U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY, E. A. BIRGE, DIRECTOR; COLLEGE OF AGRICULTURE, UNIVERSITY OF WISCONSIN, H. L. RUSSELL, DEAN; A. R. WHITSON, IN CHARGE SOIL SURVEY.

SOIL SURVEY OF PORTAGE COUNTY, WISCONSIN.

BY

W. J. GEIB, IN CHARGE, AND L. R. SCHOENMANN, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND LEWIS P. HANSON, OF THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY.

THOMAS D. RICE, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1915.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1917.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., January 18, 1917.

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of Portage County, Wis., and to request that they be published as advance sheets of the field operations of the Bureau of Soils, 1915, as authorized by law.

The selection of this area was made after conference with the State officials cooperating with the Bureau in the work of surveying and classifying the soils of Wisconsin.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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SOIL SURVEY, PORTAGE COUNTY, WIS.

By W. J. GEIB, In Charge, and L. R. SCHOENMANN, of the U. S. Department of Agriculture, and LEWIS P. HANSON, of the Wisconsin Geological and Natural History Survey.—Area Inspected by THOMAS D. RICE.

DESCRIPTION OF THE AREA.

Portage County is situated in the central part of the State of Wisconsin. It comprises an area of about 812 square miles, or 519,680 acres. It is bounded on the north by Marathon County, on the east by Waupaca County, on the south by Waushara and Adams Counties, and on the west by Wood County. Stevens Point, the county seat, is 108 miles north of Madison by rail and 252 miles from Chicago. It is in about the same latitude as Bangor, Me., and Pierre, S. Dak., and in about the same longitude as Springfield, Ill., and Memphis, Tenn.

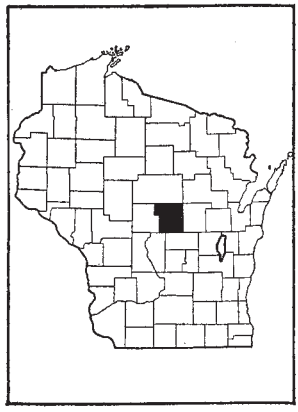

FIG. 1.—Sketch map showing location of the Portage County area, Wisconsin.

A preliminary report and map on the soils and agricultural conditions of north-central Wisconsin, made by Dr. Samuel Weidman, of the Wisconsin Geological and Natural History Survey, were published in 1903. This survey covered Taylor, Lincoln, Marathon, Clark, Wood, and Portage Counties, and parts of Langlade and Rusk Counties. In 1905 a soil survey of Portage County was made by F. N. Meeker and R. T. Avon Burke, of the United States Department of Agriculture. The present survey was undertaken for the purpose of making a more detailed study of the soils and reclassifying them in the light of more recent studies, so that the mapping in this county should be consistent with that now being done in other sections of the State. The information contained in the reports covering the earlier work has been drawn upon in the preparation of the present report.

The surface features of Portage County fall naturally into three divisions. Extending north and south through the county, from a point near the center of the north line to the southern and southwestern boundaries, is an extensive belt of level land. On the south this has a width of about 18 miles, but it becomes narrower toward the north and on the northern boundary line is about 12 miles wide.

The soils over this extensive plainlike tract are made up largely of water-laid stream-terrace and outwash-plain deposits. Some very extensive tracts of marsh occur within this level belt. To the west of this level land, in the northwestern corner of the county, a driftless area occurs. Here the surface is undulating and the topography more mature than elsewhere in the county. The slopes in this section are usually long and gentle. East of the level area, over about one-third of the county, the surface is characteristic of a glaciated region. Immediately bordering the level plain on the east is the terminal moraine of the late Wisconsin ice sheet forming a drainage divide. Back of this, drumlins, recessional moraines, high terraces, eskers, potholes, and other topographic features make up a surface which ranges from level to rolling and hilly and comprises the roughest part of the county. Some slopes here are too steep to be cultivated, and on others farming operations are carried on with difficulty. Throughout the plainlike region there are only slight differences in elevation, and most of the lower places are occupied by marshes. In the northwestern section there are no steep slopes and but few marshes.

The general slope of most of the county is from north to south. Elevations above sea level at various places are as follows: Stevens Point, 1,086 feet; Junction, 1,142 feet; Almond, 1,161 feet; Amherst Junction, 1,101 feet: Bancroft, 1,089 feet; and Rosholt, 1,135 feet. The average elevation of the county is about 1,100 feet above sea level.

The principal drainage way is the Wisconsin River, which flows southward across the northwestern corner, within the border of the more level area in the central part of the county. Both the Little Eau Pleine and the Plover Rivers empty into the Wisconsin within the county. Buena Vista and Tenmile Creeks, which empty into the Wisconsin River in Wood County, drain the large swampy area in the southwestern part of Portage County. Mill Creek, another small stream tributary to the Wisconsin, drains the northwestern part. The water of all these streams eventually reaches the Mississippi River. East of a divide which extends north and south through the eastern part of the county the Waupaca River and the Little Wolf River, with many tributaries reaching throughout this section, flow to the southeast and finally reach Lake Michigan.

Throughout the area of the moraine there are numerous comparatively small lakes where water has accumulated in depressions in the uneven surface. Some of these lakes have no surface outlet. Some depressions which were originally lakes are now marshy or swampy areas, while in others the accumulated organic matter has so far decayed as to form a peaty or mucky soil. In the southwestern part of the county there is a marshy area, covering about

55,000 acres, a large part of which has been drained. Another large marsh occurs along the Little Eau Pleine River, in the northwestern part of the county. Part of this also has been reclaimed.

The streams of the county are still cutting their channels deeper, and in most of them the current is quite swift. Water power is developed extensively on the Wisconsin River, and more is available for development. The smaller streams present some possibilities for power development.

Portage County was organized in 1844 to embrace a large part of northern Wisconsin. By later acts of the legislature several other counties were formed from its original territory. The last county to be set off was Wood, in 1856. As late as 1820 this part of Wisconsin was an unbroken wilderness. It was first visited by white men for the pine timber. In 1836 the Menominee Indians ceded a strip of land 40 miles long and 3 miles in width on each side of the Wisconsin River. This was offered for public sale in 1840, and considerable land was thus made available for occupation and settlement. The first settlers came principally from Illinois, Ohio, Pennsylvania, New York, and Maine, with a few from Canada. Quite a large proportion of the present population is made up of Poles, Germans, Norwegians, and Swedes, who came into this territory mostly between the years 1850 and 1870. Many of them came directly from Europe and others from the Eastern and Central States.

In 1910 the population of Portage County was 30,945. Of the total population, 71.9 per cent is classed as rural, the urban population being confined to the city of Stevens Point. The density of rural population is 27.4 persons per square mile.

Stevens Point, the county seat, had a population in 1910 of 8,692. It is the only town in the county having a population of over 1,000. Among the towns and villages are Junction, Plover, Arnott, Amherst, Bancroft, Rosholt, Almond, and Custer.

Four railway systems have lines extending into this county, the Chicago & North Western, the Green Bay & Western, the Minneapolis, St. Paul & Sault Ste. Marie, and the Chicago, Milwaukee & St. Paul. Almost every section has good transportation facilities. Throughout the plainlike region the wagon roads are naturally sandy, as are some in the southeastern part of the county. Throughout the remainder of the county the soils are heavier and the roads are naturally better. In practically all communities good roads are being constructed, and there are now many miles of excellent highways. Rural mail-delivery routes reach all parts of the county, and the telephone is in common use throughout the country districts.

The towns within the county provide markets for considerable farm produce, but most of the surplus from the farms is shipped out.

Live stock goes mostly to Chicago and Milwaukee, as does also the potato crop. Dairy products find a market throughout the Middle West.

CLIMATE.

The climatic conditions in Portage County are fairly uniform from place to place except in regard to frost occurrence. The liability to frosts varies somewhat with local differences in topography. Throughout the northeastern, east-central, and extreme northwestern parts of the county, where the surface is gently rolling to rolling, the danger from late spring and early fall frosts is not as great as over the lower lying sections, such as the extensive marsh areas in the southwestern part of the county and the sandy tracts, with numerous intervening marsh areas, throughout the valley of the Wisconsin River and along part of the southern border.

Climatic data from two stations of the Weather Bureau are given below. The records from the station at Stevens Point, which is near the Wisconsin River, are representative of conditions prevailing over the extensive level, sandy terraces throughout the county. The station at Amherst is situated in a more rolling country and represents the upland part of the county.

Normal monthly, seasonal, and annual temperature and precipitation at Stevens Point and Amherst.

Month.	Stevens Point (elevation, 1,113 feet).		Amherst (elevation 1,200 feet).	
	Temperature.	Precipitation.	Temperature.	Precipitation.
	° *F.*	*Inches.*	° *F.*	*Inches.*
December	19.2	1.34	19.4	0.63
January	14.7	1.08	14.1	1.27
February	14.3	.76	14.3	1.28
Winter	16.1	3.18	15.9	3.18
March	29.1	1.32	27.9	1.78
April	44.8	2.55	43.8	2.61
May	56.1	4.04	55.1	4.07
Spring	43.3	7.91	42.3	8.46
June	66.0	3.92	64.9	4.29
July	69.8	3.34	69.6	3.62
August	67.4	3.07	67.3	3.27
Summer	67.7	10.33	67.3	11.18
September	60.2	3.51	60.0	3.25
October	47.1	2.69	47.7	2.60
November	32.7	1.61	31.7	1.70
Fall	46.7	7.81	46.5	7.55
Year	43.5	29.23	43.0	30.37

The climate of this region is healthful and well suited to a high development of agriculture. Storms of a destructive nature are very rare. The winters are long and severe, with an average snowfall of about 41 inches, but the summers are pleasant and farm crops make a rapid growth. A large proportion of the rainfall occurs during the growing months, when most needed, but occasionally, especially in July and August, crops suffer from lack of moisture.

The average date of the last killing frost in the spring as recorded at Stevens Point is May 25, and that of the first in the fall, September 26. The average growing season in the vicinity of this place is thus about 123 days in length. At Amherst the average date of the last killing frost in the spring is May 22, and that of the first in the fall, September 27. The records of the Stevens Point station cover a period of 17 years and those of the Amherst station a period of 18 years.

AGRICULTURE.

The development of agriculture in this region was preceded by the growth of the logging and lumbering industry. The earliest settlements, about 1840, were made in the areas of sandy land, as the forest growth here was largely pine, which was the only timber handled by the early lumbermen. Hardwood at that time had but little value, and where early clearings were made in hardwood areas the timber was frequently burned.

The first farms opened after the advance of the lumbermen were small, and often large areas of land remained in the cut-over stage for a considerable time before being parceled out in small tracts. While farming ventures were first begun chiefly on the sandier soils, following the cutting of the pine, the highest agricultural development has been reached in those sections where the soils are heavier than those immediately along the Wisconsin River. Farming has extended to all parts of the county, and on the whole it is well improved agriculturally. The sections of least development are in the north-central and northeastern parts of the county and in those regions where marshy conditions prevail over large areas.

While practically all the general-farming crops now grown were produced in the early history of the county, the relative importance of a number of the crops has changed to a considerable degree. In 1879 wheat occupied 21,853 acres, more than twice the acreage in oats. By 1909 the total area devoted to oats had increased to 37,838 acres, while only 397 acres were devoted to wheat. The acreage devoted to hay, corn, and rye has steadily increased since the early history of the county. The development of the potato-growing industry has been very marked. In 1879 there was a total production of 213,570 bushels, while in 1909 the crop amounted to slightly over 2,500,000 bushels.

The agriculture of Portage County at present consists chiefly of general or mixed farming, with dairying and potato growing as the two most important branches. The chief crops grown, in order of acreage, according to the 1910 census, are hay, oats, potatoes, rye, corn, and barley, with buckwheat, wheat, peas, and beans as crops of lesser importance. While the dairy industry is important, it is not as highly developed as in some of the adjoining counties where there is a larger proportion of heavy soils.

Practically all the crops grown may be considered in part as cash crops, for hay, corn, oats, rye, and barley are sold to some extent directly from the farm. Potatoes are grown mainly for sale, although they are one of the most important subsistence crops. The greater part of the hay, corn, oats, and barley produced is used in feeding live stock, and much of it finally reaches the market in the form of dairy products, beef, and pork. A considerable quantity of grain and hay is used as feed for work stock.

Hay is grown more extensively than any other crop. The 1910 census reports 48,286 acres in all hay crops, with a production of 47,982 tons, or nearly 1 ton per acre. About 75 per cent of the tame hay grown consists of mixed clover and timothy. Little clover is grown alone. Minor hay crops are wild hay, small grains, millet, and alfalfa. The best hay crops are produced on the heavy soils of the Spencer, Gloucester, and Merrimac series. As most of the soils are acid, alsike clover is sometimes grown in place of red clover. Red clover does well on land whose productiveness has been kept up and succeeds on new land in spite of the acidity, but on run-down fields it is not very successful.

In 1909 oats were grown on 37,838 acres, with a total production of 697,853 bushels. This crop gives best results on the fine sandy loams, loams, and silt loams. It is often grown on some of the light sandy soils, but with unsatisfactory results.

Potatoes in 1909 occupied 30,637 acres, giving a total production of 2,508,521 bushels. This crop is grown successfully throughout the sandy areas of the county, but best yields are obtained where there is sufficient clay in the soil to make it somewhat loamy. Potatoes are grown in all parts of the county and to some extent on practically all the soils.

Rye was seeded on 19,858 acres in 1909, and produced 222,333 bushels. Rye is grown most extensively on the sandy soils, and it gives better results on the extremely sandy types than any of the other small grains.

The total area in corn in 1909 was 15,834 acres, and the production amounted to 394,189 bushels. Corn is not as successful as some other crops on the extremely sandy soils, which cover a large aggregate area in this county.

Barley is grown to a small extent. In 1909 this crop was grown on 1,184 acres, and produced 25,652 bushels. The acreage of barley has apparently increased somewhat during the last few years.

Wheat is grown only to a very small extent, although at one time it was the most important crop in the county. Buckwheat is grown in various parts of the county, chiefly on the marshy tracts where the drainage conditions have been improved. Peas and beans are grown to a limited extent.

Some trucking is done in the vicinity of Stevens Point. On most farms small plots are devoted to cabbage, lettuce, radishes, onions, strawberries, brambleberries, and other vegetables and small-fruit crops for home use. The sandy soils are probably better adapted to trucking than to any other line of farming.

The following table shows the acreage and production of the principal crops in the last four census years:

Crop.	1879		1889		1899		1909	
	Acres.	*Bushels.*	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*	*Acres.*	*Bushels.*
Corn	12,131	278,743	14,489	403,088	17,289	388,100	15,834	394,189
Oats	9,749	225,614	24,453	739,527	31,878	734,070	37,838	697,853
Wheat	21,853	204,778	4,342	54.814	6,373	85,910	397	5,376
Rye	10,144	111,659	15,151	186,155	20,409	217,780	19.858	222,333
Barley	965	16,544	471	12,779	421	7,550	1,184	25,652
Buckwheat	723	3,819	1.607	19,086	983	9.270	496	3,859
Potatoes	.....	213,570	12,904	1,324,761	29,099	1,978,344	30,637	2,508,521
Peas	.....	782	.....	7,560	417	6,608	319	1,799
Beans	.....	1,210	.....	1,451	43	379	52	480
		Tons.		*Tons.*		*Tons.*		*Tons.*
Hay	16,346	13,470	29,388	30,203	36,884	43,444	48,286	47,982

Fruit growing receives little attention in Portage County, since a large proportion of its area is not well adapted to this industry. Apples are grown more extensively than any other fruit. On many of the farms there is a small orchard which usually supplies apples for home use and in some years a surplus to sell. Apples do best over the eastern and northeastern parts of the county, where the surface is more or less rolling. The level tracts of sandy soil are not suited to this fruit.

The raising of live stock is an important industry. The 1910 census reports 31,378 head of cattle, 9,255 horses, 13,264 hogs, and 5,075 sheep in the county. In 1909 there were 7,954 calves sold or slaughtered, 5,415 other cattle, 13,980 hogs, and 2,198 sheep. Animals sold or slaughtered in that year amounted in value to $413,564. Most of the calves and steers sold are from dairy herds. Hogs are raised in conjunction with dairying and general farming. Hog raising is not as well developed in this county as in sections where more corn is grown.

There were 18,783 dairy cows in the county in 1910, and the dairy products of the preceding year, exclusive of those used in the home, had a value of $606,348. There were 27 creameries and 3 cheese factories in the county in 1913. Milk and cream are sold at retail in the towns in a small way. Dairy cows of Holstein breeding are more numerous than those of any other breed. The use of purebred sires is gradually improving the stock.

Differences in the character of the soil in various parts of the county have some influence upon the distribution of the crops. Oats are grown more extensively on the heavier soils than on the sandy types, while potatoes are more profitable on the sandy types than many other crops. Rye is grown most extensively on the light-textured soils and gives better results on this class of land than do the other small grains. The dairy industry is most successfully developed on soils which have a texture as heavy as or heavier than a fine sandy loam.

The general methods of farming followed are about the same as those practiced throughout the general farming and dairying districts of Wisconsin. The silo is in quite common use on dairy farms, and a considerable part of the corn crop is handled as ensilage. The hay crop is mostly stored in barns or stacked and used mainly as feed for stock. In potato growing modern machinery is in common use, and where the acreage justifies their purchase most farms are supplied with horse-drawn planters, diggers, and spraying outfits. In all lines of farming modern machinery is in common use on most of the farms. The farm buildings vary greatly in quality. On the extremely sandy soils the buildings are frequently inferior and in poor repair, while those on sandy loam and heavier soils are much better. The barns are usually equipped with large hay forks or slings for use in unloading hay. The work stock and implements are not as heavy over most of the county as in many other parts of Wisconsin, since most of the soils are sandy and easy to cultivate.

A rotation quite commonly followed on the sandy soils consists of small grain followed by clover and this by potatoes. The second crop of clover in a few cases is plowed under as a green-manure crop. On the extremely sandy types it is desirable to arrange the system so that the ground may be covered as much of the time as possible to prevent drifting, which often causes considerable damage to growing crops. In some cases so much of the soil is blown away that the seed is left exposed. On the heavier soils the usual rotation is somewhat different from that on the lighter types. Here corn more frequently takes the place of potatoes, and the land is usually left in grass for hay for two years and frequently is pastured for one year before again being plowed. On neither the sandy nor

heavy types has the question of crop rotations been given careful study.

Stable manure is the fertilizer used most extensively, but the supply of this is not sufficient to meet the requirements of the soil. Commercial fertilizers are not in common use. They are used mainly on the marsh soils, especially in the vicinity of Coddington. The Peat soil is deficient in potash and phosphorus and is also acid. A large tonnage of wood ashes was recently applied to Peat soils near Coddington at the rate of about 1,000 pounds per acre. A considerable amount of rock phosphate is used in the county, usually at the rate of about 1,000 pounds per acre. Acid phosphate is in some instances applied by itself or along with the rock phosphate. The use of ground limestone for correcting soil acidity is coming to be recognized as profitable, and a number of farmers both on the Peat soils and on the uplands have tried liming, with success.

The supply of farm labor is fairly good. In many cases women and children assist with the farm work. Where hands are hired for the year or by the month the wage usually ranges from $25 to $40 a month, depending upon the experience of the laborer. Married men are usually given fuel and the use of a house and garden. During haying and harvest periods, when extra day help is often needed, the wage is usually $1.50 to $2 a day.

The average size of farms in Portage County, as given by the census of 1910, is 127 acres. In the marshy areas and in the least developed parts of the county land is frequently held in large tracts. In 1910 there were 3,229 farms in the county, comprising 79.1 per cent of its total area. Each farm has on an average 68 acres of improved land. Practically 90 per cent of the farms are operated by the owners.

In 1900 the average assessed value of land in the county was $13.47 an acre. By 1910 this had increased to $27.94 an acre. Where general farming is most highly developed, on the heavier soils, land values frequently reach $100 an acre. Comparatively few farms have a higher value than this. On the extremely sandy soils many partly improved farms can be bought for $20 to $40 an acre. On reclaimed marsh land farms sell for $30 to $70 an acre, the price depending largely upon the improvements, drainage, and location. Cut-over land in the undeveloped sections may be bought for $18 to $30 an acre. Unimproved marsh land, where no effort has been made toward reclamation, is usually of lower value than any other character of land in the county.

SOILS.

Portage County, in common with several other counties in central Wisconsin, owes the general character of its surface materials to

several distinct methods of accumulation. These materials may be of glacial, residual, alluvial or, possibly, loessial origin. To these important agencies may be added the accumulation of organic matter in low places, a later process resulting in the formation of Peat.

In a geological classification, based upon the character of the underlying rocks, the county falls naturally into two divisions.[1] To the north of a line extending across the county through Plover and Custer the upper formation consists of crystalline rocks made up chiefly of granite and gneiss. To the south of this line the bedrock consists largely of Potsdam sandstone.

The terminal moraine of the Late Wisconsin drift sheet crosses the county north and south through the center of range 9 east, passing near or touching the villages of Polonia, Custer, and Arnott, and continuing south into Waushara County, where it runs but a short distance east of Plainfield. To the east of the moraine, which consists of an irregular, rather low range of hills, the country shows a typical glacial topography. The surface ranges from level to broken and hilly. There are numerous outwash plains, stream terraces, filled-in valleys, potholes, recessional moraines, drumlins, and other evidences of glaciation. Marshes abound and from a geological standpoint the topography of the region is young. Stones and bowlders are in many places numerous, but it is probable that most of these have been transported only short distances.

The soil material throughout this part of the county has been derived largely from the underlying crystalline rocks through glacial action. The ice sheet moved from the northeast to the southwest and deposited large quantities of crystalline glacial material over the Potsdam-sandstone formation which occurs in the southeastern part of the county. Some of the sandstone material has doubtless been mixed with the crystalline-rock debris, but probably not in sufficient proportion markedly to alter the nature of the resulting soils.

That part of the county west of the terminal moraine is within what is commonly called the driftless area. Occupying the greater proportion of the southwestern quarter of the county, and extending north along the Plover and Wisconsin Rivers, is an extensive area made up largely of alluvial soils. These represent alluvium deposited by the Wisconsin and Plover Rivers during glacial or interglacial times, and also outwash material carried from the front of the ice sheet by rushing waters. The surface of this region is level. The soils are stone free and for the most part quite sandy. In the lowest places the accumulation of decaying vegetable matter has given rise to extensive areas of Peat.

[1] For a full discussion of the geology of this region see Bul. XVI, Wis. Geol. and Nat. Hist. Survey, by Dr. Samuel Weidman, on the Geology of North-Central Wisconsin. The geological discussion in this chapter is based largely on this report.

In a belt in the extreme northwestern quarter of the county the soils are largely of residual origin, having been derived by weathering from the underlying crystalline rocks. This belt may have been traversed by an early ice sheet, but its influence was not sufficient to alter the soils to any appreciable extent, and this section is therefore commonly considered part of the driftless area.

Over part of the county there is a covering of silty material which has some of the characteristics of loess. It is thought that this may be a remnant of a blanket of loesslike material which covered part of this region, and which is more pronounced in counties to the west and throughout parts of northern and western Wisconsin.

There are extensive areas of marsh land in various parts of the county in which the accumulation of decaying vegetable matter has given rise to deposits of Peat.

All the rock formations in the county have contributed to a greater or less extent in the formation of the soils. A larger proportion of the material has come from crystalline rocks than from sandstone formations. Since they were first deposited by the ice sheet the various soil materials have been modified by running water, by the action of wind, by weathering, and by the accumulation and decay of vegetable matter. The soils of Portage County are classified in 9 soil series, which include 23 types, and 1 miscellaneous type, Peat.

The surface soils of the Gloucester series are light brownish or grayish brown and are underlain by yellow or yellowish-brown subsoils. These soils are derived by glaciation from crystalline rocks consisting largely of granite and gneiss. Stones and bowlders are scattered upon the surface, but seldom in sufficient numbers to render the land unfit for cultivated crops, though their presence often makes cultivation difficult. The topography ranges from nearly level to rolling and hilly, the hills often being quite high, broad, and smoothly rounded. The drainage of these soils is usually good and on some of the lighter types it is excessive. This is one of the most important and extensive series in Portage County, especially in the eastern half. The types mapped in the Gloucester series are the sand, sandy loam, and fine sandy loam, each with a shallow phase, the loam and the silt loam, shallow phase.

The surface soils of the Spencer series are similar to those of the Gloucester series. They are gray or grayish brown in color. The subsoils usually are lighter brown or yellowish, with sometimes a reddish cast, and are always strongly mottled with brown, rusty brown, gray, and yellow. The surface soil also is mottled in places. The mottling is the chief point of difference between the Spencer and Gloucester soils. Some stones and bowlders occur upon the surface, but they are not as plentiful as on the Gloucester types.

The material forming the Spencer soils consists chiefly of glacial débris, largely of pre-Wisconsin glaciation. This material has been derived from crystalline rocks, largely granite and gneiss. No calcareous material is present and both surface soil and subsoil are in an acid condition. The topography ranges from nearly level to undulating and gently rolling. The natural surface drainage is often deficient, and the underdrainage is always so. This series is of limited extent in Portage County, but it is widely distributed in the counties to the west and north. The only types of the Spencer series mapped in this county are the fine sandy loam and silt loam, the latter with a rolling phase.

The Vesper series consists of brown or grayish-brown surface soils underlain by light-textured subsoils overlying sandstone. The surface soils are derived wholly from the silty material that covers central Wisconsin. The subsoil is derived from the Potsdam sandstone, which it overlies. The subsoil passes gradually through a layer of disintegrated sandstone into the unweathered rock, usually at less than 3 feet. The topography of these soils is flat and drainage is usually deficient. Both surface soil and subsoil are acid. One type, the silt loam, is mapped in this county.

The Merrimac series includes light-brown or grayish surface soils underlain by grayish-brown or yellowish subsoils, which are usually lighter in texture than the surface material. The deeper subsoil consists of stratified sand and gravel. The soils forming this series are developed in or bordering the glacial region, and occur as glacial outwash plains, glacial terraces, and filled-in valleys. The parent material has been derived largely from crystalline rocks, consisting chiefly of granite and gneiss. Both surface soil and subsoil are in an acid condition. The surface is level to very gently undulating. Because of the loose character of the subsoil the drainage usually is thorough, and sometimes excessive. In Portage County the sandy loam, fine sandy loam, and loam are mapped.

The surface soils of the Plainfield series range in color from brown to grayish brown, while the subsoils are usually yellow to pale yellow. This series is developed in the drift-covered areas of Michigan, Wisconsin, and Minnesota, and comprises soils formed from sandy and gravelly glacial débris washed out from the fronts of glaciers. It is also developed in deep filled-in valleys along streams, such as the Manistee and Au Sable Rivers in Michigan and the Wisconsin River in Wisconsin. The first class occurs as nearly level or gently sloping outwash aprons connected with terminal moraines, while the second was formed by the filling in of valleys, often several miles wide, during periods of glaciation. The greater part of the material has been much assorted and consists mainly of sand and gravel.

The deposits are usually deep and the soils leachy and droughty. The types of this series mapped in the present survey are the sand and fine sandy loam. They are confined to the Wisconsin River Valley.

The Waukesha series is characterized by dark-colored surface soils underlain by stratified material which is lighter in color. The material consists of deposits in the form of stream terraces, outwash plains or filled-in valleys, and both surface soil and subsoil are in an acid condition. The types mapped in this county are the Waukesha sand, sandy loam, and fine sandy loam.

The surface soils of the Boone series are brown or light brown, and are underlain by yellow, grayish or brownish-yellow subsoils. The material has been derived largely from the weathering of Potsdam sandstone, but in some places this residual material appears to have been covered by a later loesslike deposit. In places there is associated with the underlying sandstone a shaly substance. This may give rise to material rather high in silt and clay particles, while the pure sandstone rock on weathering gives rise to a soil largely made up of sand particles. The Boone soils mapped in this area are the sandy loam and silt loam. They are of very small extent, and are confined to the west-central part of the county.

The Whitman series consists of dark-brown or black surface soils underlain by drab, bluish or yellowish subsoils, which are usually strongly mottled. These soils occupy a position usually similar to that of the Clyde soils, but they differ from the Clyde in showing varying degrees of acidity and in having been derived largely from a noncalcareous source, chiefly crystalline rocks. Because of their low position the natural drainage of these soils is deficient. They may occur in first-bottom situations as alluvial material or in depressions in the upland where there has been an accumulation of organic matter. The types mapped in Portage County are the sand, sandy loam, and silt loam.

The members of the Genesee series are light to dark brown in the surface soil and usually lighter colored in the subsoil. They occur as first-bottom land in regions of recent and old glaciation along streams heading in glacial areas. Practically all the area of these soils is subject to overflows. The types mapped in this survey are the fine sandy loam and silt loam.

In addition to the soils included in these nine series, a miscellaneous type of Peat is mapped. Peat consists of accumulations of vegetable matter in varying stages of decomposition, with which there has been incorporated a small proportion of mineral matter.

In subsequent pages of this report the various soil types mapped in Portage County are discussed in detail. The distribution of the

various soils is shown on the map accompanying this report, and the actual and proportionate extent of each is shown in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Peat	66,560	16.4	Spencer silt loam	12,800	2.6
Shallow phase	18,624		Rolling phase	640	
Plainfield sand	78,592	15.1	Merrimac fine sandy loam	8,128	1.6
Gloucester sand	68,480	14.2	Waukesha sandy loam	5,440	1.0
Shallow phase	5,440		Merrimac loam	5,312	1.0
Gloucester sandy loam	51,840	10.9	Whitman silt loam	5,248	1.0
Shallow phase	4,928		Genesee fine sandy loam	5,248	1.0
Gloucester fine sandy loam	22,976	7.0	Genesee silt loam	4,544	.9
Shallow phase	13,440		Gloucester silt loam, shallow phase	3,008	.6
Merrimac sandy loam	33,536	6.4	Plainfield fine sandy loam	2,112	.4
Whitman sand	23,232	4.5	Boone sandy loam	1,920	.4
Spencer fine sandy loam	22,720	4.4	Waukesha fine sandy loam	1,856	.4
Waukesha sand	21,824	4.2	Boone silt loam	1,536	.3
Whitman sandy loam	15,232	2.9	Vesper silt loam	832	.2
Gloucester loam	13,632	2.6	Total	519,680	.....

GLOUCESTER SAND.

The surface soil of the Gloucester sand, extending to a depth of 6 to 10 inches, consists of a brown or grayish, rather loose, incoherent sand of medium texture. In some small areas the texture approaches a fine sand. In places the virgin soil is somewhat darker than usual in the surface 1 or 2 inches, owing to a small accumulation of organic matter. This usually disappears after cultivation for a few years. The subsoil consists of a yellowish-brown or light-brown sand of medium texture. It usually becomes lighter in color and coarser in texture with increasing depth. Gravel may occur sparingly in the surface soil, but is more abundant below a depth of 24 inches.

A few stones and bowlders of glacial origin occur over the type, but typically they are not sufficiently numerous to interfere materially with cultivation. In townships 24 and 25, ranges 9 and 10, a few moderately stony areas are included. Stones and bowlders in places are sufficiently abundant to interfere with agricultural operations. Such areas are indicated on the soil map by symbol. Where the soil is stony there is often more variation in texture of the soil material than over the typical areas of the type.

In some areas, none of which are more than a few acres in extent, the surface soil is a sandy loam and in the subsoil a compact sandy loam stratum, about 6 inches thick, may occur at a depth of 18 to 24 inches.

The Gloucester sand is found most extensively in the eastern half of the county, where it is associated with other types of the Gloucester series. It occurs in numerous small areas rather than in extensive continuous tracts.

The surface of the typical soil varies from undulating to gently rolling. There are included some rather steep slopes, which represent a drop from one terrace to another. The soil here is not typical Gloucester sand, but is included because of its small extent. It has about the same agricultural value. The areas of the type indicated as being covered with stones and bowlders are rougher than typical and include the roughest land in the county. The surface in these areas varies from rolling to hilly and broken, with only a few small tracts similar in topography to the typical soil.

Because of the loose, open character of this type and the surface relief, the natural drainage is excessive and the soil is droughty. Highest yields are obtained in years of most abundant rainfall.

Although this type covers a rather large total area, it is of minor agricultural importance. Probably the greater proportion of the typical soil is cleared and under cultivation, but in the stony areas most of the land is still in timber. The original growth consisted chiefly of scrub oak and jack pine.

The type of agriculture most extensively followed on this soil consists of general farming, with potato growing as the most prominent branch. Dairying is engaged in to a smaller extent than on the heavier soils. The chief crops grown are potatoes, rye, oats, corn, and hay. Potatoes on the average yield 75 to 125 bushels per acre, rye 8 to 15 bushels, oats 15 to 25 bushels, corn 15 to 30 bushels, hay one-half to 1 ton, and buckwheat 12 to 18 bushels. Yields depend much upon the amount and distribution of the rainfall and the manure or organic matter applied to the soil. The type is easily exhausted by continuous or improper cropping, and the methods followed are usually not those best suited to building up the productiveness. The soil is easy to cultivate.

The Gloucester sand has a lower selling value than most of the other types in the county, and little of it changes hands.

To improve this soil very careful management is necessary. The organic-matter content should be increased by plowing under green-manuring crops to supplement the stable manure. To get best results with clover and alfalfa, liming is necessary. The soil is low in phosphorus, and this element may be supplied with profit. A rotation consisting of small grain, clover, and corn or potatoes is well adapted to the soil. The second crop of clover should be plowed under. The rocky areas of the type should be left in timber or used for pasture.

Gloucester sand, shallow phase.—The surface soil of the shallow phase of the Gloucester sand, extending to an average depth of 8 or 10 inches, consists of a grayish-brown sand, loamy sand or sometimes a fine sand. The surface soil is low in organic matter. It is loose and open in structure and shows varying degrees of acidity. The subsoil consists of a loose, yellow sand of medium texture, through which there often occur coarser angular particles. The underlying granite is often encountered at a depth of 2 to 3 feet. In some places a sticky sandy loam occurs in the deep subsoil, lying directly upon the underlying rock. This sandy loam appears to be residual. It may be varied in color, as is characteristic of the heavier residual material.

In areas of this phase along Mill Creek in township 24, range 6, occasional granitic bowlders occur on low knolls or slopes. In the large area 3 miles north of Junction and in the areas east and northeast of Junction, in the vicinity of the Wisconsin River, the soil is thickly covered in places with angular blocks and fragments of granitic rocks. In sec. 9, T. 24 N., R. 7 E., these fragments and blocks also occur in the subsoil and grade into the underlying rock. In some instances a few rounded granitic bowlders also occur, especially in areas near the Wisconsin River.

The Gloucester sand, shallow phase, is confined to the northwestern part of the county, in Twps. 24 and 25, Rs. 6 and 7, and in T. 25, R. 8. It occurs on knolls and in strips of upland, often bordering streams or in the vicinity of marshes. The largest single area occurs on elevated, undulating to rolling bluffs or knolls in the vicinity of the Wisconsin River, east and northeast of Junction.

The surface varies from undulating to rolling. Because of the surface relief and the loose, open nature of the material the natural drainage is excessive.

This phase is of minor importance, owing to its rather limited extent and its rather low agricultural value. The greater proportion of it is cleared and under cultivation. The original timber growth was chiefly pine, all of which has been removed. The productiveness varies somewhat with the fineness of the sand and the depth to heavier, more compact material. Much of the soil is subject to drought, the areas of finer soil less so than those where the texture is medium to coarse. The crops commonly grown are potatoes, corn, rye, and oats, with a small acreage of hay. Average yields are lower than on the fine sandy loam types, and range from poor to fair. General farming is followed, but the branches of dairying and stock raising are not as well developed as on the heavier soils.

The soil is easy to plow and cultivate. No fertilizers other than stable manure are used, and the supply of this is limited. Definite

systems of crop rotation are seldom followed. It is difficult to get a good stand of clover on this soil.

The selling price of farms on this phase ranges from $25 to $50 an acre, depending upon the location and the character and extent of the improvements.

In the improvement of this land the first step should be to increase the organic-matter content. This can be done by the use of green-manure crops, of which the legumes are best. Where clover can not be grown easily, the use of commercial fertilizers may help in getting a stand. Liming the soil will aid in growing clover and will make possible the growing of alfalfa. Soy beans and serradella grow on acid soils better than clover, and these legumes might well be given a trial. A rotation well adapted to sandy soils such as this consists of small grain seeded to clover; clover one year, with the second crop plowed under; and one year of potatoes or corn.

GLOUCESTER SANDY LOAM.

The soil of the Gloucester sandy loam to an average depth of 10 to 14 inches consists of a brown or grayish-brown, mellow sandy loam, with only a moderate content of organic matter. The subsoil is a buff-colored or yellowish-brown, light-textured sandy loam. It changes at 20 to 24 inches into a light-brown, compact, gravelly sandy loam or gravelly clay loam layer which has a thickness of 6 to 10 inches. Below this a gravelly sand extends to a depth of over 36 inches. Stones and bowlders occur in places upon the surface, but usually not in sufficient numbers to detract from the value of the type. Areas wherein stones and bowlders are so numerous that their removal presents a serious problem are indicated on the soil map by means of stone symbols.

A variation in texture occurs in this type, where the surface soil is a brown or light-brown loamy sand. This light-textured soil is confined chiefly to the region south and west of Amherst. Some eroded terraces are also included, the soil here differing from the typical Gloucester sandy loam chiefly in topography, although it also contains more gravel.

The surface of the Gloucester sandy loam varies from gently rolling to rolling and hilly. The roughest areas are those which are extremely stony. Because of the surface relief and the loose character of the material the natural drainage is sometimes excessive and the type is somewhat droughty, though not as markedly so as the Gloucester sand. An exception to this thorough drainage occurs in township 25, range 9, where several areas have rather imperfect drainage, even though the surface is somewhat rolling, owing to the impervious nature of the compact layer in the subsoil.

The Gloucester sandy loam occurs in the eastern half of the county. The greater proportion of this type is cleared and under cultivation. The original timber growth consisted chiefly of oak, maple, and white pine. The soil is moderately productive. The chief crops grown and representative acreage yields obtained are: Potatoes 75 to 150 bushels, corn 25 to 35 bushels, oats 25 to 40 bushels, rye 15 to 20 bushels, and hay three-fourths to 1½ tons. The best yields are obtained in years of more than average rainfall.

The methods of farming followed on this soil are not those best suited to increasing its productiveness. Stable manure is the only fertilizer used to any considerable extent, and the supply of this is inadequate. Green manuring is seldom practiced.

The selling price of land of this type probably averages somewhat lower than that of the fine sandy loam.

In improving this soil efforts should be made to increase the supply of organic matter. Liming will help in growing alfalfa, but the soil must also be inoculated. Careful attention should be given to selecting a rotation best suited to the soil conditions. The rotation suggested for the Gloucester sand may be used to advantage.

Gloucester sandy loam, shallow phase.—To a depth of 8 to 12 inches the soil of the shallow phase of the Gloucester sandy loam is a brown or brownish-gray sandy loam, of a mellow, friable structure. The subsoil to a depth of 20 to 24 inches is a light-brown or mottled drab and yellow sandy loam, grading into a compact, rather impervious, mottled sandy loam to gritty clay. In places a drab or mottled drab and yellow layer of sand and gravel is encountered below 30 to 34 inches, though the heavier material usually exceeds 36 inches in depth.

The principal variation in this phase is in the lower subsoil. In small areas scattered throughout the phase the subsoil at some point below 20 inches changes to a heavy, greasy, gritty, dark-red clay, which continues to a depth of over 36 inches. This material is residual from the underlying granitic rock. Angular granitic stones are scattered over the surface in places. Extremely stony areas of the phase are indicated on the map by symbol.

This phase, with the other shallow Gloucester soils, is confined to the northwestern part of the county and occurs chiefly in small tracts associated with other soils of the same series.

The surface varies from undulating to gently rolling and in most cases the natural drainage is fair to good. In some places where the compact subsoil is nearer the surface than usual the drainage is somewhat deficient.

The original timber growth on this soil consisted chiefly of oak, elm, birch, and maple, with some white pine and spruce. Probably the greater proportion of the phase is under cultivation. It is de-

voted largely to general farming. The chief crops grown are oats, hay, potatoes, and corn. Average yields are slightly lower than on the fine sandy loam type. The same methods of cultivation, fertilization, and crop rotation are followed as on the Gloucester fine sandy loam, shallow phase, and this phase responds to the same farming methods.

GLOUCESTER FINE SANDY LOAM.

The surface soil of the Gloucester fine sandy loam extends to an average depth of 14 inches and consists of a buff-colored or yellowish-brown heavy fine sandy loam of a friable structure. In the surface 1 or 2 inches the virgin soil is dark gray in color owing to the accumulation of considerable organic matter. Over plowed areas this material becomes distributed through the surface soil to the depth of the plowing, giving it a grayish-brown color. The surface soil grades into a subsoil of brown or reddish-brown, compact sandy loam, fine sandy loam or sandy clay, which passes at 20 to 24 inches or below into gravelly sandy loam or gravelly sand of the same or lighter color. A small content of gravel frequently occurs in the surface soil and upper subsoil, but this material is concentrated mainly below the heavy stratum in the subsoil. Stones and bowlders of moderate size occur here and there over the surface and through the soil profile, but typically not in sufficient numbers to interfere seriously with cultivation.

While this type is quite uniform in texture, color, and structure, there is a wide variation in the number of stones upon the surface and through the soil section. In places the bowlders are so large and numerous as to interfere seriously with cultivation and to make their removal expensive as well as difficult. Areas in which this stony condition prevails are indicated on the map by means of symbols. In these extremely stony areas there is frequently a larger percentage of gravel in the subsoil than in areas where but few stones occur.

The Gloucester fine sandy loam is confined chiefly to the east-central part of the county. The type is associated with other soils of the Gloucester and Merrimac series and with small tracts of Peat in low places.

The surface of this type ranges from gently rolling to rolling. Owing to the favorable surface features and the gravelly nature of the subsoil the natural drainage is good. The soil retains moisture well and suffers less from drought than most of the other types of the county.

The Gloucester fine sandy loam is one of the most desirable soils in the county, and especially in that part where it occurs most extensively. The greater proportion of the type is under cultivation and well improved. The original timber growth consisted chiefly of

maple, hemlock, and oak, with some birch and white pine. That part of the type not under cultivation is either in "slashings" or consists of cut-over land from which the best trees have been removed.

This soil is well adapted to general farming and dairying. The chief crops grown and ordinary yields obtained are as follows: Potatoes about 150 bushels, corn 35 to 50 bushels, rye about 20 bushels, oats 30 to 40 bushels, barley about 25 bushels, and hay about 1½ tons. Dairying and potato growing are the most important branches of agriculture, though on all farms these are combined with other types of farming. Apples and small fruits are grown on many farms, but usually for home use only.

Where bowlders are not abundant this soil is comparatively easy to handle. It can be cultivated under a rather wide range in moisture content and maintained in good tilth without difficulty. A rotation quite commonly followed consists of corn or potatoes followed by a small grain which is seeded to timothy and clover. Two crops of hay are usually cut before the land is again plowed for a cultivated crop. The field may be pastured for a year before being plowed. Stable manure is most often applied to sod land.

Farms on this type of soil sell at $40 to $75 or more an acre, the price depending upon the acreage cleared, the improvements, and the location.

The productiveness of this type can be improved by increasing the organic-matter content. This may be done by supplementing the supply of stable manure with green-manure crops, of which the legumes are best. As this soil shows varying degrees of acidity, the use of lime is necessary if alfalfa is to be grown, and its use will also be profitable for clover and other general farm crops. The growing of small fruits and berries could well be extended, and the home orchard should be given careful attention. Apples, plums, pears, and other fruits for home use can be grown successfully, and with proper care in selecting orchard sites and varieties and in cultivation and spraying these fruits may be grown successfully on a commercial scale.

Gloucester fine sandy loam, shallow phase.—The surface soil of the shallow phase of the Gloucester fine sandy loam, extending to a depth of 10 inches, consists of a dark-brown to grayish-brown fine sandy loam. The subsoil consists of a yellowish-brown fine sandy loam extending to 36 or 40 inches. A layer of sandy loam, loamy fine sand or sticky sandy clay and crumbly, disintegrated rock is encountered below 2 feet in some borings. The subsoil often varies in color, depending upon the color of the rock from which derived. Granitic-rock fragments and quartz pebbles are scattered over the surface in many places. The soil is subject to numerous variations over areas of small extent.

This phase is confined to the northwestern part of the county, chiefly in Eau Pleine and Carson Towns. The surface is undulating to gently rolling and the natural drainage is good.

This phase is more extensive than the shallow phase of the Gloucester silt loam and is of greater agricultural importance. A large part of it is cultivated and highly improved. The soil is well adapted to all the general farm crops grown in this region. Yields probably average somewhat higher than on the shallow phase of the silt loam.

This soil is comparatively easy to cultivate, and a good seed bed can be obtained more readily than on the silt loam. Practically the same methods of culture are followed as on the silt loam. No commercial fertilizers are used, but all the stable manure produced is returned to the land.

Improved farms on this phase sell for $60 to $90 an acre. Cut-over, unimproved land is valued at about $30 an acre.

In improving this soil the organic content should be increased by supplementing the stable manure with green-manure crops, preferably the legumes. If alfalfa is to be grown the soil must be limed. Liming will also increase yields of most of the general farm crops.

GLOUCESTER LOAM.

To a depth of 14 to 18 inches the soil of the Gloucester loam is a light-brown or buff-colored loam to silt loam underlain by a brown, compact, gravelly sandy loam or sandy clay, which changes gradually at 24 to 30 inches or below into brown sand and gravel. Over virgin areas the soil in the surface few inches is dark in color, owing to an accumulation of organic matter. In plowed areas this material has been incorporated with the surface soil to the depth of plowing, giving a resultant grayish-brown color. Typically there are a moderate number of stones and bowlders on the surface and through the soil mass, but these are not so numerous as to interfere seriously with cultivation. A variable content of gravel occurs in the surface soil and upper subsoil in places, but such material is most abundant in the lower subsoil.

The most important variation in this soil is in stoniness. In some areas stones and bowlders are sufficiently numerous to interfere materially with cultural operations. Such areas are indicated on the soil map by means of symbols. In a few places the land is so rocky that the cost of removing the stones is almost prohibitive, and the land will doubtless be used only for pasture.

The Gloucester loam is confined almost entirely to the eastern edge of the county, where it occurs associated with other types of the Gloucester series.

The surface varies from undulating to broadly rolling. Although this type occurs on some of the largest and highest drumlins, there are few steep or abrupt slopes. Practically all the type is capable of cultivation except the extremely stony areas.

Owing to the surface relief and the pervious character of the subsoil the natural drainage is good, but the type retains moisture well. It is considered one of the strongest soils of the county and is well adapted to general farming and dairying, which are the chief lines of agriculture engaged in. Most of the type is under cultivation. The original timber growth consisted of maple, hickory, hemlock, birch, oak, and white pine. All the best timber has been removed.

The chief crops grown and average yields per acre obtained are: Oats 35 to 60 bushels, hay 2 to 2½ tons, corn 40 to 50 bushels, and potatoes 150 to 200 bushels. Small farm orchards, especially of apples, appear to do well, and strawberries and bush berries thrive.

This soil is somewhat heavier to work than the lighter members of the Gloucester series, but a good tilth can be worked up without difficulty. The heaviest areas of the type occur chiefly on broad-topped hills or drumlins south of Polonia and in the vicinity of Bensons Corners and Amherst. More care must be exercised in cultivating this heavy soil than the remainder of the type.

Land of this type has a selling price ranging from $50 to about $100 an acre.

An increase in the organic content of this soil would add to its productiveness. The use of lime would correct the acidity and make possible the successful growing of alfalfa. Liming will also insure better clover and larger yields of other general farm crops.

GLOUCESTER SILT LOAM, SHALLOW PHASE.

The surface soil of the Gloucester silt loam, shallow phase, extending to an average depth of 10 to 12 inches, consists of a brown or dark yellowish brown silt loam. Small granitic rock fragments of irregular shape are scattered quite thickly over the surface in places and some fragments also occur through the soil section. The subsoil is lighter yellowish brown than the surface soil and consists of a compact silt loam which at 20 to 30 inches becomes a reddish or yellowish heavy silty clay or sandy clay loam, containing small residual granitic fragments of various colors. A layer of fine sandy loam or sandy loam occurs in the heavy residual subsoil in some places. The underlying formation, which is invariably crystalline rock, is usually reached at a depth of 3 to 6 feet. In some places the subsoil consists simply of disintegrated rock, which is often quite highly colored.

The total area of this soil is small. It is confined to the northwestern part of the county, chiefly in Carson Town, with a few small areas in Eau Pleine Town. The surface ranges from undulating to gently rolling and in a few instances broadly rolling. The surface is everywhere sufficiently rolling to insure fair to excellent surface drainage.

The Gloucester silt loam, shallow phase, is mainly under cultivation and highly improved. The original timber consisted of maple, basswood, elm, birch, and some white pine.

This soil is devoted to general farming, with dairying as an important branch. It is strong and productive and well suited to all the common general farm crops. Corn yields on the average about 50 bushels per acre, oats 30 to 50 bushels, barley 30 to 35 bushels, potatoes 150 to 200 bushels, and hay 1½ to 2 tons.

Fall plowing is commonly practiced on this soil. It is more difficult to cultivate than soils of lighter texture. The presence of rock fragments in places also makes cultivation more difficult. The soil is acid, but no efforts are made to correct this condition.

Land values on the Gloucester silt loam, shallow phase, range from $70 to $100 an acre, the price depending upon the location and improvements.

In the improvement of this soil the acid condition must first be corrected. This may be done by the use of one to two tons of ground limestone per acre. Liming is necessary if alfalfa is to be grown, and it will increase the yields of all the general farm crops. The supply of organic matter in the surface soil should be increased by supplementing the stable manure with green-manure crops, of which the legumes are best.

SPENCER FINE SANDY LOAM.

The Spencer fine sandy loam to an average depth of about 8 inches consists of a dark-brown to grayish-brown fine sandy loam or sandy loam which has a fair content of organic matter. This is underlain by a yellow or yellowish-brown fine sandy loam to a depth of over 3 feet. Sticky, clayey layers or layers of mealy sandy loam and compact fine sand occur in the subsoil. Angular rock fragments occur upon the surface and mixed with the soil and are quite abundant in places. The underlying crystalline rocks are sometimes encountered within the 3-foot section, while in other places partly disintegrated rock occurs at about 3 feet.

In the area of this type in secs. 28, 29, 30, 31, 32, and 33, T. 24 N., R. 7 E., where the surface soil is a sandy loam rather than the typical fine sandy loam, a marked variation occurs in the subsoil, a heavy red clay being encountered at depths ranging between 12 and 36 inches.

The Spencer fine sandy loam occurs only in the northwestern part of the county. The surface varies from level to gently undulating or sloping, and the natural drainage is deficient. The type occurs on gentle slopes or bordering streams and swamps in level strips, which are kept more or less permanently wet by springs, seepage, and run-off from higher lying land. In places the type includes elevated areas which have a very gently undulating to flat topography. These areas are better drained than the low-lying tracts, but they do not have adequate drainage.

The type is of small extent. Probably about one-half of its total area is cleared and improved. The better drained land is cultivated to the general farm crops common to the region—principally hay, oats, corn, and potatoes—while the wettest areas are used for pasture. The best yields are obtained in dry years. The poorly drained condition makes the soil cold and backward in the spring. Average yields are somewhat lower than on higher lying, better drained soil of the same texture.

The methods of farming followed are not those best adapted permanently to improve the soil. Little attention is given to crop rotations and to tillage methods best adapted to the soil.

In improving this type better drainage is necessary. The acid condition could be corrected to advantage.

SPENCER SILT LOAM.

The surface soil of the Spencer silt loam, extending to an average depth of 8 inches, consists of a light grayish brown silt loam which has a very high silt content and consequently a smooth feel. The subsoil consists of a heavy, compact, drab or bluish silt loam, strongly mottled with yellow, brown, and red. This grades at about 24 inches into mottled silty clay loam, which usually extends to a depth of over 3 feet. In some places there occurs in the subsoil a layer of red sticky sandy loam or sandy clay loam, which contains angular rock fragments. These are small and impart a gritty feel. This red layer is usually reached at about 30 to 36 inches and rests upon the underlying crystalline rocks from which it has been derived. In some places this red material is 50 feet or more in thickness.

The area of this type in secs. 19 and 20, T. 24 N., R. 7 E., has a subsoil composed of dull-reddish sticky clay loam to clay, containing sand and fine sand in places. The depth of this reddish material varies from 8 to 36 inches or more. It comes to the surface in various places.

A few rounded bowlders occur in this type in places, especially where it borders the shallow phases of the Gloucester soils, and are occasionally quite abundant. Small rounded quartz pebbles occur throughout the soil section in places.

The Spencer silt loam occurs over the driftless area in the northwestern part of the county. There are no large bodies of the type, but numerous areas of irregular size and outline are scattered over the section west and north of the Wisconsin River.

The surface of the Spencer silt loam varies from almost level to gently rolling. Where the surface is level or only gently undulating the soil is considered typical of the Spencer series. Areas in which the surface is sufficiently sloping to insure fairly good or good surface drainage are separated as a rolling phase. The texture of the material is practically the same in both soils. Because of the compact nature of the subsoil, both the typical soil and the rolling phase are quite impervious to the movement of water.

Most of the Spencer silt loam is cleared and under cultivation. It is a strong, productive type. The original timber growth consisted of elm, maple, birch, basswood, and white pine.

The type is well adapted to general farming and dairying and is in general well improved. In its undeveloped stage the soil is inclined to be rather wet, but when cleared and cultivated the drainage conditions improve markedly. Tile drainage, however, is needed in order to permit the soil to drain out and warm up earlier in the spring.

The chief crops grown are clover and timothy, oats, barley, corn, and potatoes. On the best drained areas very good yields are usually obtained. The type is especially well adapted to grasses, and areas too wet to be tilled in the spring provide excellent pasturage.

This soil is more difficult to handle than any of the other types of the county and must be plowed when moisture conditions are most favorable. With care a mellow seed bed can be worked up with little difficulty. Fall plowing is practiced on many farms, and is advisable.

Land values vary from $40 to $75 or more an acre, depending upon the improvements and location.

In the further development of this soil one of the most important needs is improvement in drainage. Tile must be placed closer together than in the case of most other types. The soil is sour and lime should be used to insure permanent success with red clover. Alfalfa can not be grown without liming. Thorough tillage is necessary, and more organic matter should be incorporated in the surface soil.

Spencer silt loam, rolling phase.—The surface soil of the Spencer silt loam, rolling phase, is a gray to brown, friable silt loam 8 to 10 inches deep. The material is very smooth to the feel owing to a large percentage of silt. It is comparatively low in organic matter. An occasional bowlder occurs on the surface. The subsoil consists of a grayish-brown silt loam mottled below 12 inches with yellow, brown, and gray. Below 15 inches the subsoil becomes a strongly

mottled, heavy silt loam or silty clay loam. It is very compact, tenacious, and impervious to water.

On the whole, the surface soil of this phase is markedly uniform, but the lower subsoil is variable. Prevailingly a mottled silty clay loam extends to a depth greater than 3 feet, but occasionally within 30 inches a gravelly clay loam of glacial origin occurs. Reddish, gritty clay loam or clay of residual origin is encountered in places. In some of the more rolling areas the mottling is very slight, and in places there is almost none.

The rolling phase of the Spencer silt loam occurs in the northwestern part of the county as the continuation of an extensive development in Wood County. It has a gently rolling to rolling topography. The natural drainage over the greater part of the phase is good, but some of the more gentle slopes would doubtless be benefited by tile drainage.

A large percentage of this soil is under cultivation. Grains such as oats, rye, and barley do well and occupy a large proportion of the total cultivated area.

The suggestions made for the improvement of the typical soil apply also to this phase, except in regard to the drainage conditions. Because of its better drainage the phase can be cultivated earlier in the spring. It is somewhat easier to handle and on the whole is a more desirable soil.

VESPER SILT LOAM.

The surface soil of the Vesper silt loam, extending to an average depth of 12 inches, is a light-brown to brown silt loam, underlain by buff or mottled drab or yellow silt loam. At a depth of 18 to 22 inches a layer of reddish-brown or mottled, compact silty to sandy clay loam, 2 to 6 inches thick, is encountered. Below this the subsoil consists of either a mottled drab and yellow sandy loam or a yellowish sticky sand. Sandstone occurs in this lower subsoil at or near the depth of 3 feet and fragments and slabs of this rock are common on the surface and through the surface soil, but not in sufficient abundance to render the soil stony.

The Vesper silt loam occurs southwest of Stevens Point, in Linwood Town. The topography is level to slightly sloping. Both surface drainage and underdrainage are slow and imperfect. The original timber growth included oak, elm, maple, basswood, and white pine.

The type is largely under cultivation. The principal crops are hay and oats. Part of the type is used for pasture and a smaller acreage for growing corn. Potatoes are grown to a small extent, but the soil is rather unfavorably heavy and wet for this crop. Hay yields 1 to 1½ tons per acre and oats about 35 to 45 bushels.

This soil occurs in a region devoted largely to general farming, and it is utilized chiefly for this purpose. It is more difficult to handle than soils which have a somewhat rolling surface and better drainage. No commercial fertilizers are used, and little stable manure is available.

In the permanent improvement of this soil the supply of organic matter should be increased. Where clover or alfalfa is to be grown the soil should be limed, and the use of rock phosphate will be found profitable.

MERRIMAC SANDY LOAM.

To an average depth of 8 to 12 inches the Merrimac sandy loam consists of a grayish-brown or brown sandy loam, low in content of organic matter. The upper subsoil is a yellowish-brown loamy sand to sandy loam, changing at 20 to 24 inches into a brown, compact gravelly sandy loam or gravelly clay loam. This may either continue to a depth of over 36 inches or change abruptly to a coarse yellow sand intermixed with layers of well-rounded granitic gravel.

The chief textural variation occurs where the type adjoins the Plainfield sand, in which case the surface soil is often a loamy sand or, in a few places, a sand. South of Ellis the surface soil is somewhat darker than typical, but the texture is still a sandy loam. The same condition occurs to a lesser extent in a number of places throughout the type. Small quantities of gravel occur upon the surface in places, and also in the upper subsoil, but as a rule the gravelly material is concentrated in the lower subsoil, chiefly below a depth of 20 inches.

The Merrimac sandy loam is quite an extensive soil. Its greatest occurrence is in a broken, irregular belt extending through the center of the county from north to south. A number of smaller areas are scattered through the eastern half of the county. The largest area, about 7 miles long, extends from a point north of Ellis to a point several miles south of Stockton. Several areas covering 1 square mile or more are mapped in Almond and Buena Vista Towns, and in the northeastern corner of the county in the vicinity of Rosholt.

This type, like the other Merrimac soils, occurs as terraces or outwash plains having a level to very gently undulating surface, and lying well above present flood stages. In places the terraces are 50 to 75 feet or more above present stream courses. They may occur at several different elevations, separated by steep, abrupt slopes. These slopes are frequently quite badly eroded and in some instances erosion channels have worked their way back into the terrace for a short distance. Areas in which the surface has thus been rendered quite irregular are mapped with the Gloucester series where of sufficient

extent to separate. The soil on such slopes is usually lighter in texture than on the level terraces they border.

Because of the elevated position of some areas, and because of the pervious character of the surface soil and subsoil, the natural drainage of this type is good. Spring rains may cause small pools of water to stand on the surface of low-lying areas for a while, but seldom so long as to delay the usual spring farm work. The soil is in most places sufficiently heavy to retain moisture fairly well, and general farm crops do not suffer to any greater extent than on the heavier types of the county.

The Merrimac sandy loam is considered a moderately productive soil, slightly inferior to the fine sandy loam. It is easy to work and can be cultivated under a wide range of moisture conditions.

The usual crops grown and the acreage yields commonly obtained are as follows: Potatoes 150 to 200 bushels, corn 40 to 60 bushels, oats 35 to 45 bushels, hay 1 to 2 tons, rye 18 to 20 bushels, barley 15 to 30 bushels, and soy beans 25 to 35 bushels. Potatoes constitute the most important cash crop, but barley and rye also are grown for sale. Alfalfa has been tried in a number of instances and tests made east of Plover and at other places in the county indicate that farmers would be justified in greatly extending the acreage of alfalfa on this type. The soil must be limed and inoculated to insure success, and it should be well supplied with plant food.

Practically all the Merrimac sandy loam has been brought under cultivation. The trees on the few woodlots remaining indicate that the original timber growth consisted of white oak, red oak, maple, elm, and white pine.

In the improvement of this soil the first requirement is an increase in the supply of organic matter. As the type is acid, ground limestone should be applied. Liming is necessary if alfalfa is to be grown. It will also make conditions much more favorable for clover, and will tend to increase the yields of most of the general farming crops. Green manuring should be practiced to a greater extent; for this purpose the legumes are best.

MERRIMAC FINE SANDY LOAM.

The Merrimac fine sandy loam to an average depth of 10 to 12 inches consists of a grayish-brown to brown fine sandy loam. This has only a moderate content of organic matter and shows some acidity. The subsoil begins as a yellowish-brown fine sandy loam and changes at 20 to 24 inches to a brown, compact gravelly clay loam. This compact stratum may extend to a depth greater than 36 inches or it may pass abruptly into stratified sand and gravel at 30 inches or below. This type, like all the Merrimac soils, is free from large stones and bowlders, but a noticeable quantity of gravel and

cobbles occurs commonly on the surface and in the subsoil. The type is quite uniform from place to place, but there is some variation in the texture of the surface soil. In several areas in the southeastern part of the county this is finer than typical, while in the vicinity of Bensons Corners part of the type approaches a loam in texture. The boundary line drawn between this type and the Waukesha fine sandy loam is frequently an arbitrary one. As the latter type is approached the Merrimac fine sandy loam gradually becomes darker in color.

The Merrimac fine sandy loam is of rather small extent. It occurs in areas ranging from a few acres to about a square mile in extent, scattered chiefly through the east-central part of the county. One of the largest areas is mapped in sections 5 and 6, Lanark Town. The surface of this type is level to very gently undulating. In places there is a gentle slope toward the stream along which the type occurs. It usually occupies a position well above all flood stages, and because of this favorable situation and the pervious character of the subsoil the natural drainage is excellent.

The Merrimac fine sandy loam is considered one of the most desirable soils in the county but it is of small extent, and few farms are located entirely upon it. It is very highly improved. The soil is well adapted to all the general farm crops grown in the region. It is devoted chiefly to general farming and dairying, with potato growing as an important branch of the agriculture. Owing to the friable structure the soil is easy to cultivate and can be kept in a good state of tilth under a wide range of moisture conditions. The favorable surface features permit the use of all kinds of modern farm machinery.

The crops most extensively grown on this soil are oats, corn, hay, barley, rye, and potatoes. Oats ordinarily yield 35 to 60 bushels per acre; corn, 40 to 65 bushels; corn silage, about 15 tons; hay, 1½ to 2½ tons; barley, 25 to 35 bushels; rye, about 20 bushels; and potatoes, from 150 to 200 bushels. Strawberries and bush berries for home use are grown. The lack of good air drainage would doubtless make commercial orcharding uncertain, but apple trees make a thrifty growth on this soil, and a few well-selected varieties could doubtless be successfully grown for home use.

In the improvement of this soil the most important need is to increase the supply of organic matter. The use of lime will also be found profitable, since the soil is acid.

MERRIMAC LOAM.

The Merrimac loam to an average depth of 12 inches consists of a brown or buff loam. The surface soil may be underlain by several inches of lighter colored sandy loam or loam, or may grade into a

brown, compact, gravelly clay or sandy clay loam, which changes abruptly at 24 to 30 inches or below into brown coarse sand and fine gravel, with frequent layers of coarser gravel interbedding. This type is free from large stones and bowlders, but gravel and small rounded cobbles occur quite generally in noticeable quantities on the surface and through the surface soil.

This type is mapped principally in the northeastern part of the county, chiefly in Alban Town. It occurs in areas mostly less than 1 square mile in extent. The type chiefly occupies flat or slightly undulating terraces, which are frequently dotted with pits and potholes. The natural surface drainage and underdrainage are good. In places where the terraces are badly eroded and where the potholes are so numerous as to produce a rolling surface the soil is mapped with the Gloucester loam, being separated chiefly because of the difference in topography.

A silty variation of the Merrimac loam occurs on the high glacial terrace along the valley of Waupaca River, in the northern part of township 22, range 10, occupying areas most of which are less than one-half square mile in extent. If this soil were of sufficient extent it would be mapped separately as the Waukesha silt loam. The soil of this variation to an average depth of 8 inches consists of a grayish-brown silt loam resting upon a buff-colored silt loam, which changes at a depth of 14 to 16 inches to a light-brown, compact silty clay loam. This heavy subsoil may continue without change to a depth of over 36 inches or it may change abruptly at any depth below 24 inches to a brown coarse sand interstratified with well-rounded gravel. Over the greater part of its extent this soil is quite uniform. In sec. 1, T. 22 N., R. 10 E., just south of where the Minneapolis, St. Paul & Sault Ste. Marie Railway crosses the eastern boundary of the county, the surface soil is decidedly darker than typical.

The Merrimac loam is a desirable soil agriculturally. By far the greater part of it is under cultivation and quite highly improved. The original timber growth consisted largely of oak, maple, elm, and hemlock, with some white pine.

The principal crops grown, named in the order of their importance, are hay, oats, potatoes, and corn. The type of agriculture most largely followed consists of general farming, with dairying and potato growing as the two leading branches. Hay on the average yields 1½ to 2½ tons per acre, oats 40 to 60 bushels, potatoes 100 to 200 bushels, corn 30 to 60 bushels, and silage 12 to 16 tons. Little difficulty is experienced in working up a good seed bed. Stable manure is practically the only fertilizer used, but in a few instances green manuring has been practiced.

Land values on this type range from $60 or $75 to about $100 an acre, the price depending upon the location of the farm, the acreage under cultivation, and the improvements.

The content of organic matter in this type is rather low and may be increased by supplementing the stable manure with green-manure crops, of which the legumes are best. The acid condition may be improved by the use of some form of lime. Before alfalfa can be successfully grown it is necessary that the soil be limed and inoculated.

PLAINFIELD SAND.

The Plainfield sand to a depth of 8 to 10 inches consists of a yellowish-brown or brownish-gray, loose, incoherent sand, low in organic matter. In general the surface is free from gravel, but in a few places there is a scattering of gravel on the surface and a small quantity mixed with the soil. The subsoil is a yellow sand which in places has a brownish cast. The color usually becomes lighter with depth and at 3 feet is generally pale yellow. The deep subsoil is stratified.

The soil as a whole is quite uniform, but a few slight variations occur. In small depressions there is more organic matter than usual, and this gives the material a slightly loamy appearance. In the southwestern part of the county there is a large proportion of quartz grains in the sand, while in the central part of the county the feldspathic materials are more abundant.

The line drawn between this type and the Merrimac sandy loam is somewhat arbitrary. Usually as the sandy loam is approached the surface soil becomes somewhat more loamy, and in small slightly depressed areas there is a sticky layer in the subsoil at a depth of 20 to 24 inches. Small areas differing little in topography from the remainder of the type and situated well within its general development are frequently somewhat darker in the surface soil than typical.

The Plainfield sand is one of the most extensive types in the county. It occurs mainly in the south-central and central parts, near Bancroft and to the south of this place, south of Plover, and about Arnott. Smaller areas occur in the valley of the Plover River northeast of Stevens Point and scattered through the eastern and southwestern parts of the county.

The surface of the type is level to very gently undulating. The slight surface relief is due chiefly to wind action. A few hummocks occur which are quite pronounced sand dunes.

Because of the loose character of the surface soil and subsoil the natural drainage of the type is usually excessive, except where the water table comes close to the surface. Bordering the marsh land the type is in places deficient in drainage.

The original timber growth on this soil consisted of scrub oak, jack pine, and white pine, with hazel brush and sweet fern quite abundant. Most of the type has been cleared and placed under cultivation, but because of its low productiveness and droughty condition numerous farms have been abandoned. It is not uncommon for fields to remain idle for several years at a time.

Potatoes, rye, corn, and hay are the chief crops. Clover does not do well unless special attention is given to it. Dairying is not as extensively developed as on heavier soils, and the supply of manure is consequently limited. Few farmers have worked out crop rotations suited to the soil and the land is farmed under inefficient methods. The yields are usually low, but in a few instances where careful management has been practiced the soil has given good returns.

The organic-matter content of this type should be materially increased. As the soil is acid it will be necessary to use lime for best results with clover. The use of commercial fertilizers may be necessary in getting a stand of clover. A rotation consisting of a small grain, clover, and potatoes or corn gives good results on this soil. Each successive second crop of clover should be turned under until the organic content of the soil is materially increased, unless there is a supply of stable manure available. Soy beans can be grown to very good advantage on this land.

A sandy loam variation of this type, which on account of its small extent is not shown separately on the map, occurs in the southwestern part of the county, principally in the southwestern part of township 22, range 7, bordering the extensive marshy areas in that region. This soil is not very uniform in characteristics, but in general to a depth of 8 inches it consists of a light-brown or yellowish-brown sandy loam, low in organic matter. The subsoil consists of a brown, rusty-brown or yellow sand or sandy loam in which the fine particles consist largely of iron oxide. This material is sometimes concentrated in a thin, compact layer in the subsoil. In other places it is fairly well distributed through the soil section. At a depth of 2 to 3 feet a loose, yellow sand is usually encountered. The surface of this soil is level, but the natural drainage is usually excessive except immediately bordering the marsh, where it may be somewhat deficient. The soil material is part of an extensive alluvial deposit. It shows varying degrees of acidity. The original timber growth on this land consisted of scrub oak, pine, birch, and hazel brush.

PLAINFIELD FINE SANDY LOAM.

The Plainfield fine sandy loam to an average depth of about 14 inches consists of a brown fine sandy loam which contains in places

a small quantity of fine gravel. The subsoil consists of a stratified, yellowish-brown gravelly sand or fine sand. Layers of gravel frequently occur in the lower subsoil. Both surface soil and subsoil are subject to considerable variation, owing to the deposition of the material by running water and to the range in abundance of vegetative growth from place to place, resulting in a lack of uniformity in organic-matter content of the soil.

The Plainfield fine sandy loam occurs largely in the northern part of the county, within the valley of the Wisconsin River. It is confined to a few areas which in the aggregate cover only 3.3 square miles.

This type occurs on terraces, some of which are rather low, but all of which appear to lie above present overflow. The surface of the type is level to very gently undulating, and the natural drainage is in most cases fair. On some of the higher terraces it is somewhat excessive, while on the lower terraces the soil is inclined to be rather wet during early spring.

A considerable proportion of the type is under cultivation, devoted mainly to general farming. Potatoes are probably the most important crop, followed by corn, small grains, and hay. Potatoes yield 125 to 150 bushels to the acre. Small grains usually give satisfactory yields if the land is manured or if clover or some other green crop is plowed under.

The soil is somewhat acid, and clover does not make its best growth unless some form of lime is applied. The type is easy to handle, and no difficulty is encountered in working up a good seed bed. No fertilizers are used except stable manure. Occasionally a crop of clover or rye is plowed under.

In the improvement of this soil the supply of organic matter should be increased. This may be done to best advantage by plowing under a green-manuring crop, of which the legumes are best. Where there is difficulty in getting clover started, the soil should be limed, and liming is necessary for alfalfa. A rotation which has given good results on this type consists of a small grain followed by clover (of which the second crop should be plowed under), and this by potatoes or corn.

WAUKESHA SAND.

The Waukesha sand to an average depth of 6 to 8 inches consists of a dark-brown or dark-gray sand or loamy sand, which appears nearly black when moist. The content of organic matter is considerably greater than in the Plainfield sand, with which this soil is associated. The subsoil begins as a light-brown or brown, loose, open sand and becomes lighter in color and somewhat coarser in texture with increasing depth. A small but variable percentage of

small rounded gravel occurs commonly in the subsoil at and below a depth of 20 to 30 inches. The deep subsoil is stratified, thin beds of fine and medium sand alternating with coarser material. Both surface soil and subsoil show varying degrees of acidity. The surface is stone free.

While the type as a whole is quite uniform, there are a few minor variations worthy of note. In sec. 5, T. 24 N., R. 8 E., the surface soil is somewhat coarser than typical and has a small content of angular gravel. West of Jordan the surface is slightly undulating and the soil is variable in color within short distances. The surface soil in the higher places is usually lighter colored than in the depressions.

The Waukesha sand is confined largely to the valleys of the Wisconsin and Plover Rivers. The largest area extends along the Plover River from Plover to a point about 15 miles north, and constitutes an extensive terrace formation 1 to 4 miles wide.

The surface of this type is for the most part level, with a few minor undulations which appear to have been caused by wind action. Because of the loose, open character of the surface soil and subsoil the natural drainage is thorough and usually somewhat excessive. The type suffers from lack of moisture during part of practically every growing season.

This soil is very favorably situated and is of greater importance agriculturally than if distantly removed from cities or transportation facilities. The greater proportion of it has been cleared and placed under cultivation, but because of the low yields fields are frequently abandoned or allowed to remain idle for several years at a time.

Part of this soil was originally treeless and is spoken of as prairie. Over small areas and around the margin of larger tracts pine was the chief timber growth. Practically all of this has been removed and the type now presents the appearance of a sandy prairie.

The chief crops grown are potatoes, corn, rye, oats, buckwheat, and hay. General farming is the leading type of agriculture followed. Dairying and hog raising are not nearly as extensively developed as in regions of heavier soils in this and adjoining counties.

Yields of all the general farm crops are ordinarily small, but in seasons of abundant or well-distributed rainfall fair to good yields may be obtained. Near Stevens Point some trucking is carried on, and where the soil is given the best of management the returns are profitable. The productiveness is not lasting, however, and frequent fertilization is necessary to insure profitable yields from year to year.

Because of its loose, open structure, this soil is easy to cultivate. Difficulty is encountered in getting clover started, chiefly because

the soil is acid but partly because of its low productiveness and droughty nature. Practically the only fertilizer used is stable manure, some of which is obtained in the city of Stevens Point. Little stock is kept on the average farm.

Land of this type of soil sells at $20 to $75 or more an acre, the price depending upon the location and improvements. The highest prices are commanded by small tracts suitably situated for trucking.

In the improvement of this soil the stable manure should be supplemented by green-manure crops. Increasing the organic-matter content improves the water-holding capacity of the soil. Liming and the use of commercial fertilizers containing phosphorus and potash will assist in getting clover started. A good rotation for this soil consists of small grain and clover, followed by potatoes or corn. Soy beans and serradella usually do better on acid soil than most other legumes and would apparently prove profitable crops on this type.

WAUKESHA SANDY LOAM.

The surface soil of the Waukesha sandy loam is a sandy loam ranging in depth from 8 to 16 inches. It is dark brown to black in color when moist, and dark gray to dark grayish brown when dry. This soil was originally prairie and its dark color is due to the high content of organic matter. The surface soil is underlain to a depth of 18 to 24 inches by a brown sandy loam, which passes into a brown, compact, gravelly sandy loam or gravelly clay loam. This compact stratum may extend to a greater depth than 36 inches, but it is usually underlain at a depth of 30 inches or more by sand and gravel. This coarse material is distinctly stratified, and the change to it from the overlying layer is almost everywhere very sharp and abrupt. The change from the Waukesha sandy loam into the associated Merrimac types is usually somewhat indistinct.

The principal areas of the Waukesha sandy loam occur in the vicinity of Almond, where the type forms an extension of the "Grand Prairie," which lies to the south in Waushara County. A smaller area is mapped north of Arnott, and another south of that place. The type occurs on terraces which constitute a succession of nearly level to slightly undulating benches. Its natural drainage is in general adequate, but in the spring or during wet periods water sometimes stands for a time in low places. The type retains moisture well and crop yields are much more certain than on the lighter soils of the county.

The Waukesha sandy loam is considered one of the best soils in the county. It is almost entirely under cultivation, being devoted to general farming and dairying. The farms and buildings have a prosperous, well-kept appearance. The type is one of the best corn

soils in the county. The principal crops grown are corn, potatoes, oats, hay, and rye. Very good yields are usually obtained.

The soil is easy to work and is free from stones. It can be cultivated under a wide range of moisture conditions. Improved farm machinery can be used to advantage, as there are no hills. While most of this type was originally treeless and covered chiefly with prairie grasses, there was a scattering tree growth about the margins of the prairie in a number of places, consisting of red, black, and white oak, with some pine.

Land values on this type of soil are high, averaging about $100 an acre.

In the improvement of this soil the use of lime is important. Before clover will make its best growth the acidity of the type should be corrected. When limed this soil produces excellent crops of alfalfa. It is probable that this prairie land will respond profitably to the use of rock phosphate. A rotation well suited to this soil consists of small grain, clover, and corn or potatoes. The second crop of clover may well be plowed under to supplement the supply of stable manure.

WAUKESHA FINE SANDY LOAM.

The surface soil of the Waukesha fine sandy loam extends to an average depth of 12 to 14 inches. It consists of a black or very dark brown fine sandy loam to loam, high in organic matter. The subsoil begins as a brown sandy loam and changes at 20 to 24 inches to a brown or yellowish-brown, compact, gravelly sandy loam or gravelly clay loam. This compact layer usually extends to a depth greater than 3 feet, but it is underlain by lighter colored, stratified sand and gravel, which may be encountered at or below 30 inches. The color of the surface soil grows lighter as the neighboring Merrimac types are approached.

The Waukesha fine sandy loam is of very small extent. The largest area occurs directly south of Arnott. The type occupies nearly flat to slightly undulating terrace positions. Although the downward movement of water through the soil is somewhat slow, the type in general is fairly well drained. After heavy spring rains water may stand in the lower situations for a short time. The type retains moisture well and crop yields are seldom lowered by lack of moisture.

This is a very good soil for general farming, and it is all cleared, under cultivation, and highly improved. The chief crops grown and the average yields abtained are: Oats 30 to 50 bushels per acre, corn 40 to 60 bushels, corn silage 14 to 16 tons, potatoes 100 to 200 bushels, hay 1 to 1½ tons, and rye from 15 to 20 bushels. General farming is the chief type of agriculture followed, with dairying an important branch. More hogs are raised per farm than on the sandy soils.

This soil is heavier to handle than the sand types, but owing to its large content of organic matter a good tilth is readily worked up. Stable manure is the only fertilizer used. Green manuring is seldom practiced. Lime has not been used to any extent, although the soil is acid.

The land sells at $60 to $100 or more an acre, the price depending upon the improvements, location, and other factors.

In the improvement of this soil the most important need is to correct the acidity. Ground limestone is probably the best form of lime to use for this purpose. One or two tons per acre should be sufficient. When the acidity is corrected and the soil inoculated, alfalfa can be grown successfully, and the yields of the usual farm crops will be increased.

BOONE SANDY LOAM.

The surface soil of the Boone sandy loam to a depth of 8 to 12 inches is a brown sandy loam, underlain to about 20 or 24 inches by a light-textured, yellowish-brown sandy loam. In places where the Potsdam sandstone does not lie within the 3-foot section the subsoil from about 20 to over 36 inches is a yellow sand. Slabs and fragments of the parent rock occur on the surface and through the soil mass, but usually not in abundance.

The type as mapped includes small areas of a more sandy soil, occurring over undulating to gently rolling areas or on low mounds and narrow ridges. The surface soil here to a depth of 6 inches is a brownish-gray sand, underlain by a subsoil of yellowish-brown sand which passes into yellow sand. Slabs and fragments of sandstone occur to some extent on the surface and through the surface soil. The subsoil is underlain by brown sandstone, which frequently is encountered in the lower subsoil. The surface drainage of these sandier areas is good and the underdrainage excessive, so that the soil frequently suffers from lack of moisture.

The Boone sandy loam covers only 3 square miles. It is confined to that part of the county southwest of Stevens Point, and occurs to the north and west of the Wisconsin River, chiefly in Linwood Town.

The surface of this type varies from undulating to gently rolling. The surface drainage is fairly good, but the underlying sandstone rock frequently lies within 2 or 3 feet of the surface, and this sometimes causes rather imperfect underdrainage. The overlying soil has the capacity to absorb a large amount of water, but the sandstone is less pervious. The water follows this rock stratum, and there is consequently a springy condition over the areas where the surficial material is shallow or on slopes where the horizontal rock strata lie close to the surface. In such localities the surface soil is usually

somewhat darker than typical, and the subsoil is mottled more or less with drab, yellow, and rusty brown.

Practically the same methods of farming are followed on this type as on the Merrimac sandy loam. The systems of crop rotation, fertilization, and methods of soil improvement that are suited to the Merrimac soil are also applicable to this type. The Boone soils have a somewhat lower agricultural value than the Merrimac soils.

BOONE SILT LOAM.

The soil of the Boone silt loam to a depth of 8 or 10 inches is a light-brown, or when dry a grayish-brown, silt loam. This is underlain by a buff-colored silt loam. A reddish-brown, compact layer of sandy clay, 2 to 6 inches in thickness, is usually encountered in the subsoil at a depth of 16 to 24 inches, and passes below into brown sandy loam or yellowish-brown sand. This sandy portion of the subsoil is the result of the weathering of Potsdam sandstone, which formation is often encountered at or near a depth of 3 feet. Fragments and slabs of this rock occur to some extent on the surface and through the surface soil. Areas in which this material is sufficiently abundant are indicated on the map by stone symbols. In the western part of secs. 18 and 19, T. 23 N., R. 7 E., a small area of fine sandy loam is included with the silt loam. Except for these variations the type is very uniform in characteristics.

The Boone silt loam is of small extent and is confined to a few small areas southwest of Stevens Point, chiefly in Linwood Town. It occurs associated with areas of the Vesper silt loam.

The Boone silt loam has a gently rolling to rolling topography, and both surface drainage and underdrainage are good. The original timber growth consisted of oak, maple, and white pine. The soil is considered productive and especially adapted to small grains and hay and pasture grasses. A fairly large proportion of the type has been cleared and put under cultivation. The principal crops are oats and hay, with a smaller acreage of corn and potatoes. Oats ordinarily yield from 35 to 50 bushels per acre, hay 1½ to 2 tons, potatoes 150 bushels or more, and corn 30 to 40 bushels.

This soil is not difficult to handle, and a good seed bed can be worked up with little difficulty. No commercial fertilizers are used and green manuring is seldom practiced. The supply of stable manure is inadequate. Little attention is given to selecting crop rotations best suited to the soil.

In the improvement of this type the supply of organic matter should be increased by plowing under green-manure crops. The soil is somewhat acid, and lime should be used to insure best results with such crops as alfalfa and clover. A good rotation for this type

of land consists of corn, small grain, and clover. The second crop of clover should be plowed under about every second rotation, or in every rotation if no manure is available.

WHITMAN SAND.

The Whitman sand to an average depth of 6 to 12 inches consists of a dark-gray to almost black sand rather high in organic matter. The subsoil to over 36 inches is a dull-gray or mottled gray and yellow sand, with more or less fine, well-worn gravel in the lower part. In a few places the soil is loamy in texture.

The chief variation from typical occurs in the Buena Vista Drainage District, in an irregular area which originally consisted of shallow peat overlying Whitman sand. The shallow covering of peaty material has been burned off over this area, and the resultant soil consists of Whitman sand streaked and spotted with areas over which the surface soil from 2 to 10 inches consists of a gray, yellowish-brown or dark-gray ash mixed with sand. Here and there occur remnants of shallow peat which were not destroyed by the fire. These usually stand a few inches above the level of the surrounding soil.

The Whitman sand is confined largely to the southwestern part of the county, where it occurs chiefly as a marsh-border type. It is encountered bordering areas of Peat, in shallow depressions or basin-like areas in association with the Plainfield soils, and along stream courses throughout the region where sandy soils predominate. The largest tract occurs several miles west of Coddington.

The surface of the Whitman sand is level and the natural drainage is deficient. Much of the type lies within drainage districts, where the drainage conditions have been greatly improved by the construction of large open ditches. In some places these have been supplemented by tile drains.

Because of its generally rather poor drainage at present and also because of its rather small extent, this type is not of much agricultural importance. Only a comparatively small proportion of it is under cultivation. The original vegetation consisted of willow, spruce, and poplar, with some jack pine in the higher places and coarse marsh grasses in open stretches.

The chief crops grown on this soil and the best yields obtained are as follows: Oats 45 bushels an acre, corn 50 bushels, potatoes 150 bushels, and hay 1 ton. These yields are above the average and represent the returns on well-drained tracts, well farmed and fertilized. Buckwheat, alsike clover, millet, and rye are sometimes grown. This soil is not considered very desirable, as it is deficient in potash and phosphorus and occupies such a low position that it must all be drained by open ditches or tile drains. In some cases

the outlet ditches already installed do not appear to be deep enough to permit thorough drainage.

Where thoroughly drained this soil is easy to handle and responds fairly well to good farming methods. Little commercial fertilizer has been used on it, but stable manure has been applied in some instances. Where a covering of peaty material has been burned off it is probable that the supply of potash is sufficient for several seasons, but ultimately both potash and phosphorus will be required.

WHITMAN SANDY LOAM.

The surface soil of the Whitman sandy loam, extending to an average depth of 10 inches, consists of a dark-brown or black sandy loam or heavy sandy loam, high in organic matter. The subsoil usually consists of a yellow or gray sand, sticky sand or sandy clay loam. It is frequently mottled. The lower subsoil is subject to considerable variation, ranging from rather heavy sandy loam to beds of quite sandy soil. Thin lenses of clay loam may also occur, and gravelly material is frequently encountered in the subsoil. There is no calcareous material in the glacial drift from which the type is derived, and both surface soil and subsoil are acid.

The Whitman sandy loam occurs in widely scattered areas, associated chiefly with the Gloucester and Spencer soils. The type frequently grades into the Whitman silt loam without a sharp line of separation.

The surface of this type is level. It is low lying and naturally poorly drained. The type occurs largely as first-bottom land along stream courses, or in depressions in the upland where there has been an accumulation of organic matter sufficient to give a dark color.

Because of the rather small extent of this soil and its naturally poor drainage conditions, it is of little importance agriculturally. Only a small proportion of the type is under cultivation. The original timber growth consisted mainly of alder and poplar, with some red oak and white pine in the better drained areas. Coarse marsh grasses also grew upon this soil. The chief crops produced are hay, small grains, corn, and buckwheat. The soil when thoroughly drained is easily cultivated, but it requires careful management. It is deficient in some of the mineral plant foods, especially phosphorus.

In the improvement of this land the most important need is better drainage. A number of large ditches have already been constructed, but in a number of cases laterals and tile drains are necessary for thorough drainage. When properly drained and well handled this will be a fairly productive type, and satisfactory yields can usually be obtained in seasons not excessively wet.

WHITMAN SILT LOAM.

The soil of the Whitman silt loam to an average depth of about 12 inches consists of a dark-brown or black silt loam containing a high percentage of organic matter. The subsoil consists of a heavy silt loam or silty clay loam which usually extends to a depth of 36 inches or more, and frequently becomes somewhat heavier as the depth increases. It is usually dark gray or drab in color, frequently mottled with brown or yellow and sometimes with both. In the deep subsoil there is frequently some fine sand, and coarser material may occur, giving the subsoil a somewhat gritty character. In some instances beds of fine sand are encountered at a depth of 30 to 36 inches. The type as a whole is rather uniform in color and in texture of the surface soil.

The Whitman silt loam is confined largely to the northwestern quarter of the county, where the upland soils consist largely of the Gloucester and Spencer series. It also occurs to a small extent where the upland soils are of the Boone series; in such localities the deep subsoil is usually sandy. For the most part this type occupies narrow strips along stream courses, and few of its areas cover more than one-fourth square mile.

The surface is level or very gently sloping. Because of the low position and the general liability to overflows the natural drainage is poor, and the type is of little importance from an agricultural standpoint. Very little of its area has been cleared and placed under cultivation. The original growth consisted of elm, ash, alder, and other water-loving trees and shrubs, with coarse grasses.

In places there is sufficient fall to permit artificial drainage. The type can be cultivated with profit when the drainage conditions have been improved. It is naturally very productive and is adapted to all the common crops which can be grown in this region. In its present condition the land has a very low selling value.

GENESEE FINE SANDY LOAM.

The surface soil of the Genesee fine sandy loam extends to a depth of 16 to 18 inches. It consists of a brown sandy loam to fine sandy loam. In the surface 4 to 6 inches the color is usually darker brown than below. The subsoil begins abruptly as a yellowish fine sand, and is stratified in the lower part with layers of fine, waterworn gravel.

This type occurs in the bottom lands along the Wisconsin River. It usually lies somewhat higher than the Genesee silt loam, but is subject to periodic overflows. The surface is flat to slightly undulating, relieved frequently by abandoned stream channels or sloughs, which are filled with peaty accumulations or hold water

after the subsidence of the overflows. The drainage of the type is good between inundations.

The Genesee fine sandy loam is of small extent and minor importance. Most of it is still timbered with oak, elm, basswood, maple, and white pine. The chief crops grown are rye, corn, oats, hay, and potatoes.

Farming on this soil is uncertain, because of the danger of flooding. Reports indicate that floods occur every 3 to 5 years sufficient to destroy all crops, and less destructive floods occur more frequently. On account of the small extent of this type, the expense of constructing dikes to protect the land from flooding is apparently not warranted.

GENESEE SILT LOAM.

The surface soil of the Genesee silt loam, extending to a depth of 16 to 18 inches, consists of a brown, dark-brown or reddish-brown silt loam. A few inches of reddish-brown sandy loam may intervene between the surface soil and the underlying loose, open, yellow sand and gravel, but usually the change from silt to sand is abrupt. The subsoil is distinctly stratified.

This type is confined to the valley of the Wisconsin River, where it occurs as first-bottom land subject to overflows. The surface is flat to slightly undulating except for abandoned stream channels or sloughs. The sloughs are either filled with a deposit of peaty material or hold water after the subsidence of floods. The drainage of the type is good between overflows.

The Genesee silt loam is of small extent, and most of it is heavily timbered with water maple, elm, basswood, and oak, with some birch. A few tracts have been cleared, and oats, corn, hay, and potatoes are grown. The danger of flooding makes farming uncertain. To prevent flooding, dikes would be necessary and the expense of their construction would not be justified under present conditions.

PEAT.

The material mapped as Peat consists of vegetable matter in varying stages of decomposition, with which there has been incorporated a small mineral content. When raw, fibrous, and only slightly decomposed the Peat has a brown color, but when more completely decayed it becomes somewhat darker. It is light in weight as compared with other soil, and is loose and rather spongy. The surface material is often of a lighter brown color than that at a depth of 2 feet or over. This is usually true of the timbered marshes in the region of glacial soils. In some instances the more thoroughly decomposed material occurs at the surface, and raw, fibrous peat is encountered at the lower depths. This appears to be the case most frequently where the marshes were originally treeless.

The peaty matter ranges in depth from 18 inches to over 3 feet. Probably over about one-third of the area of the type its depth is greater than 3 feet. In some instances the deposits are known to be 10 feet or more deep. The underlying material usually consists of grayish or nearly white sand of medium texture. In the northwestern part of the county, where some of the upland soils are heavy, the underlying material is sometimes a clay loam or sandy clay. This is also true of a few marshes in the eastern half of the county, especially in the northeastern part, where some of them are surrounded by heavy soils. Where the marshes are bordered by sandy soils they usually have sandy bottoms. Some of the Peat areas, including much of the Buena Vista Drainage District, have been burned over, leaving the surface covered with a thin deposit of ash.

Peat, with its shallow phase, is the most extensive type in the county. By far the largest tract is found in the southwestern part of the county, in what is known as the Buena Vista Drainage District. Another extensive marsh development occurs in the northwestern part of the county, chiefly in Eau Pleine Town, and is included in the Dancy Drainage District. This marsh extends for over 10 miles along the Little Eau Pleine River, but only a small proportion of it is within Portage County. Another marsh occupied by typical Peat occurs immediately east of Jordan, extending north from Stockton for over 6 miles, with a width of about 1 mile. Numerous smaller peaty marshes occur throughout the northern and eastern parts of the county.

The surface of all the Peat areas is low, level, and naturally very poorly drained. A large proportion of the Peat is included within drainage districts and has been drained more or less thoroughly by large open ditches. In some cases these have been supplemented by tile drains.

The native vegetation on the open marsh areas consisted largely of coarse marsh grasses, sedges, and sphagnum moss. Over most of the Buena Vista Drainage District and quite a large proportion of the marsh in the Dancy Drainage District the growth was of this nature. Where the type was timbered alder, poplar, and tamarack were found. Within the glaciated area in the northern and eastern parts of the county many of the marshes support a dense growth of tamarack, cedar, and alder, with some ash. On marshes which are wholly or in part within drainage districts some of the timber has been removed and the land cleared, but in most cases the treeless portions of the marshes are the first to be prepared for cultivation.

By far the most extensive farming development on this marsh land is in the Buena Vista Drainage District, in the southwestern part of the county. Approximately one-half the area of this marsh consists of

Peat land, and a considerable proportion of this has been placed under cultivation. Many substantial farm buildings have been constructed here, and farming is carried on with varying degrees of success. It was at first thought by those who developed this project that the use of commercial fertilizers would not be necessary on this land. Some good yields were obtained without the use of fertilizers of any kind. It has come to be quite generally recognized, however, as has been advocated by the Wisconsin experiment station, that marsh land of this kind can not be successfully farmed over a period of years without fertilization and that mineral plant foods in the form of commercial fertilizers are doubtless the most economical means of insuring profitable crops. The Peat is deficient in potash and phosphorus, and it also shows varying degrees of acidity. At present considerable quantities of wood ashes, rock phosphate, and acid phosphate are used, with success. Lime is also applied in some instances.

The chief crops grown on the Peat are corn, oats, rye, millet, buckwheat, timothy and alsike clover, potatoes, and various root crops. Where proper methods of fertilization and cultivation are followed and where the drainage is sufficient the yields are equal to those obtained on good upland soils. In many cases, however, the necessity of using fertilizers has not been realized, and the cultural requirements of this class of land have not been fully met by most of the farmers. For these reasons, and owing to the fact that in some places the drainage has not been sufficient, crop yields have often been low, and some farmers have become discouraged. Abandoned farm buildings and idle fields are not uncommon. Where the drainage is not sufficient for cultivated crops, marsh hay is cut. In some places wire grass has been cut for use in grass-matting factories. With drainage, however, the wire-grass production has been greatly reduced.

In the Dancy Drainage District some development has taken place on Peat. A much smaller proportion of this land is under cultivation here than in the Buena Vista Drainage District, owing to the fact that all the drainage ditches have not been completed and to the further fact that in some cases drainage has been insufficient even where ditches have been installed. The outlet ditch has recently been deepened, so as to insure an outlet which will make thorough drainage possible over the entire district.

A few other reclamation projects are being organized or are under consideration in various parts of the county, but on a much smaller scale. Some small tracts of Peat are being reclaimed by individual effort.

Because of the extensive areas of Peat in this county its improvement is of great economic importance. This soil is deficient in

potash and phosphorus, and these elements must be incorporated before crops can be successfully grown from year to year. They may be supplied in the form of stable manure or commercial fertilizer. Owing to the present high cost of the usual forms of potash, the best source of this element at present is wood ashes. Phosphorus may be applied in the form of finely ground rock phosphate or as acid phosphate. The nitrogen contained in manure is not needed on Peat, and this element is largely wasted when stable manure is applied to Peat land. The physical nature of this soil is such that it requires special care in cultivation. The use of a roller to compact the seed bed and compress the loose peaty material about the seed is advisable. The roller should be followed by a light harrow, unless a corrugated roller is used, in which case harrowing is not so necessary. With proper fertilization and cultivation this soil can be farmed with profit, as has been demonstrated in this and other counties of Wisconsin and in adjoining States.

Peat, shallow phase.—Peat, shallow phase, includes those areas in which the depth of the peaty accumulation averages about 18 inches, although it varies from about 10 inches to as much as 24 inches in a few small areas. The peaty matter usually rests upon a gray to white sand of medium to fine texture, but in some instances a clay loam or sandy clay is the underlying stratum. This heavy material usually occurs in the northwestern part of the county, where there is considerable heavy soil in the uplands adjoining the marshes.

Peat, shallow phase, is not as extensive as the typical Peat. Its most extensive area is in the southwestern part of the county, in the Buena Vista Drainage District, where the phase occurs closely associated with the typical Peat. It usually occurs as a gradation from typical Peat to soils of the Whitman series, and includes material ranging between these types in characteristics. Smaller areas of the phase occur in the northwestern part of the county.

The surface of this phase is low, level, and naturally poorly drained. A number of large open ditches have been constructed, and in places tile drains have been installed.

The original vegetation on the Peat, shallow phase, was about the same as on the typical Peat, consisting of marsh grasses, sedges, sphagnum moss, willows, and alder, with some poplar and in a few places tamarack. Tamarack was not as common as on the typical Peat.

Little development has taken place on the Peat, shallow phase, outside the Buena Vista Drainage District, where it has been improved along with the typical Peat. The same crops are grown. Practically the same yields are obtained, and the same methods of treatment are required to make farming on the phase profitable.

As is the case with the typical Peat, the soil of the shallow phase is deficient in potash and phosphorus and is in an acid condition.

The value of land of Peat, shallow phase, is probably a little higher than that of the typical Peat, especially where there is clay in the subsoil.

SUMMARY.

Portage County is situated in the central part of the State of Wisconsin. It comprises 812 square miles, or 519,680 acres. The surface features vary from level to rolling and hilly. The average elevation of the county above sea level is about 1,110 feet.

The eastern third of the county drains toward the east through tributaries of the Little Wolf and Waupaca Rivers into Lake Michigan, while the remainder of its area drains into the Wisconsin River, and thence into the Mississippi.

Portage County was organized in 1844. The early settlers came largely from eastern States. The total population in 1910 was 30,945. The population is 71.9 per cent rural. Stevens Point, the county seat, with 8,692 inhabitants, is the only place with a population larger than 1,000. Portage County has good railroad connection with many large cities and markets.

The mean annual precipitation for the county is about 30 inches, and the mean annual temperature is about 43° F. The winters are long and severe, with a snowfall of about 41 inches, but the summers are warm and crops make rapid growth. There is a growing season of about 125 days free from killing frosts.

The agriculture of the county shows all stages of development. The best farming land is in the northwestern, northeastern, and eastern parts of the county, where fine sandy loam or heavier soils predominate. Soils of lower value, mostly sandy or marshy, occur throughout the central, southern, and north-central sections.

The principal crops are hay, oats, potatoes, rye, corn, barley, and buckwheat. General farming is the prevailing type of agriculture, and dairying and potato growing are two of the most important interests.

Over 79 per cent of the total area of the county is in farms. The average size of the farms is 127 acres, of which on an average 68 acres are improved. About 90 per cent of the farms are operated by owners.

The soil material of Portage County has been derived from glacial, residual, alluvial, and possibly loessial materials. The soils, exclusive of Peat, are classed in nine series.

The Gloucester series comprises light-colored upland soils in the region of recent glaciation, where the material has been derived chiefly from crystalline-rock formations. The lighter textured

members of this series are droughty, but the heavier types are very productive, comprising some of the best land in the county. General farming and dairying are well developed on these soils. Potatoes are an important crop, and miscellaneous fruits and vegetables are grown.

The Spencer series consists of grayish upland soils in the driftless area or in regions of old glaciation where the subsoil is strongly mottled and the natural drainage conditions somewhat deficient. The greater part of the area of these soils is under cultivation. The silt loam type is difficult to work.

The Vesper silt loam consists of a brownish soil overlying sandstone. The surface soil is derived from a loesslike deposit, while the subsoil is derived from the underlying Potsdam sandstone. Hay and oats are the principal crops grown on this soil in a system of general farming.

The Merrimac series comprises light-colored timbered soils, which occur as outwash plains, stream terraces or filled-in valleys where the parent material has come largely from crystallized-rock formations. The Merrimac soils are largely under cultivation. They are productive types and rank among the most desirable in the county.

The Plainfield soils are very similar to the Merrimac in surface features and origin, except that the parent material has come largely from sandstone formations. The series is quite extensive in the southwestern part of the county, in the Wisconsin River valley. The sand type is droughty, but the fine sandy loam is a desirable farming soil.

The Waukesha series comprises dark-colored soils, occurring on outwash plains, in filled-in valleys or on stream terraces. The parent material has come both from crystalline rocks and from sandstone. The sand member of the series is inclined to be droughty and gives rather poor yields except in particularly favorable years, but the sandy loam and fine sandy loam are almost entirely under cultivation and are highly improved.

The Boone series comprises brownish upland soils derived largely from the weathering of Potsdam sandstone. The types mapped are the sandy loam and silt loam. These types are of small extent. They are confined to the west-central part of the county. The Boone soils are fairly good agricultural types.

The Whitman series comprises dark-colored, low-lying, poorly drained soils within the region of crystalline rocks. The soils are partly of alluvial origin, partly glacial, and in part residual. The types mapped are the sandy loam and silt loam. They are farmed to only a small extent at present, but with reclamation and improvement they would be productive and adapted to a wide range of crops.

The Genesee series comprises brownish soils in first-bottom areas along streams. The types mapped in this county are the fine sandy loam and silt loam. These soils in general can not be safely farmed at present, owing to their liability to overflows.

The soils mapped as Peat and its shallow phase consist of vegetable matter in varying stages of decomposition. These soils occur in poorly drained, low-lying places and cover a considerable total area. Some of this marsh land has been reclaimed.

[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

Areas surveyed in Wisconsin.

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