table, compiled from the 1910 census and from the Wisconsin Dairy Statistics for 1913, gives the number of dairy cows in the various counties of the area and the number and distribution of cheese factories and creameries.

Status of Dairy Industry

	Marathon	Clark	Taylor	Lincoln
No. of dairy cows	30,430	32,300	7,745	4,642
Milk produced—gal.	7,950,379	9,960,135	1,363,665	964,843
Creameries:				
1910	29	33	11	4
1913	17	24	11	5
Cheese factories:				
1910	61	50	5	12
1913	84	71	5	13
Value of dairy products, excluding home use of milk and cream.	$883,816	$1,171,341	$240,383	$138,753

Total value of dairy products for entire area for year 1909..... $2,434,290

Relation of Soils and Crops.—The question of the adaptation of soils to crops has not been given as much consideration in this region as in older sections of the country. It is generally recognized, however, that certain soils favor certain crops or class of crops as, for instance, that rye will do better on sandy soils than any other small grain. Greater success is possible in dairying on the silt loam soils than on the sandy lands, since the heavy types are much better adapted to grasses and clovers and corn than the light soils. Potatoes, beans, and buckwheat give good results on the sandy types.

Crop Rotations.—Various crop rotations are practiced within the area, but little careful study has been given to the selection of rotations best adapted to the individual types of soil. Many instances were observed where fields have been allowed to re-

main in grass, cut for hay for five to eight years. In other cases small grains have been grown for years upon the same field without the introduction of any legumes or intertilled crops. In the southern part of the area, on the silt loam soils where considerable corn is grown a rotation quite commonly consists of corn 1 year followed by oats or barley seeded to timothy and clover. Hay may be cut for 1 or 2 years and the field then pastured for a year or two, after which it is again plowed for corn. On the sandy soils a common rotation consists of rye 1 year, followed by clover, and this crop by potatoes, corn, or beans. Buckwheat may then be grown for 1 year.

Weeds.—The most important weed pests within the area are the Canada thistle and quack grass. The use of imported feed in the lumber camps is largely held responsible for the introduction of these weeds. In a number of places they are so abundant as to materially reduce yields in the fields they infest. Wild mustard is abundant in places.

Land Clearing.—In the opening up of new farms the clearing of the land is the first operation. In some sections stones are plantiful and their removal sometimes is as expensive as clearing of timber. This, however, is unusual. Usually a site is selected which seems best suited for the location of the farm buildings, and clearing goes on from this center. All brush, logs, and stumps may be removed from a small tract for cultivated crops, and a larger area simply cleared of brush and logs sufficiently to be seeded and pastured. The stumps can then be gradually removed, or cultivated crops grown between them. After a few years the hardwood stumps will decay and can be readily pulled or burned out. Stump-pulling machines, dynamite, and fire are used in removing the stumps. In many places fires have run through the cut-over country and cleared away most of the underbrush and old logs, so that the cost of preparing the land for the plow is greatly reduced.

Land Values

As shown by the census of 1910 the average value of farm property at that time was $21.67 per acre for Lincoln County, $23.31 per acre for Taylor County, $29.35 for Marathon County, and $34.68 per acre for Clark County. The increase in value during the decade from 1900 to 1910 was approximately 100 per

cent. The selling price of improved and unimproved land is variable, depending upon the character of the soil, topography, location, improvements, and merchantable timber. Some of the lightest sandy soils can be bought for $5.00 per acre. The best grade of cut-over land frequently brings 20 to 25 dollars per acre and most of the wild land without timber has a value between these limits. Hardwood-timber land has a selling value of 20 to 50 dollars per acre, depending upon its location, condition of the timber, and ease with which it can be gotten out. In the regions where farming is well developed, as in most sections of Clark County and much of Marathon County, land values are quite high, numerous well located and well kept farms having been sold for $100 or more per acre. Probably the majority of farms throughout the best developed farming communities would have a selling value of between 60 and 100 dollars per acre.

The following table, compiled from the 1910 census, shows the conditions as to size, state of improvement, value, and tenure of farms in the counties in the area surveyed.

Size, Improvement, Value, and Tenure of Farms

	Marathon	Clark	Taylor	Lincoln
Approximate land area, acres	994,560	779,520	634,240	577,280
Per cent of land area in farms	53.6	52.8	21.5	21.6
Per cent of total land area improved	18.5	29.5	4.3	5.7
Average size of all farms, acres	105	98	86	112
Per cent of farm land improved	34.6	36.9	24.8	26.8
Average improved land per farm, acres	36	36	21	30
Improved land in farms, acres:				
1910	184,153	151,891	33,892	33,549
1900	145,060	120,964	23,392	23,317
Average value per acre of farm property:				
1910	$29.35	$34.68	$23.31	$21.67
1900	14.29	19.57	10.88	10.57
Per cent of farms operated by owners	95.8	91.8	96.1	95.6

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 agriculture which can be practiced to best advantage.

The distribution of rainfall over Wisconsin is remarkably uniform, the average yearly precipitation ranging 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 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 seaosnal distribution, and in this respect Wisconsin is unusually fortunate, since about half of the total rainfall occurs 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. The small winter precipitation in Wisconsin, mainly in the form of snow, causes virtually no erosion or leaching of fertility from the soil. The average rainfall for the state during the winter is 3.9 inches, during the spring 8.3 inches, during the summer 11.4 inches, and during the autumn 7.4 inches.

The following table gives the mean precipitation at three points within the survey. Records for Madison are also given for purposes of comparing the area with southern Wisconsin.

*For further information see Wisconsin Expt. Sta. Bul. 223.

Mean Monthly, Seasonal, and Annual Precipitation

	Wausau	Neillsville	Medford	Madison
	inches	inches	inches	inches
December	1.26	1.63	1.29	1.72
January	1.16	1.11	0.96	1.63
February	1.11	1.42	1.09	1.50
Winter	3.53	4.16	3.34	4.85
March	1.84	2.14	1.45	2.08
April	2.58	2.84	2.26	2.54
May	4.11	4.24	4.26	3.66
Spring	8.53	9.22	7.97	8.28
June	4.18	4.91	5.10	4.01
July	4.19	3.79	4.09	3.80
August	3.58	3.28	3.52	3.15
Summer	11.95	11.98	12.71	10.96
September	3.70	3.77	4.05	3.08
October	3.02	2.92	3.41	2.32
November	1.70	1.74	1.57	1.76
Fall	8.42	8.43	9.03	7.16
Year	32.43	33.97	33.05	31.25

Average for three stations in area surveyed..... 33.15 inches.
The average snowfall at Neillsville is..... 40.70 "

It will be seen from the above table that the mean annual precipitation of the area surveyed is 33.15 inches and that the greater part of this occurs during the growing season when most needed. It will be noted that for the months from April to October inclusive there is an average monthly rainfall of over 2.25 inches and that for the months from May to September, inclusive, the rainfall is over 3 inches for each month.

The northern portion of the area surveyed occupies part of

the southern slope of the Northern Highland, and the southern portion of the area occupies the northern extremity of the Southern Highland. These highlands are two of the eight climatic provinces of Wisconsin. The greater portion of the area has an elevation of from 1,000 to 1,600 feet above sea level. The main streams traversing this region have a general course from north to south. This section is characterized by cold winters and warm summer days with rather cool nights. In the northern part of the survey the average growing season for corn is about 110 days, while in the southern part is about 130 days. Clark and Marathon Counties have a growing season of nearly the same length as Juneau, northern St. Croix, northern Trempealeau, and northern Sauk Counties.

The following table gives the average dates of the last killing frosts in the spring and the first in the fall at various stations within the survey and also at Madison, Wisconsin.

Average Dates of Killing Frosts

Station	Length of record (years)	Last killing frost in spring*	First killing frost in fall*	Elevation of station above sea level—feet
Wausau	14	May 30	Sept. 22	1,212
Neillsville	21	May 23	Sept. 20	996
Medford	19	June 3	Sept. 12	1,420
Madison	31	April 22	Oct. 18	974

*Aggregate.

From this table it will be observed that the average date of the first killing frost in the fall at the different stations ranges from Sept. 12 to Sept. 22, and of the last killing frost in the spring from May 23 to June 3. In the extreme northern part of the area light summer frost may occur, but these are seldom so severe as to injure growing crops. As the timber is cleared away, the land more thoroughly drained, and more of the land put under cultivation the growing season gradually lengthens.

The table following gives the mean monthly, seasonal, and annual temperature as recorded at three stations within the area. Records for Madison are also given so temperatures may becompared with those prevailing in the southern part of the state.

Mean Monthly, Seasonal, and Annual Temperature

	Wausau	Neillsville	Medford	Madison
	F°	F°	F°	F°
Elevation of station	1,212 ft.	996 ft.	1,420 ft.	974 ft.
December	18.3	19.1	17.9	22.8
January	14.8	13.1	12.9	16.9
February	14.9	13.8	13.6	18.7
Winter	16.0	15.3	14.8	19.5
March	27.6	27.8	26.2	30.4
April	43.0	44.2	42.1	45.6
May	55.4	55.5	53.9	57.6
Spring	42.0	42.5	40.7	44.5
June	64.6	65.9	65.1	67.3
July	68.3	69.8	68.8	72.0
August	66.5	67.1	67.1	69.7
Summer	66.5	67.6	67.1	69.7
September	59.2	59.4	59.7	62.3
October	46.9	46.9	46.0	50.0
November	32.3	31.3	30.2	35.1
Fall	46.1	42.5	45.3	49.1
Year	42.6	42.8	42.0	45.7

It will be seen from this table that the mean summer temperature at the different stations ranges from 66.5° to 67.6° and that the mean annual temperature for the three stations is 42.4° F. There are only a few days during summer when the temperature rises above 90°, and it seldom reaches 100°. There are also only a few days during winter when it falls lower than 20° below zero.

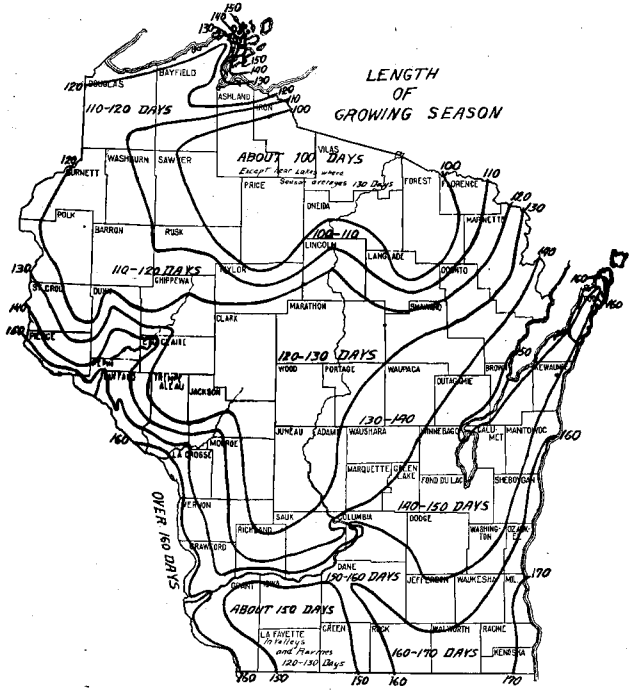

Fig. 2.—Map showing length of growing season for corn. Data collected since the above map was prepared, and covering a longer period, show the counties covered by this report to have a growing season of from a week to ten days longer than is indicated by this map.

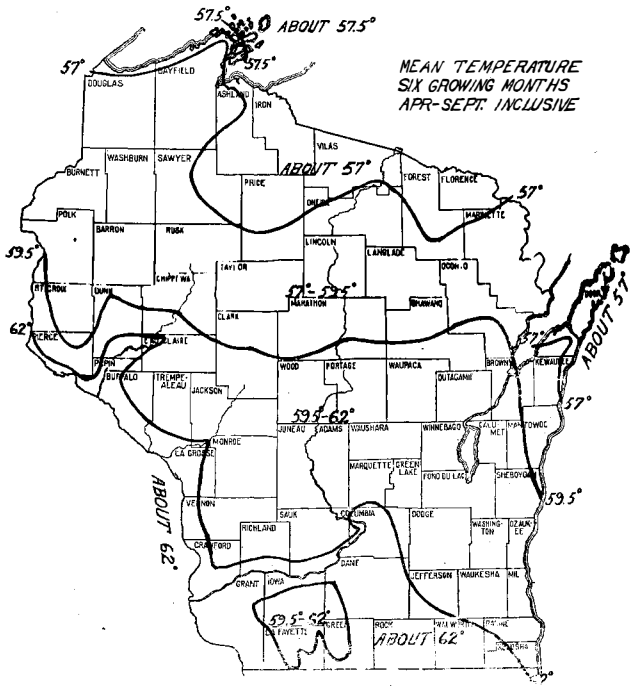

Fig. 3.—Map showing average temperature for the six growing months April to September, inclusive. Note that the difference between the average temperature for the area surveyed, and the southern portion of the State is only slight.

While the growing season for corn, potatoes, and other crops affected by light frosts is relatively short in the extreme northern portion of the area, the growing season for small grains, grass and root crops is more nearly equal to that in the southern part of the state. The spring is a little later, but grass and hardy vegetables grow nearly if not quite as late in the fall as they do in southern 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 good quality. These factors, together with the large areas of excellent unimproved agricultural land, especially in Taylor and Lincoln Counties, are instrumental in attracting large numbers of new settlers to the region.

SUMMARY

The area covered by the reconnoissance soil survey of the South Part of North Central Wisconsin includes four counties—Marathon, Clark, Taylor, and Lincoln, and embraces a total area of 4,865 square miles or 3,113,600 acres, located just north of the center of the state. The surface features of the northern and eastern portions of the area are characteristic of a glacial region and the topography ranges from level to rough and broken, but the remainder of the survey has a surface much older geologically, and the topography is more mature. Slopes are long and gentle and but few lakes and swamps are found. Elevations range from about 784 feet to 1,940 feet above sea level. The major portion of the region ranges from 1,000 to 1,600 feet above sea level. The streams traversing the region afford much potential water power. The first mill in Marathon County was established in 1840. In 1855 German immigrants started to come into the region and agricultural development may be said to date from about this time. Lumbering was the most important industry for a long period and is still important in Taylor and Lincoln Counties. Agricultural operations were not well under way until the seventies and farming could not be considered of much importance before the eighties, when the southern portion of the region surveyed, in Clark and parts of Marathon Counties, were rapidly being settled and put under cultivation. Throughout the northern part of the area lumbering is still an important industry, but agriculture is rapidly developing wherever the timber has been removed and the land is of good quality.

Three important railway systems and several smaller lines traverse this region, providing excellent transportation facilities and connecting this section with most of the largest and most important markets of the Middle West.

The winters of this region are long and cold, but the summers are delightful, and all crops make rapid growth. Excellent water is available in all parts of the area, and the region is a healthful one.

Within the region surveyed all stages of agricultural development are represented. In the southern portion of the survey, in Clark and Marathon Counties, much of the land is highly improved with values ranging from 60 to over 100 dollars per

acre, while in Taylor and Lincoln Counties there are still numerous extensive tracts of virgin hardwood forest. Cut-over land can be bought for $5 per acre and up, depending upon the character of the soil and location. The lightest sandy soils, originally covered with pine, have a low agricultural value, but the cut-over hardwood regions include much excellent land which offers exceptional opportunities for agricultural development. This land can be bought for from 10 to 25 dollars per acre. The chief crops grown at present are oats, hay, corn, potatoes, barley, rye, wheat, peas, and some buckwheat, with small patches of truck crops close to the towns. As reported in the census of 1910 Marathon County had 53.6% of its entire land area in farms, and 18.5% of the total land area was improved. In Clark County 52.8% was in farms and 29.5% of the total was improved. In Taylor and Lincoln Counties only 4.3% respectively of the total area was improved. During the past decade development has been rapid so that at the present time there is a larger percentage of improved land in all of these counties. During the decade 1900 to 1910 the average value of farm property practically doubled. The type of farming chiefly followed at present consists of general farming in conjunction with dairying. In 1913 there were 173 cheese factories and 57 creameries in the area. For 1909 the output of dairying products for the area amounted to $2,434,000, and the total for Clark County alone was $1,171,000.

The soil material covering the region has been derived largely from the underlying geological formations of which there are several. Twelve soil series and 30 soil types, excluding peat, have been recognized and mapped in this survey.

KEEP THE MAP

The Experiment Station will publish bulletins from time to time dealing with the managment 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.