Issued October 4, 1913.

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 JUNEAU COUNTY, WISCONSIN.

BY

W. J. GEIB AND E. B. WATSON, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND L. R. SCHOENMANN, C. A. LE CLAIR, AND O. E. BAKER, OF THE WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY.

J. E. LAPHAM, INSPECTOR IN CHARGE OF NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1911.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1913.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., February 12, 1913.

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of Juneau County, Wis., and to request that they be published as advance sheets of the Field Operations of the Bureau of Soils, 1911, 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. JAMES WILSON,
Secretary of Agriculture.

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SOIL SURVEY OF JUNEAU COUNTY, WISCONSIN.

By W. J. GEIB and E. B. WATSON, of the U. S. Department of Agriculture, and L. R. SCHOENMANN, C. A. LE CLAIR, and O. E. BAKER, of the Wisconsin Geological and Natural History Survey.

DESCRIPTION OF THE AREA.

Juneau County is located a little south of the center of Wisconsin and is bounded on the north by Wood County, on the east of the Wisconsin River, which separates it from Adams County, on the south by Sauk County, and on the west by Vernon, Monroe, and Jackson Counties. It has a length north and south of 42 miles and a width east and west varying from about 17 to 27 miles. The county comprises an area of about 796 square miles, or approximately 509,440 acres.

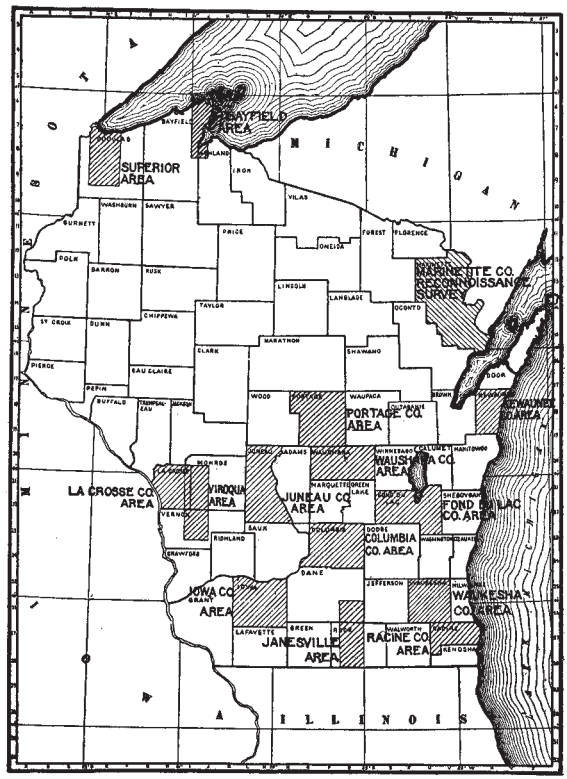

FIG. 1.—Sketch map showing areas surveyed in Wisconsin.

The surface of the area surveyed falls naturally into two topographic divisions and the line separating them follows, in a general way, the main line of the Chicago, Milwaukee & St. Paul Railroad, which passes through Lyndon, Mauston, New Lisbon, and Camp Douglas. The region to the north, comprising about two-thirds of the county, is a nearly level plain with a gradual rise to the north and west. Projecting through the floor of this plain and rising to elevations from 20 to 200 feet or more are a few sandstone and quartzite hills, which form the most con-

spicuous features of the landscape. The country in general consists of extensive sand flats, on which some low dunes have been formed and which give way in the northwestern portion of the area to large stretches of marsh, dotted with innumerable small sand islands only 1 or 2 feet above the level of the lowlands. The fertility of the sands is low and agricultural development limited. On the marshes hay is the chief crop, though some cranberries are grown.

The region to the south, comprising about one-third of the area surveyed, consists of a very rugged country, much dissected by valleys and ravines, the slopes of which are often steep and frequently rocky. The surface is hilly to broken and there is an abrupt rise from the level land on the north to the hill country on the south. The difference in elevation ranges from 200 to more than 400 feet. Two and one-half miles northeast of Lyndon, on what is about the lowest portion of the plain, the elevation above sea level is 857 feet. The hilly country to the southwest of Lyndon ranges from 1,000 to 1,250 feet above sea level. Farther west the elevation is still greater. Although rough, this region includes the best farming land in the area.

The drainage of the entire county is into the Wisconsin River. The Yellow River enters the county at about the center of the northern boundary line and joins the Wisconsin River at Germantown, which is several miles below the center of the county. The Little Yellow River drains the northwestern portion of the county and flows into the Yellow River about 4 miles northwest of Germantown. The Lemonweir River traverses the county from northwest to southeast, passing through New Lisbon and Mauston and flowing into the Wisconsin River about 9 miles north of the southern boundary. This stream receives drainage water from the level sand areas to the north and also from the hill region to the south. The Baraboo River crosses the southwestern corner of the county and joins the Wisconsin River after traversing Sauk County. These rivers receive the drainage waters from numerous smaller streams and drainage ditches.

The first settlers came into the county in 1832 and located in the Lemonweir Valley. In 1837 a trading post was established where Mauston is now located. New Lisbon was settled in 1846, Necedah in 1849, and Elroy in 1860. The land south of the Lemonweir and west of the Wisconsin River was ceded in 1836 to the General Government by the Indians, and settlement in this region began after that date. The region north of the Lemonweir, however, was not settled until some years later. Adams County, which originally included Juneau, was established in 1848, but in 1857 Juneau was made a separate county. Lumbering was the chief industry about 1850, but this lasted for only a comparatively short time, after which permanent settlement was more rapid. In 1857 Mauston had a population of 800. What is now the Chicago, Milwaukee & St. Paul Railroad was completed through the county in 1837.

Among the early settlers were a considerable number of English and Irish and some French. Many settlers came from Michigan, Illinois, Ohio, New York, and some from other Eastern States. There are a number of Poles and Bohemians in the northeastern part of the county and in general the foreign population is greater on the sandy soils. At present all parts of the county are settled, although some sections are more thickly populated than others. The region most thinly settled is in the northwestern part of the county, while all of the level, sandy country contains a much smaller population per square mile than the hilly region throughout the southern and southwestern sections.

Mauston, with a population of 2,400, is the county seat and largest town in the area. It contains a large feed mill operated by water power from the Lemonweir River, an electric-light plant, water works, sewage system, fire department, machine shops, woolen mill, pickle factory, brewery, creamery, cooperage works, cigar factory, knitting works, glove factory, two banks, two newspapers, and in all over 50 places of business. Elroy, with a population of 1,450, is located in the southwestern part of the county, on the Baraboo River and the Chicago & North Western and Chicago, St. Paul, Minneapolis & Omaha Railways. It is an up-to-date city, having an electric-light plant, waterworks, two banks, two newspapers, and a number of other business interests. Division headquarters of the Chicago, St. Paul, Minneapolis & Omaha Railway are located here, and the shops and switching yards give employment to a number of men. The city is surrounded by a good agricultural country, and live stock, grain, and produce are shipped in large quantities. Necedah, with a population of 1,116, is located a little north of the east-central portion of the county, on the new line of the Chicago & North Western Railway and a branch of the Chicago, Milwaukee & St. Paul Railroad. It is an enterprising village and the central market and shipping point for a large area of sandy country in Juneau and Adams Counties. New Lisbon is a city of 1,300 inhabitants, 7 miles northwest of Mauston, on the Chicago, Milwaukee & St. Paul Railroad and the Lemonweir River. It contains over 25 business places, receives and ships farm produce quite extensively, and is the third largest town in the county. Wonewoc, Camp Douglas, Mather, Lyndon, Meadow Valley, Union Center, and Hustler are smaller villages in various parts of the area.

The county is well supplied with railroads. The main line of the Chicago, Milwaukee & St. Paul Railroad crosses the area from northwest to southeast, passing through Camp Douglas, New Lisbon, Mauston, and Lyndon. A branch of this line goes north from New Lisbon through Necedah to Grand Rapids and other points north. Another branch of this road crosses the northwestern corner of the

county, passing through Mather and Meadow Valley. The Chicago & North Western system, including the Chicago, St. Paul, Minneapolis & Omaha Railway, has a line crossing the southwestern part of the county from Chicago to Minneapolis and St. Paul and passing through Wonewoc, Union Center, Elroy, Hustler, and Camp Douglas. From Elroy the Chicago & North Western extends to La Crosse and points in Minnesota. The new short line of the Chicago & North Western Railway crosses the county from east to west, passing through Necedah and Cranberry Center. The Hillsboro & Northeastern Railroad extends from Union Center to Hillsboro, in the adjoining county.

The numerous towns within the county furnish a market for considerable farm produce, but the greater proportion is shipped to outside points. Practically all of the fat stock sold is shipped to Chicago. The output of the creameries goes principally to Chicago and the cities of the East. From Mauston to Chicago is 214 miles and to Milwaukee 128 miles over the Chicago, Milwaukee & St. Paul Railroad. From Mauston to Minneapolis the distance is 209 miles.

The roads throughout the northern two-thirds of the county are sandy. In places there are deposits of clay which could be utilized in making sand-clay roads, and this has been done to a limited extent. In the southern and southwestern parts of the county the roads are generally good, but the country is rough and the steep grades make the hauling of large loads very difficult and often impossible. The soil in this region is silty and roads through such material are comparatively easy to keep in good condition. Washing on the steep grades sometimes damages the roadbed.

CLIMATE.

The climatic conditions prevailing in Juneau County are somewhat variable, owing to the differences in topography. The northern two-thirds of the area consists of extensive marshes and sand flats, while the southern third is a rough, broken country, with an average elevation of over 200 feet above the level of the lowlands. The most pronounced variations resulting from differences in topography are in connection with the occurrence of frosts. The only Weather Bureau station in the county is located at Mauston, which is close to the border of the extensive sand plains area and considerably lower than the upland region in the southern part of the county. It is about 8 miles from the border of the main marshy tract, and the records taken there, particularly those applying to frost occurrence, do not apply to the extensive low, wet areas in the northwestern portion of the county or to the higher lands to the south, but must be confined to a comparatively small tract of country similar to that in the immediate vicinity of the station. The following tables give data col-

lected at the Mauston station and at Hancock, which is about 20 miles east of the eastern county boundary and on the eastern border of the sand plains region, together with frost data for Mauston, Hancock, and La Crosse. The records from the two latter places are given for the purpose of making comparisons.

Normal monthly, seasonal, and annual temperature and precipitation at Mauston and Hancock.

Month.	Mauston.				Hancock.						
	Temperature.			Precipitation.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	Inches.	°F.	°F.	°F.	Inches	Inches.	Inches.	Inches.
December	19.4	60	−25	1.12	20	50	−25	1.2	1.8	1.1	7.5
January	15.8	55	−40	1.06	16	53	−30	1.1	1.4	1.6	10.1
February	15.2	55	−50	1.07	16	53	−35	1.2	1.2	1.6	7.9
Winter	16.8			1.08	17			3.5	4.4	4.3	25.5
March	30.2	77	−15	2.03	30	73	− 8	1.7	0.5	1.2	6.5
April	45.0	87	5	2.40	46	85	11	2.4	1.0	2.9	2.8
May	56.1	90	20	4.36	58	93	25	3.7	1.8	5.6	0.5
Spring	43.7.			2.93	45			7.8	3.3	9.7	9.8
June	65.4	100	26	4.58	67	99	31	4.2	1.4	7.3	0.0
July	70.2	10e	39	4.29	72	100	44	4.0	1.8	4.0	0.0
August	67.8	96	29	3.34	69	100	40	2.9	3.4	4.0	0.0
Summer	67.8			4.07	69			11.1	6.6	15.3	0.0
September	60.8	94	14	3.16	61	94	20	2.6	1.4	2.7	0.0
October	48.9	84	10	2.49	50	84	15	2.1	0.4	1.0	0.5
November	34.7	77	−13	1.64	32	68	10	1.2	1.7	1.1	3.9
Fall	48.1			2.43	48			5.9	3.5	4.8	4.4
Year	44.1	106	−50	31.54	45	100	−35	28.3	17.8	34.1	39.7

Dates of first and last killing frosts.

Station.	Length of record.	Average date of—		Average length of growing season.
		First killing frost in autumn.	Last killing frost in spring.	
	Years.			Days.
Mauston	14	Sept. 24	May 17	130
Hancock	18	Sept. 28	May 18	133
La Crosse	37	Oct. 10	Apr. 30	163

From the Mauston records it will be observed that the mean annual temperature is 44.1° F. and the mean annual precipitation 31.54 inches. The average date of the first killing frost in the fall is September 24 and that of the last killing frost in the spring, May 17. This gives an average growing season of about 130 days. In the marshy region to the north and west from Mauston the period free from frost is shorter than this, while over the hilly country to the south it is somewhat longer.

The records show that the rainfall is normally well distributed throughout the growing season, and that during the months of May, June, July, and August there is on the average over 3¼ inches of rain each month, yet during any of these months, especially July and August, there may be dry spells, during which crops will suffer considerably from drought. The winters are long and severe, but the summers are pleasant.

It is regretted that there are no data available showing the differences in the occurrence of frosts in the hilly sections and in the low marshy areas within the county. Nevertheless in the improvement of the agriculture of the low marshy areas in the county the probability of the occurrence of frosts during summer months should be kept in mind, for it may be a determining factor in selecting a type of farming best suited to prevailing conditions.[1]

AGRICULTURE.

Prior to 1850 lumbering was the chief industry in Juneau County and farming received but little attention. About this time, however, farms began to be opened up and settlement became quite rapid. The country along the Lemonweir River and to the south was opened up sooner than the country to the north and farming was also begun there earlier. Wheat was the important cash crop for a considerable period, while corn and oats were grown on a less extensive scale. The methods of farming followed were crude and but little, if any, attention was given to the selecting of crops or methods best suited to particular soils.

During the period from 1860 to 1880 the hop industry was developed to considerable proportions. The crop was at first so profitable that nearly every farmer went into the business. Frequently one crop would pay for the land and entire equipment. The industry grew to considerable proportions in other sections of the State and overproduction finally resulted. In connection with low prices, the

[1] Buls. Nos. 119, 213, and 219 of the Wisconsin Agricultural Experiment Station, Madison, give valuable information concerning the climatic conditions in the cranberry marshes and also in the construction and management of cranberry bogs. For a further discussion of climatic conditions in the lowlands see Bul. T of the U. S. Weather Bureau. See also Bul. 223, Wis. Expt. Sta. This gives information on the climate of Wisconsin and its relation to agriculture.

hop louse invaded this region, which aided in bringing failure upon many farmers. By 1880 the hop industry was almost entirely abandoned.

The growing of tobacco has been and is still an important industry, but the acreage is being gradually decreased.

For over 30 years cranberries have been grown on the areas of Peat in the northwestern part of the county. At first only the berries which grew wild in the bogs were gathered. About 15 years ago nearly all of the marshes were destroyed by fire, and since that time cranberry vines have been transplanted and a larger proportion of the cranberry marshes cultivated. A few marshes have been sanded, but the industry as a whole is not nearly as extensive as it was formerly.

The type of agriculture most extensively followed in Juneau County at the present time consists of general farming, with dairying and stock raising as the most important branch. In the southern and southwestern portions of the county the soil is better, land values are higher, and agriculture is more highly developed than in the northern part, where the soil is either sandy or in a marshy condition and the drainage conditions have not been sufficiently improved to insure the growing of cultivated crops. All of the general farm crops common to the region, including corn, oats, barley, wheat, hay, and rye, are grown. Some special crops, including tobacco, potatoes, and cranberries, are produced and trucking is carried on to a limited extent in different parts of the county. The cutting of wire grass and the gathering of moss are special industries confined to the marshy portions of the county.

The figures given in connection with the various crops are taken from the census reports of 1910 and cover the farm products for the year 1909. While these reports cover but one year, they give an idea of the size of the various crops grown.

The acreage devoted to hay is greater than that of any other crop. From 37,024 acres in 1909 a crop of 55,927 tons was harvested, which is an average yield of about 1.2 tons per acre. This includes the marsh hay, of which there was over 10,000 acres, as well as the hay from tame grasses and clover. Most of the tame hay consists of a mixture of clover and timothy, which is seeded with barley, oats, rye, or wheat. There is a small amount of timothy grown alone and a smaller amount of clover. Only a few patches of alfalfa are grown, but where reported the yield averaged a little over 2 tons per acre. The average yields of hay on the silt loam soils of the southern part of the country are considerably higher than the average for the county, while the yields on the sandy types are much lower.

The oat crop is second to that of hay and it is the most extensive of the cultivated crops. From 27,618 acres a yield of 809,963 bushels,

or 29.3 bushels per acre, was secured in 1909. Oats are more extensively grown in the hilly portion of the area, where the soils are heavier and the yields larger than in the flat country, where the soils are sandy. Most of the crop is fed, though a number of farmers sell some each year.

Corn is the cultivated crop of second importance from the standpoint of acreage, and from 18,768 acres in 1909 a yield of 370,899 bushels, or 19.7 bushels per acre, was secured. This average yield is very low, owing to the fact that considerable corn is planted in the sandy section where the yields are light. In fact, the crop is often a complete failure on the sand, while on the heavier soils very good yields are secured. Practically all of the corn is fed on the farms where it is grown.

Rye is an important crop, especially on the sandy soils. The crop yield of 1909 from 7,123 acres was 52,977 bushels, or an average of 7.4 bushels per acre. Rye is seeded in the fall and the land may be used for pasture both in the fall and early spring. On the sandy loam types fair crops are secured, but on the Boone fine sand, low phase, and the Plainfield sand the yields are low and the crop is frequently a failure.

At present barley is not as extensively grown as in former years, yet it is a profitable crop. But little is produced on the sandy soils. From 4,748 acres 121,008 bushels, or an average of 25.4 bushels per acre, was secured in 1909. Clover is frequently seeded with the barley in the spring.

Buckwheat is confined largely to the sandy portion of the county and is not extensively grown. The acreage in 1909 was 2,349, yielding 23,680 bushels, or an average of 10 bushels per acre.

Wheat was extensively grown earlier in the history of the county, but the acreage at present is small. In 1909 there were 449 acres of winter wheat, which averaged 16.8 bushels per acre, and 901 acres of spring wheat, which averaged 18.1 bushels per acre. Wheat is confined chiefly to the heavier soils of the area and as a rule does fairly well. It is not probable that the acreage will be increased, since dairying is becoming the chief factor in the agriculture of the area, especially in the region where most of the wheat was formerly grown.

Potatoes are grown more extensively than any of the other special crops and the acreage exceeds that of several of the general farm crops. In 1909 there were 11,992 acres, which yielded 748,530 bushels, or an average of 62.4 bushels per acre. Most of the potatoes intended for market are grown on the sandy soils, though on the silt soils they are grown for home use and the surplus sold. The growing of potatoes could doubtless be profitably extended.

The growing of tobacco[1] began about the time the hop industry declined, and while it is not cultivated as extensively at present as it has been, there is still considerable grown in various parts of the county, especially in the southern part. The fine sandy loam soils are probably the most desirable, as they produce an early crop of thin, light-colored, elastic leaves. These soils usually contain only a small amount of humus and require an annual dressing of barnyard manure to maintain their fertility. The slit loam types, on account of a tendency to become heavy and compact in texture through the loss of humus, do not always produce as fine a leaf after several years of cultivation as the sandy soils. The "new breaking" on this type of soil, however, has the reputation of producing the finest quality of heavy-yielding crops. Where tobacco is grown, nearly all of the manure produced on the farm is applied to the tobacco field at the expense of the rest of the farm. Crop rotations are necessary to maintain the fertility of the soil. A successful method provides for growing tobacco three years in succession, followed by corn, barley, and clover each one year. Oats may be substituted for barley on the poorer soils. Since tobacco occupies the land but a part of the year, the use of a cover crop is desirable. Grains and legumes such as rye and hairy vetch are used to advantage.

The cranberry[2] industry of Wisconsin is confined chiefly to the counties of Wood, Jackson, Juneau, Monroe, Winnebago, and Waushara. The average crop of Wisconsin is about 75,000 barrels per year. The industry in Juneau County is not as extensive as formerly, many of the bogs having been run over by fires and never replanted. The cranberries are grown on areas of Peat, and under the the head Peat and Muck (undifferentiated) the industry is discussed at greater length.

The cutting of wire grass and the gathering of sphagnum moss are special industries which have reached considerable magnitude in this county. The growth of these plants is confined to the low, marshy areas mapped as Peat and Muck (undifferentiated) and Sands and Peat (undifferentiated). Fires have reduced the amount of moss available, and shipments are decreasing yearly. From 20 to 30 carloads are shipped from Mather each year. As high as 154 carloads of baled wire grass have been shipped from Cranberry Center in one season.

A small amount of clover seed is produced in connection with general farming in various parts of the county. In Lyndon Township more alsike clover seed is grown than in any other part of the area.

[1] For further information on tobacco culture see Bulletin 206, University of Wisconsin Agricultural Experiment Station.

[2] Buls. 119, 213, and 219, Wis. Agr Expt. Sta., and Bul. "T," Weather Bureau, U. S. Dept. of Agr.

Some red clover seed is also secured in certain sections of the hilly country.

Cucumbers for pickling are grown at various points in the county, especially on the sand or fine sandy loam types. The crop is usually a profitable one and very satisfactory returns are frequently secured. Pickle factories are located at Lyndon and Mauston.

Trucking has not been extensively developed on a commercial scale in any part of the county. However, such crops as strawberries, bush berries, cabbage, tomatoes, melons, etc., are grown to supply the home markets, and it would seem that the industry could be extended, especially along the railroad lines, which provide excellent transportation facilities.

The fruit industry has not been developed on a commercial scale, though there are small apple orchards on a number of the farms. There are many good orchard sites throughout the rougher portions of the county and locations could be selected which would be suitable for the growing of apples. Each farm, where the soils and other conditions are favorable, should at least support a small apple orchard sufficient to supply the home and perhaps provide some for the market. Other fruits, such as bush berries and strawberries, are as well adapted to conditions here as the apple and are being successfully grown in the Sparta district, the soils of which are similar to those in Juneau County.

While the dairy industry is not as highly or as extensively developed in Juneau County as in many other sections of Wisconsin, it is, nevertheless, the most important branch of farming in the region surveyed. There are 10 creameries and 3 cheese factories in the county. One creamery is located at Necedah, and the remainder are in the west-central and southern sections of the county. Dairying has been developed mostly on the silt loam soils and on the sandy types which are underlain by clay. In the northern part of the region surveyed, where the soils are very sandy or where marshy conditions prevail, there are no creameries or cheese factories. For every 100 head of cattle in Juneau County there are 54.8 milch cows. The total number of dairy cows is 15,345. Wherever the Knox silt loam and the other heavier soils of the county are found the number of cows is considerably greater than where the soils are very sandy. Aside from the milk and cream disposed of through the cheese factories and creameries, considerable butter is made on some of the farms, and all of the towns within the area are supplied with milk and cream from near-by dairy farms. There are a number of good dairy farms in the county, and on some of these pure-bred, registered stock of the various dairy breeds is raised.

A gradual decrease is taking place in the production of grain and tobacco and an increase in dairying and hog raising. This change

seems to be more apparent among the American farmers than among those who are foreign born. Dairying is not only more profitable from a financial standpoint, but it tends to build up the fertility of the soil and is a more certain proposition from year to year than the growing of tobacco. The slopes of the rough country furnish sufficient pasture for a larger number of dairy stock than is now kept, and the industry should be extended.

The raising of beef cattle is not nearly as extensive as the dairy industry, though there are some purebred Aberdeen Angus, Shorthorns, and a few Herefords in the area. Most of the stock sold for beef is of mixed breed and usually consists of a few head from a number of farms rather than a large number from a few beef-producing farms.

Some hogs are raised in connection with dairying, but the number of hogs in the county is less than the number of dairy cows. The number of both classes of stock is comparatively small and could well be increased. Hog raising in conjunction with dairying can be made a very profitable line of farming.

The number of sheep in the county is about equal to the number of hogs. Sheep raising is confined largely to the rougher portion of the county, where there is considerable steep land which can not be used for cultivated crops. The number of sheep in the area surveyed, as given in the census for 1910, is 15,716. It would seem that even though more pasture is required for cows, owing to the extension of dairying, a greater number of sheep could readily be kept, since there is a considerable area on the average farm in the hill country which can be used for nothing but pasture.

It is generally recognized within the county that certain soils are better adapted to certain crops than other soils. For example, the finest grade of tobacco is grown on the sandy soils which are underlain by clay. Barley, oats, and corn give better results on the heavy soils than on the sands. Rye and buckwheat do better on the sands than any of the other crops commonly produced in the county. Potatoes give the best results on the sands or sandy loams underlain by clay. But little success has been attained in raising clover on the sand, while on the heavier soils good yields are usually secured. The question of adaptation of soils to crops, however, has not been thoroughly worked out, and considerably more study and experimental work are necessary before final recommendations can be made.

A number of different rotations are practiced, but in many cases it was found that no definite system was followed. On the heavier soil types, which are confined to the southern part of the county, the most common rotation consists of corn, barley, and oats, with the oats seeded to clover and timothy mixed. Hay may be cut for one or two years or the field may be pastured a year before plowing

again for corn. On the sandy soils in the central, eastern, and northeastern parts of the county rye and buckwheat are quite commonly grown, and more potatoes are produced than on the heavier soils. A rotation consisting of clover, potatoes, and rye is a good one for the sandy soils, but as a rule no definite system has been followed on the majority of sand farms. In the rotation suggested the first crop of clover should be cut for hay and the second crop plowed under as a green manuring crop. It is important that every farmer should give the matter of selecting a crop rotation very careful attention. It has been found that commercial fertilizers can often be used to advantage on the sandy soils in getting legumes started.

The methods of cultivation which are followed on the heavier soils of the southern and southwestern parts of the county are better adapted to conditions existing there than are the methods followed in the central and northern parts adapted to sandy soils. On the heavier types considerable fall plowing is done. As a rule the fields are well cultivated and in a fair condition of tilth at the time of seeding. More frequent after cultivation of intertilled crops would tend to conserve the soil moisture by forming a mulch upon the surface. The question of erosion is an important one, and many of the slopes which are now badly washed could have been preserved had proper methods been followed to prevent erosion. The steepest slopes now timbered should be kept in timber. When steep slopes are cleared they should be kept in grass and pastured as much as possible. Where cultivated, strips of sod may be alternated with cultivated crops, the strips running at right angles to the slope. On the more gentle slopes contour cultivation may be followed over the entire field. In some places strips of sod form shallow ditches down the slope, through which the surface water runs off. This system, however, is less desirable than where the sod strips run at right angles to the slope.

Throughout that portion of the county occupied by the deep sand types the farm buildings, fences, etc., are of inferior grade, often in a poor state of repair, and the equipment is limited. On the sandy types underlain by clay conditions are better, while on the heavier soils the farm buildings, cultivated fields, and farm stock indicate a more thrifty and prosperous condition than is found elsewhere in the area surveyed.

The question of securing farm labor is not as serious here as in some other parts of the State, since there are no large cities or manufacturing plants very near to draw away the labor. Some difficulty, however, is experienced in getting the quality of help desired. The wages paid range from $25 to $35 per month, with board, or $1.50 to $1.75 per day during haying and harvest time.

Of the total land area of the county 67.1 per cent is in farms, and on the average 66 acres of each farm is improved land. There are 2,470 farms in the county, the average size being 140 acres. Of all farms 87.6 per cent are operated by the owner, and of the remainder something over half are operated on the share system of renting.

The value of farm land in Juneau County is extremely variable, and there is frequently a considerable difference between the true value and the selling price. Large tracts of land classed as Sands and Peat (undifferentiated) recently sold for $6 an acre. Land of the same nature frequently retails in smaller tracts for $20 to $25 an acre. Dealers interested in the sandy areas frequently exchange such land for real estate in Chicago and other cities and place a false value on the farms. The records of such exchanges indicate a selling price which in many cases is twice or three times the actual value of the land. The value of the poorer types, unimproved, is about $5 an acre, though much of it sells, to people who know but little of the true conditions, for prices considerably above this figure. The sandy types underlain by clay have a higher agricultural value than the deep sand and sell from $20 to $50 or more an acre. The silt-loam types have the highest agricultural value of any in the county, and the selling price ranges from $25 to over $75 an acre, depending upon location, topography, improvements, and the amount of waste land. Some of the best farms are valued at more than $100 an acre.

Most of the soils of the county, and especially the sandy types, are deficient in organic matter, and the system of farming followed on any farm should be so arranged as to gradually increase the humus content of the soil. This may be accomplished by applying stable manure, supplemented by the plowing under of legumes. Where Peat beds are convenient to the farm Peat may be spread upon the surface and plowed under. This will supply nitrogen, but should be supplemented by commercial fertilizers to provide the mineral requirements of the soil. On the sand types very careful methods of farm management must be practiced if the fertility of the soils is to be increased and farming operations made profitable. Careful rotations should be worked out to suit the varying conditions. Many of the soils of the county are in an acid condition, and this must be corrected before the best results can be expected. Ground limestone is the best form in which to apply lime, and its effect will be seen in the soil for a long time.

Erosion in the hilly country and the conserving of moisture in all parts of the county are very important questions and should be given careful study by all farmers. More specific suggestions will be found in connection with the discussion of the various soil types.

The dairy industry could be profitably extended and more creameries and cheese factories established. Hog raising in connection with dairying could also be developed on a larger scale. The trucking industry should be carried on to a greater extent, especially along the railroad lines, where excellent transportation facilities are afforded. Various crops for canning, such as peas, tomatoes, etc., could be successfully grown on a commercial scale.

SOILS.

Juneau County lies within the unglaciated portion of Wisconsin and comprises two distinct physiographic divisions, the sandy plains and marshy lowland, which occupies the northern two-thirds of the county, and the rougher highland, which occupies the southern third. The underlying rock consists chiefly of Potsdam sandstone, with a very small amount of Lower Magnesian limestone in the southern part of the county and a few outcrops of quartzite near Necedah. The material comprising the various soil types has been formed through the weathering and disintegrating of the limestone, sandstone, and possibly some shale associated with the sandstone, and by the action of wind and water, which have transported the material and redeposited it in various forms. Material foreign to this immediate section has been brought in by these agencies, and this has assisted in or is responsible entirely for the formation of some of the types. The accumulation of decaying vegetable matter has modified the original deposits in places and formed types dependent on the high organic-matter content.

In the soil survey of Juneau County 16 soil types, including Meadow, Rough stony land, Peat and Muck (undifferentiated), and Sands and Peat (undifferentiated), have been recognized and mapped. All of these types have characteristics by which they can be recognized.

The Knox series is found in the southern part of the county, occupying the hill country, and consists of silty material which overlies the Potsdam sandstone. There seems to be some question as to its origin, and it may have been derived in part from the limestones originally overlying the Potsdam sandstone. This series comprises the best and most extensive areas of highly improved agricultural land in the county. One type, the Knox silt loam with a shallow phase, was mapped in this area.

The Boone series consists of residual material from the Potsdam sandstone, in one type of which there is frequently mixed a small amount of silt from the soils of the Barnes series. These soils are confined principally to the southern half of the county and have a low agricultural value. Two types, the Boone fine sandy loam and

fine sand, the latter type containing two phases, were recognized and mapped as belonging to this series.

The La Crosse series comprises dark-brown to black alluvial material found as terraces or valley fill along the streams which flow through or border the hilly portion of the county. This material has been derived largely from the silty covering of the hills by being washed down the slopes and carried away and again deposited by stream action. It is above the present flood plain. One type only, the La Crosse silty clay loam, was mapped.

The Lintonia series includes the colluvial material which has been washed from the silty hills and accumulated on the lower slopes, frequently bordering the La Crosse soils. The color of the Lintonia soil is usually light brown or grayish, though it grades into dark brown in places. One type, the Lintonia silt loam, was mapped in the present survey.

The Baxter series includes the material derived from the weathering of the Lower Magnesian limestone, only a few remnants of which still remain in this region. This series is characterized by gray surface soils over red clay subsoil. A large amount of chert is present upon the surface and mixed with the soil. The Baxter silt loam is the only type of this series mapped.

The Superior series represents soils of lacustrine origin, but the true Superior material is exposed at the surface only over comparatively small areas in the present survey. The lacustrine deposit is characterized by a heavy red clay, over which, in many cases, there has been laid down varying amounts of sand. Most of these soils are found in the region adjacent to the Lemonweir River. The thickness of the deposit of red clay immediately along the river is frequently 10 feet and this is underlain by a fine sand. Back from the stream a mile or two the deposit is seldom over a foot in thickness, and many times it can not be found at all. Traces of lacustrine deposits are found at Necedah, but these consist of silt instead of clay. At Shenington, which is just outside of the county on the new line of the Chicago & North Western Railway to the west, the lacustrine silt has a thickness of 26 feet, as found in two wells. Less than a mile east the deposit is only from 4 to 12 inches thick. It would seem, therefore, that the lacustrine material was laid down in basins and not over the entire low-lying country occupied by the sand plains region. Three types of the Superior series were mapped—the Superior clay loam, fine sandy loam, and the sand.

The Plainfield series consists of the material occupying a large proportion of the sand plains region. It seems that all of this has been influenced more or less by the action of water. All of the types found are very sandy and of low agricultural value. They are light

in color and contain but little organic matter. The types mapped as belonging to the Plainfield series are the Plainfield sand and fine sand.

The Dunning series consists of dark-colored soils of similar origin to the Plainfield, but with which there is sufficient organic matter to impart a dark color. It occupies a low position bordering the marshes and is poorly drained. The Dunning sand is the only type of the series mapped in the survey.

Peat and Muck (undifferentiated) include extensive areas of vegetable matter in varying stages of decomposition, with which there is incorporated only a small amount of mineral matter. Such areas are quite extensive in Juneau County.

Sands and Peat (undifferentiated) include large areas of low marshy land in which there are numerous small islands of sand. The total area of the islands is about equal to that of the marsh, but on the scale used in mapping it was impossible to separate such small areas. The marsh includes black sand and shallow Peat, but no separations were possible, on account of the small areas and the wide variations found. This type of land has little agricultural value.

Meadow includes the low-lying, poorly drained areas along the rivers and smaller streams, in which the soils were so variable as to make classification impossible.

Rough stony land includes the steep rocky slopes, outcrops, and broken regions throughout the county, which are too rough and rocky to be cultivated and have a very low agricultural value.

The following table gives the name and extent of each soil mapped in the county:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Boone fine sand	55,808		Superior sand	14,848	2.9
Loamy phase	20,096	24.3	Boone fine sandy loam	10,560	2.1
Low phase	47,744		Lintonia silt loam	6,528	1.3
Sands and Peat (undifferentiated)	101,696	20.0	Dunning sand	5,952	1.2
Knox silt loam	54,656	15.4	Plainfield fine sand	3,648	.7
Shallow phase	24,064		Superior clay loam	3,264	.6
Plainfield sand	52,096	10.2	Baxter silt loam	2,560	.5
Peat and Muck (undifferentiated)	39,616	7.8	La Crosse silty clay loam	1,472	.3
Meadow	35,008	6.9	Superior fine sandy loam	1,024	.2
Rough stony land	28,800	5.6	Total	509,440	

KNOX SILT LOAM.

The surface soil of the Knox silt loam consists of 12 inches of a grayish-brown or buff-colored silt loam, having a friable structure and a smooth feel. While there is present a small percentage of fine and very fine sand, but few coarser grains are found. The lower

portion of the soil usually is of a yellowish color, and on drying the surface becomes ashen in appearance. As a whole the texture of the material is very uniform, but varies somewhat in depth with the degree of slope. The subsoil consists of a heavy yellow silt loam, grading into a silty clay loam at 18 to 20 inches, and usually becoming a light chocolate brown color at 30 to 36 inches. It is compact, contains only a very small percentage of material coarser than silt, and is uniform throughout its entire extent, except as indicated in the phase described below. The underlying rock lies from 4 to 10 or more feet below the surface.

The most important variation in the Knox silt loam is due entirely to topographic position and consists of the more rolling and broken areas, where erosion is a problem. The portions of the type thus situated may be considered a distinct phase. The texture of the soil does not differ from the above description, except that the depth is usually a little less, and where erosion has been extensive the surface soil may be entirely lacking over areas of limited extent. In such places the material has more of a clay loam character. The underlying rock comes closer to the surface than typical, and in a few instances it is within reach of the auger. On the steep slopes a few outcrops are also found.

The Knox silt loam is confined to the southern and southwestern portions of the county, in the hilly region, and is the most extensive type in that part of the survey. Practically all of this soil lies south of the main line of the Chicago, Milwaukee & St. Paul Railroad. Its continuity is broken by areas of Lintonia silt loam and Boone fine sand, Baxter silt loam, and a few other types of minor importance.

The Knox silt loam occupies a section of country which consists of a series of hills and ridges, throughout which erosion has been extensive. The typical Knox silt loam is found occupying the tops of these hills and ridges, where the surface is nearly level to gently rolling, and also on the more gentle slopes, where erosion is not a serious problem and where all ordinary farm operations can be carried on without difficulty. On the rough phase the fields are subject to erosion, and in some places deep ravines and gullies have been formed, causing considerable damage. Practically all of this phase can be cultivated, though some of it is sufficiently steep to make the operation of farm machinery difficult. Erosion is the most serious problem to be considered in the cultivation of the rough phase. On account of the uneven character of the surface, the natural drainage is good. The type is quite retentive of moisture, but suffers from drought during long dry spells.

The geology of this type has not been carefully worked out, but from its silty texture, its laminated structure, which is seen in places,

and its uniform character, it would seem to be of loessial origin, having been deposited by wind action. Some of the highest points, however, have no silty covering, which fact would tend to eliminate the loessial theory. On some of the lower slopes a shaley material is found associated with the Potsdam sandstone, and this may have weathered into the material forming the silt loam. This formation of shale is frequently found with the Potsdam sandstone in other places, and may have covered most of this region at one time. The type may be partially residual and partly loessial in origin. A slight acid condition exists over part of the type.

The original timber growth consisted chiefly of several varieties of oak, hickory, ash, and birch, with some maple, elm, and butternut. On some of the steep slopes there is still considerable timber standing, but all of the best trees have been cut.

By far the greater proportion of the Knox silt loam is under cultivation, and it is the most extensive and important improved soil in the county. The type of farming followed consists of general farming in conjunction with dairying. The crops most extensively grown are corn, oats, barley, wheat, and hay. The yields of the different crops vary considerably, depending largely upon the methods of farming followed. Corn is an important crop and yields on an average about 40 to 50 bushels per acre. Oats give an average yield of 40 bushels and barley about 35 bushels per acre. Wheat is not grown extensively at the present time, though it was an important crop in the early history of the county. At the present time it yields 20 to 25 bushels per acre. Hay, consisting of timothy and clover, yields from 1 ton to 1½ tons per acre.

Considerable fall plowing is done, and this is the best system to follow whenever possible. This also increases the water-holding capacity of the soil and destroys more weeds than when spring plowing is followed. On account of the silty nature of the soil the type is not difficult to handle, and a fine, mellow seedbed can be secured with but little difficulty. Erosion must be carefully guarded against in the cultivation of this type. The natural drainage is nearly always good, and the type can be worked under quite a wide range of moisture conditions. Too wet cultivation, however, may result in the soil becoming slightly puddled, and this should be avoided. No commercial fertilizers are used on this soil, but stable manure is applied whenever available. The plowing under of green crops is not practiced to any extent.

There is considerable variation in the crop rotations followed, and some pay but little attention to the selection of a system best adapted to conditions. The best farmers, however, have developed a definite system of crop rotation, and while this must be altered to meet the needs of various sections, it most commonly consists of corn one year,

followed by barley and oats one year each, with clover or clover and timothy seeded with the last grain crop. When wheat is grown it may take the place of the second grain crop. Hay may be cut for two years or the field may be pastured one year after being cut for hay the first year. On the steep slopes corn is sometimes omitted from the rotation because the land is more apt to erode when in an intertilled crop than when in a grain crop or in grass. The steepest slopes which are used are often kept in grass for the greater part of time, though some attempt to cultivate crops on land of this character. Stable manure is usually applied to the sod to be plowed for corn.

Nearly every farmer produces enough potatoes for home use and many have some to sell each year. The yield is usually about 150 bushels per acre. The soil is not as well adapted to this crop as some of the other types, especially the sandy loams, though the quality of the potatoes grown is fair.

Tobacco was at one time more extensively cultivated than at present. It is generally grown on the same field for four years in succession, but during the first 2 or 3 years the yields are best. The fields must be heavily manured, and this is done at the expense of the remainder of the farm. Tobacco usually follows potatoes or corn and is itself followed by wheat. The yields secured range from 1,000 to 1,600 pounds per acre. Since the crop requires careful attention and considerable labor, the acreage devoted to it on any farm is comparatively small.

Alfalfa is being tried by a few farmers, and some have secured a good stand without inoculating the soil. In order to secure the best results, however, the soil should be inoculated and liming may also be necessary, since the type is slightly acid in places.

Trucking and small-fruit growing are not carried on to any extent, though the ordinary garden vegetables and berries are grown for home use, and limited quantities are marketed in the near-by towns. There are a few small apple orchards, though the fruit industry has not received special attention on this soil.

In cultivating this type it should be kept in mind that the soil is low in organic matter and that much of it is subject to erosion. The supply of organic matter may be increased by supplementing the stable manure with green crops, especially legumes, plowed under. The second crop of clover may well be utilized in this way. Erosion may be held in check by putting the steepest slopes in grass. When necessary or desirable to cultivate the steeper slopes the plow should be run at right angles to the slope. The drainage channel down the hillside is sometimes left as a shallow sod ditch, while the remainder of the field is cultivated. While dairying is carried on to some extent, it could be enlarged and stock raising in general could be increased,

since this type is doubtless better adapted to such a system than to one requiring more intertilled and cultivated crops. Alfalfa should be grown more extensively, and the acreage devoted to tobacco should be still further reduced. The growing of small fruits and berries could doubtless be profitably extended, but care should be exercised in selecting suitable locations. There are a number of good orchard sites throughout the type, and the growing of apples could well be given consideration. The planting of more small orchards, especially for home use, is recommended.

Farms on the Knox silt loam sell from $40 to $80 an acre, depending on location, topography, improvements, and the productiveness of the soil.

Knox silt loam, shallow phase.—The soil of the Knox silt loam, shallow phase, to an average depth of 10 inches, consists of a grayish-yellow or buff-colored silt loam, having a very smooth feel and containing only a comparatively small amount of organic matter. A few sandstone rock fragments occur in places upon the surface and outcrops are frequently seen on the steep slopes. The subsoil consists of a yellow silt loam or silty clay loam, extending to a depth of 18 to 30 inches, where fine sand occurs. The underlying bedrock may be encountered at 20 to 36 inches, though it is often below the reach of the auger. The fine sand is frequently mixed with the silty clay subsoil, and in places the material consists of a sandy silt loam. The first 18 inches is the same as the typical Knox silt loam in texture and color.

The shallow phase is confined to the hilly region in the southern portion of the county, where it is closely associated with the typical Knox silt loam. The most extensive development occurs 8 to 11 miles south of Mauston, though it is fairly well distributed throughout the rough part of the survey.

The surface of the shallow phase is rough, broken, and often badly dissected by ravines and gullies. It occupies the tops of narrow ridges and the more sloping sides of the valleys. On the gentler slopes and broader ridges the rough phase of the Knox silt loam is found. In general it may be said that the shallow phase of the Knox silt loam occupies a topographic position several degrees rougher and more dissected than the rolling phase of this soil. The steep slopes are subject to erosion, and this is the most important problem to be considered in the management of the type. On account of the topography and the underlying sand the natural drainage is good—sometimes excessive—and crops are apt to suffer from drought during part of the growing season.

The silty portion of the soil has the same origin as the typical Knox silt loam, which is probably loessial. The sandy material is residual, and is the result of the weathering and disintegrating of the Potsdam sandstone.

The original timber growth consisted chiefly of white, black, and red oak, and hickory, with some maple and birch. The best timber has been removed, but on many of the slopes there is still some standing. From some slopes the trees have been cut and the ground is now covered with a thick growth of berry bushes and shrubs of various kinds.

While the Knox silt loam, shallow phase, is not sufficiently steep and broken to be classed as nonagricultural land, the surface is rough enough to be the limiting factor in the selection of crops to be grown. Crops requiring intertillage, such as corn and potatoes, are not adapted to this type on account of the danger from erosion on the cultivated fields, and these crops are almost entirely excluded from the rotations followed on this soil. The crops most frequently grown consist of oats, wheat, hay, buckwheat, and sometimes barley. Oats yield on the average 35 bushels, wheat 18 to 20 bushels, buckwheat 8 to 10 bushels, and timothy and clover from 1½ to 2 tons per acre. The most common rotation practiced consists of oats one year, oats or wheat one year, followed by clover and timothy one or two years, and pasture one year.

The greatest problem in farm management with this soil is to prevent erosion, and the methods suggested for the typical Knox silt loam will also apply to this class of land. The soil is also deficient in organic matter, and this should be supplied by supplementing the stable manure with green manuring crops. The type should be kept in grass as much as possible, and dairying and stock raising are the best industries to follow. There are many good orchard sites on this phase, and it is considered a better fruit soil than the typical Knox silt loam. Bush berries, strawberries, etc., do well, and it would seem that such fruits might be profitably grown on a commercial scale, since much of the type is within easy reach of shipping points. The growing of apples might also be made successful, though care should be exercised in selecting the most favorable slopes.

The following table shows the results of mechanical analyses of samples of the typical soil and subsoil and of the shallow phase of this type:

Mechanical analyses of Knox silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
Typical:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23652	Soil	0.6	2.6	3.4	10.1	5.8	69.5	8.0
23653	Subsoil	.0	1.9	4.0	13.1	8.9	59.5	12.7
Shallow phase:								
25419	Soil	.1	.3	.7	12.7	3.4	67.1	15.6
25420	Subsoil	.0	.1	1.6	75.5	2.0	14.6	6.3

BAXTER SILT LOAM.

The surface soil of the Baxter silt loam consists of 10 inches of gray silt loam, which contains only a small amount of organic matter. There is present upon the surface and mixed with the soil from 10 to 25 per cent of angular chert fragments. The subsoil consists of a heavy red clay, which also contains from 10 to 15 per cent of angular chert fragments. One well record showed that the red clay extended to a depth of 30 feet and rested upon sandstone. This is much deeper than the average, however, for in a number of places the sandstone can be reached with the auger. In places the subsoil is a yellow silty clay, and in a few instances a sandy clay was found at from 18 to 24 inches, which then graded into the stiff, heavy red clay. Wherever the red clay is found the chert is abundant, but the chert may occur without any red clay being present. The chert is frequently so plentiful as to form an almost complete covering over the surface. This makes cultivation very difficult. One exposure of limestone (Lower Magnesian) was seen where a limekiln had once been operated.

The type is of small extent and occurs in long, narrow areas, chiefly on the tops of high, narrow, flat-topped ridges. The largest area is about 5 miles east of Wonewoc. A smaller tract is found 4 miles east and another 5 miles northeast of Elroy.

The surface of the type varies from nearly level to undulating. There is always sufficient slope to insure good surface drainage, though seldom steep enough to be damaged by erosion.

The Baxter silt loam is derived from the weathering of the Lower Magnesian limestone, a few remnants of which still remain. The chert present represents a more extensive and much thicker bed of limestone than exists at the present time. The chert, being extremely hard, has withstood weathering, while the limestone has been largely removed. There is no loessial material occurring over the residual limestone soil. While the surface soil is sometimes slightly acid, the subsoil usually contains a considerable amount of the carbonate of lime.

The original timber growth consisted chiefly of oak, hickory, and maple, with some walnut. All of the merchantable timber has been removed, and in uncultivated places there is quite a thick undergrowth.

A considerable proportion of the type has been under cultivation at one time, but on account of the numerous chert fragments, which interfere with cultivation, some of the fields have been left uncultivated. Where the chert is not too plentiful the type is considered a fairly good general farming soil, and the ordinary farm crops are grown successfully. Corn yields 40 to 60 bushels, oats 45 bushels,

and wheat about 25 bushels per acre. Hay consists of timothy and clover mixed and yields of 1½ to 2 tons per acre are secured. Where free from numerous rocks not much difficulty is experienced in putting the fields in good tilth, if plowing is carried on when the moisture conditions are the most favorable. The rotation of crops most extensively followed consists of corn, oats, wheat seeded to clover, and timothy, which is cut for hay one or two years and pastured one year. The wheat may be omitted and the oats used as a nurse crop for the clover. Manure is usually applied to the sod to be plowed under for corn. Thorough methods of cultivation, the supplementing of the supply of stable manure with green manuring crops, and the following of a definite crop rotation are factors which should be given careful attention.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Baxter silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
25514	Soil	0.9	3.2	2.8	6.1	7.9	63.4	15.6
25515	Subsoil	.6	2.0	3.4	9.4	3.8	38.7	42.1

LINTONIA SILT LOAM.

The surface soil of the Lintonia silt loam consists of a heavy grayish-brown to nearly black silt loam, from 12 to 18 inches deep, having a very smooth feel and containing in places a considerable amount of organic matter. The subsoil consists of a drab or yellow silt loam to silty clay loam, which frequently contains a considerable amount of fine and very fine sand. The subsoil sometimes has a reddish color, due to iron stains, and usually the material has a mottled appearance, due to poor drainage conditions.

The type is a gradation from the Knox silt loam on the one hand to the La Crosse silty clay loam on the other, containing areas of the latter too small to map separately on the scale used. The higher portion of the soil is light colored, while the lower portion is dark.

The Lintonia silt loam is confined to the southern and southwestern parts of the county and is associated with the Knox silt loam. One of the largest areas lies directly southwest of Mauston. More of the type is found in the vicinity of Union Center. Other areas are scattered throughout this portion of the survey.

The surface of this type is level to undulating, the highest portion extending up the slope and grading into the Knox silt loam of the upland, and the lower portion extending frequently into the valley

of streams and bordering the La Crosse silty clay loam. The natural drainage of most of the type is deficient and before the best results can be obtained tile drains will be necessary.

The Lintonia silt loam consists of silty material, a large proportion of which has doubtless been washed from the higher lying soils and is therefore colluvial. The highest part of the type is sometimes in the form of a terrace, which may be several feet above the flood plain of the stream along which it occurs. The lowest portions of the type along the streams are partially alluvial. Had these latter areas been large enough they would have been shown on the map as La Crosse silty clay loam. Tests with litmus paper indicate that this soil is somewhat acid.

The original timber growth on the Lintonia silt loam consisted of oak, hickory, and some birch on the higher portion, and ash, elm, and some oak on the lower areas. Only a small amount of good timber is still standing.

The type is limited in extent, and because of its poor drainage it is not highly improved. Hay is the most extensive crop grown and yields of 2 tons per acre are secured. Some oats, corn, buckwheat, and barley are sometimes grown, but the soil is usually too moist, especially in the spring and early summer, and the yields are low. On the highest portion of the type the drainage is better and yields on such areas, which are limited in extent, are nearly equal to those obtained upon the Knox silt loam.

The chief problem in the improvement of this soil is that of drainage. The soil is naturally productive and when handled properly capable of yielding profitable crops.

LA CROSSE SILTY CLAY LOAM.

The soil of La Crosse silty clay loam, to an average depth of 12 inches, consists of a black silt loam, which contains a high percentage of organic matter, in places approaching a mucky soil. The subsoil, to a depth of 20 inches, consists of a gray or drab silt loam to silty clay loam, below which the material is frequently mottled with yellow. In places the lower subsoil is a sandy silt or sandy clay loam.

The La Crosse silty clay loam is of limited extent, but occurs in a number of small areas. Several of these are found from 2 to 5 miles southeast of Mauston and from 2 to 3 miles south of New Lisbon. A number of other patches occur throughout the hill section and in the country immediately at the foot of the bluffs. It is confined to stream valleys, terraces, and low depressions where there has been an accumulation of organic matter.

The surface of the areas of La Crosse silty clay loam is level and the soil often occurs in basin-shaped depressions. In such places the

natural drainage is poor. Practically all of the type would be greatly benefited by tile drainage. Areas bordering the streams may be flooded in part during periods of heavy rainfall.

The soil is believed to be in the main of alluvial and colluvial origin, though it includes some lacustrine material having the general characteristics of the Clyde soils of the glaciated areas, though occupying slightly higher elevations. The dark color is due to the accumulation of a considerable amount of organic matter which has undergone decompositon under moist conditions.

The orginal timber growth consisted of elm, ash, some maple, and willows. All of the best timber has been removed.

Because of its poorly drained condition, a considerable proportion of the type is unimproved. Around the margins of the areas where the drainage is best, and in a few cases over the entire area, the type is cultivated and good crops are secured. The soil is well adapted to corn, but grains are apt to develop too much straw and lodge. In order to improve this soil tile drains will be necessary. When properly drained it will become a productive soil.

BOONE FINE SANDY LOAM.

The surface soil of the Boone fine sandy loam consists of a dark-gray fine sandy loam, 12 inches deep, which contains varying amounts of silt. The subsoil consists of a yellow silt loam carrying considerable fine and very fine sand and extending to a depth of about 24 inches. Below this depth the amount of fine sand usually increases and at 30 to 36 inches a pure fine sand is sometimes encountered. While the above covers the description of a large proportion of the type, the soil is extremely variable. In places the surface is a silt loam having a fine sand subsoil. Where the type borders the Superior clay loam the subsoil is frequently red in the lower depths. The silt loam areas throughout the Boone fine sandy loam are rarely large enough to be separated, yet in themselves they constitute a soil type quite similar to the Lintonia silt loam. Between the silt loam and the fine sandy loam there are a great number of variations, which it would be impossible to show on a map of the scale used.

The type is of comparatively small extent and is confined, with but one or two exceptions, to the southern and southwestern parts of the area, where it is closely associated with the Knox silt loam and the Knox silt loam, shallow phase. The largest area extends for about 4 miles to the northwest and about 2 miles to the southeast of New Lisbon. There are several areas in the vicinity of Mauston and Hustler and also in various sections throughout the hill country. A few small areas are found along the Wisconsin River south of Germantown. These consist of a fine sandy loam to loam, brown to quite dark in color, and underlain at from 12 to 20 inches by a

yellow, coarse silt, which in turn grades into fine, medium, or coarse sand.

The surface varies from level to undulating, and in a few cases very gently rolling. The type occurs on the lower slopes of hills and ridges, covered with Knox silt loam and Knox silt loam, shallow phase, and extends into the lowland bordering the streams. It may occupy very low ridges, the summits of which are always sandy. Sometimes it occupies all of the valley bottoms. Shallow, saucer-shaped depressions are frequently seen over the flat areas. The natural drainage in such places is poor, and tile drains will be necessary over certain portions of the type. This condition has retarded the development of this soil for agriculture.

In origin the Boone fine sandy loam is largely colluvial. It is a mixture of the silty material washed down from the hills and the fine sand formed from the disintegrating of the Potsdam sandstone. That portion of the type found along the Wisconsin River is somewhat different and consists of a river deposit. Litmus tests indicate that the soil is slightly acid.

The original timber growth consisted chiefly of ash, elm, some oak, soft maple, and hickory. Most of the timber has been removed.

The larger proportion of the type is under cultivation, and fair yields are secured. Planting is sometimes delayed in the spring on account of the soil being too wet. The crops commonly grown are corn, oats, and hay, with some tobacco and a little barley. The soil is variable, as are also the methods followed, so that there is quite a range in the crop yields. The methods of cultivation followed are similar to those practiced on the Knox silt loam, and about the same rotations are in use.

Drainage is one of the most important considerations in the higher improvement of the type. Tile drains should be installed in many places. The organic matter should be increased by plowing under green manuring crops. Where an acid condition exists ground limestone should be applied at the rate of 1,200 pounds per acre.

BOONE FINE SAND.

The soil of the Boone fine sand, to an average depth of 6 inches, consists of a gray or yellowish fine sand, in the surface inch or two of which there is a very small amount of organic matter. The soil is loose and open and is frequently blown into small dunes by the wind. Sandstone fragments and some chert may occur upon the surface and mixed with the soil. The subsoil consists of a fine yellow sand, which contains fragments of sandstone and chert, and usually grades into disintegrated sandstone or into the solid rock at less than 3 feet. The texture may become coarser as the rock is approached. The underlying rock frequently outcrops. The depth to rock is variable

and ranges from 1 foot to 5 or 6 feet. Where the depth is greatest rock fragments are seldom found; where the soil is shallow they may be very plentiful. As a rule the soil is thinner in the hill country than in the flat region. The subsoil in some places in the hilly section has a small amount of silt mixed with it from the silty types with which it is there associated. The subsoil may have a reddish-brown color, but the type as a whole is quite uniform, and what variations occur are of minor importance.

The type is confined chiefly to the southern half of the county, and the largest areas are found in the southeastern part of the survey directly north and south of Lyndon. South of Germantown is an area of considerable size, and smaller patches are scattered throughout the southwestern portion of the county, where it is associated with the silt loam soils. In the extreme northwestern corner of the survey there are also a few areas.

Where the type is associated with the silt loam soils it occupies slopes and the tops of narrow ridges from which the silty covering has been removed. Frequently such areas are quite rough. Where the type occurs in the sand plains country the topography is less broken and may be gently rolling or have a gradual slope away from low residual hills or ridges. The surface soil has in places been blown into low dunes. On account of the loose, open character of the soil and subsoil the natural drainage is excessive, and crops usually suffer from drought during a portion of every season.

The Boone fine sand is of residual origin and has been derived from the disintegration of the Potsdam sandstone. Where it occupies undulating or sloping topography surrounding an extensive outcrop the material seems to have been influenced by water and perhaps deposited in shallow lakes on being washed away by wave action from the rock. The soil shows acid reaction to the litmus test.

The original timber growth consisted of Jack pine, scrub oaks, birch, poplar, and a few other varieties. The growth was stunted and scattering. The greater part of the type is still in timber and underbrush, though much of the merchantable timber has been removed.

Only a small proportion of the type is under cultivation. In the rougher part of the county it is mostly in timber or in pasture and is of no agricultural importance. Some farming is carried on in the more level sections, especially where the underlying rock is deepest. The crops grown consist of corn, oats, rye, buckwheat, and potatoes. It is very difficult to obtain a stand of clover and but little is grown. The yields of these crops are low and frequently they are a failure. The type is very low in organic matter, and unless the rainfall is well distributed crops suffer from drought. The suggestions for the improvement of the Plainfield sand and the

loamy and low phases of the Boone fine sand types apply to the Boone fine sand. It will require very careful management before satisfactory crops can be produced. Land of this character can be bought for a small price.

Boone fine sand, loamy phase.—The surface soil of the Boone fine sand, loamy phase, to an average depth of 8 inches, consists of a gray or light-brown fine sand, which contains sufficient finer material and organic matter to make it slightly loamy. It is loose and open in structure and is blown by the wind, though to a somewhat less extent than the low phase of the type. The subsoil to a depth of over 3 feet consists of a loose and incoherent yellow fine sand. There is no gravel in the subsoil and the amount of material finer than fine and very fine sand is extremely small. Where the sand is blown into ridges the soil is almost entirely lacking in organic matter and the type is very similar to the fine sand. Along the Lemonweir River there are level areas, slightly above the flood plain, in need of drainage and having a higher organic content than usual. The subsoil in such places is sometimes a white fine sand.

The Boone fine sand, loamy phase, occurs in areas varying from a few acres to a couple of square miles in extent, and is scattered throughout the county on both sides of the main line of the Chicago, Milwaukee & St. Paul Railroad. It is chiefly confined to a strip of country from 4 to 6 miles wide directly north of the hill country. Some of the largest areas are found in the vicinity of Mauston.

The surface of the loamy phase of the Boone fine sand varies from level to undulating and in a few places very gently rolling. It is found on the lower slopes of hills and ridges occupied by the Boone fine sand and occurs as level sandy plains bordering the Lemonweir River and as undulating stretches where the surface material has been influenced by the action of the wind. The natural drainage is excessive and most of the type is droughty.

The parent material from which this soil was derived consists chiefly of the Potsdam sandstone, but has been influenced to some extent and perhaps transported short distances by the action of water. In a few places the type is undoubtedly residual. It occurs within a comparatively short distance of and considerably lower than the silt loam types of the upland country to the south and it is thought that its loamy character may be due in part to the presence of a small amount of silt from this source. The soil is acid, as indicated by the litmus test.

The timber growth consisted chiefly of Jack pine, some Norway pine, and black and red oak, somewhat scrubby. As a rule the timber was better than on the low phase of the Boone fine sand. Some prairie grasses, mostly blue stem, are found on the type.

The loamy phase is a better soil than either the typical Boone fine sand or the low phase, though much more limited in extent. The chief crops grown and the yields obtained during average seasons are as follows: Corn 20 to 40 bushels, oats 25 to 30 bushels, rye 15 to 22 bushels, buckwheat 15 to 18 bushels, and potatoes 100 to 150 bushels per acre. It is difficult to obtain a stand of clover and the yields are very low. A small amount of sorghum is grown, from which a good quality of sirup is made. During seasons when the rainfall is below normal or when it is not fairly well distributed crops suffer from drought and the yields fall considerably below those indicated above.

In the cultivation of this soil legumes should be grown and plowed under to supply humus-forming material. One is justified in going to considerable expense in getting a good stand of clover. To insure a stand it may be necessary to apply lime to correct the acidity. Ground limestone is best for this purpose and may be applied the year before the clover is sown. In the spring the ground should be thoroughly prepared and harrowed at frequent intervals until most of the weeds are killed. If manure can not be obtained, 100 pounds of sulphate of potash and about 200 pounds of acid phosphate per acre should be applied at the time of seeding. The clover seed (Medium Red or Mammoth is best) should be sown about corn-planting time, without a nurse crop. Treat as indicated for the Plainfield sand and turn under a green crop regularly. Vetch, soy beans, and peas are other legumes which may be used on sandy soils. Alfalfa can be grown, but it requires very careful treatment. More stock should be kept and all of the manure applied to the fields. To prevent the soil from blowing, the fields and crops should be arranged as indicated for the low phase of the type. A good rotation fairly well suited to this soil consists of clover one year, the first crop being cut for hay and the second plowed under, the next year a cultivated crop, as corn or potatoes, followed by rye or some other grain seeded to clover. If considerable stock is kept, this may be extended one year by allowing the clover to stand the second season and then plow under the second crop.

Boone fine sand, low phase.—The surface soil of the Boone fine sand, low phase, consists of a yellowish-brown or gray, loose, incoherent fine sand, with an average depth of 6 inches, and containing a small amount of organic matter in the first inch of virgin soil. In cultivated fields the organic matter has usually disappeared. Being fine and loose, the surface soil is frequently blown into low dunes by the wind. The subsoil consists of a yellow, loose, incoherent fine sand, extending to a depth of over 3 feet and seldom containing any trace of silt or clay. In the vicinity of Necedah, where this type is associated with the Plainfield sand along the Yellow River, there is

present in the soil a considerable amount of iron, which imparts a slightly loamy characteristic. In this respect it resembles the Plainfield sand, but is of finer texture. The position it occupies here is a second bottom which is subject to overflow at times.

The most extensive development of the Boone fine sand, low phase, is found within 10 miles of Necedah, to the southeast, south, southwest, and extending up the west side of the Yellow River for about 7 miles north of Necedah. A great number of small areas are scattered throughout the country south and west of this region but north of the hill country.

The surface of the low phase is level to billowy or undulating, with low sand-dune ridges occurring at irregular intervals. These vary in height from a couple of feet to about 20 feet. In some places there is a series of parallel ridges of varying lengths, while in other sections there seems to be no regularity. Often one dune is found surrounded by an extensive tract of level country. On account of the loose, open structure of the soil, the natural drainage is excessive and the type is very droughty, except on the phase subject to overflow, where the water table is closer to the surface than usual. Where the water table is over 3 feet from the surface, as is usually the case, the soil is droughty.

The low phase of the Boone fine sand lies entirely within the sand plains region and forms a portion of what is usually considered a former extensive flood plain of the Wisconsin River. Whether the waters from the Wisconsin River ever extended over the whole sand plain country is still a question. However, the type in question contains no material foreign to the immediate region, except bordering the Wisconsin and Yellow Rivers, and in this respect differs materially from the Plainfield sand. The Potsdam sandstone is the parent rock. This has disintegrated and been acted upon to a greater or less extent by water, and at a later date influenced somewhat by wind action. It is thought that some of the billowy topography may be due to erosion and that instead of the elevations being dunes the depressions are really shallow erosion channels formed when flood waters were receding. The larger ridges are unquestionably dunes and are being added to every year.

The timber growth consists of Jack pine, scrub oak, and poplar, with several varieties of shrubs. There is a sparse growth of prairie grasses scattered over the type, mostly blue stem, where cultivated foxtail and sand burs spring up quickly. The timber is poorer on this soil than on any of the other types.

About 10 per cent of this phase is cleared and has been cultivated. Some attempts are now being made to farm it, but many of these are meeting with failure and a number of places have been abandoned.

The Boone fine sand has a very low agricultural value; in fact, it is considered the poorest type in the county. Having a loose, open structure and fine texture, it is blown by the wind, and since it is almost entirely lacking in organic matter, the water-holding capacity is very poor. In these respects it is inferior to the Plainfield sand.

The chief crops grown and the average yields obtained during the most favorable seasons are as follows: Corn 15 to 20 bushels, oats 15 to 20 bushels, rye 12 to 15 bushels, buckwheat 10 to 12 bushels, and potatoes 50 to 100 bushels per acre. It is very difficult to obtain a stand of clover. Any of these crops may be a complete failure on account of drought, and some may be damaged a great deal by blowing sand. The methods of farming followed are inferior in every way to those practiced on the heavier soils of the area. Many people living on the type were induced to buy the land without being familiar with the true conditions. Their knowledge of agriculture is limited and, as on the Plainfield sand, failure is almost certain.

A system similar to that suggested for the Plainfield sand could well be used in improving this soil. To check blowing of the sand the farm should be divided into long, narrow fields, running at right angles to the prevailing wind of summer, and cultivated strips alternated with fields that are devoted to hay or grain. The roller, followed by a light harrow, may be used to advantage in the cultivation of this soil. Peat may be used as a fertilizer, but should be supplemented by potash and phosphate fertilizers. It is suggested that the above methods could be used in conjunction with a much more extensive system, which would require the use of larger tracts of land than the average-sized farm. A section of land on this type, for example, would furnish pasture for 60 or 70 head of cattle. The stock could be yarded at night and all of the manure saved and applied to the fields in which crops for feed and fodder should be grown. Corn could be grown for silage, and it would not be necessary to feed much grain. The steers could be sold for stockers or feeders and the females used for milk production, the aim being a moderate production of milk at a low cost. Land of this character for such a purpose would be worth about $5 an acre.

The selling price of this class of land varies considerably, and a number of sales and exchanges are made from time to time which places a false value on this soil. Judging from the returns actually secured from the farms operated, the land in itself has almost no value, and farms can often be secured, if purchased directly from the owners, for about what the improvements cost.

The following table gives the results of mechanical analyses of samples of the typical soil and subsoil of the Boone fine sand:

Mechanical analyses of Boone fine sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23656	Soil	0.4	8.0	16.9	54.5	9.3	6.2	5.5
23657	Subsoil	.0	6.9	17.4	57.3	9.1	4.9	4.2

PLAINFIELD SAND.

The typical soil of the Plainfield sand consists of a rusty or a dark-brown sand of medium texture extending to an average depth of 8 inches. The structure of the soil is loose and open, and there is present a considerable amount of iron, which gives the rusty color and a slight loaminess. It also carries a small amount of organic matter, but the color indicates a higher content than actually exists. A little gravel is seen upon the surface, and a small amount of fine gravel is mixed with the soil. The subsoil consists of a yellow medium sand, which becomes coarser in texture with increased depth until below 30 inches there is considerable coarse sand and fine gravel. The subsoil always contains more gravel than the surface soil. Where the subsoil contains considerable iron, as is frequently the case, the material has a brownish or sometimes a reddish color, but this usually fades as the depth increases. A number of variations occur, some of which may be mentioned. The amount of gravel decreases as the distance from the streams increases. On the lower benches along the Yellow and Wisconsin Rivers the brown color extends to a greater depth, and there is more iron present than where the type lies a little higher. The amount of iron varies considerably. In some places it forms concretions or bog ore and in a number of others a hardpan. In some localities lenses or pockets of silt or silty clay, highly impregnated with iron, were found. Along the Yellow River some of this type has a darker surface soil than typical and grades into the Dunning sand without any evidence of a distinct change, thus making the boundary line an arbitrary one.

The type occurs as level plains, benches, and terraces along the Wisconsin and Yellow Rivers. The largest area lies in the northeastern part of the county, where it is found occupying the greater portion of the territory between the Yellow and Wisconsin Rivers. This soil is practically confined to the northeastern one-fourth of the area surveyed.

The surface of the Plainfield sand is level for the most part, becoming gently undulating over a portion of the largest area in

the northeastern part of the county. The benches are from 4 to 12 feet lower than the main body of the type and are subject to overflow about once in every five years. On account of the loose, open structure of the material, the natural drainage as a whole is excessive and the soil droughty. The presence of the iron and a small amount of organic matter tends to increase somewhat the water-holding capacity, and the type is better in this respect than the low phase of the Boone fine sand. Where the type borders the Dunning sand the water table is closer to the surface than usual.

The type occupies an old flood plain of the Wisconsin River, and may therefore be considered an alluvial soil. The soil grains are considerably rounded, showing the action of water. While the major portion of the material consists of quartz, which came chiefly from the Potsdam sandstone of the immediate region, the presence of gravel representing rocks foreign to the region, granites, feldspars, etc., indicates that some of the material must have been transported from the country to the north, where granitic rocks abound. The coarser grains are as a rule more angular than the medium and fine grains. Litmus tests indicate that the type is acid.

The original timber growth consisted chiefly of red and black oak, Jack pine, and some Norway pine. There were fewer Norway pines than on the low phase of the Boone fine sand. As a whole, the timber growth is more thrifty than on the Boone fine sand, low phase, and the trees are larger. The best timber has been cut, but there still remains a considerable amount of small Jack pine and some oak, the largest of which is from 8 to 12 inches in diameter.

From 25 to 40 per cent of the type has been cleared and cultivated, but a considerable number of farms have been abandoned and no crops are being grown upon them at the present time. The chief crops grown at the present time and the yields secured during the most favorable years are as follows: Corn 15 to 25 bushels, oats 20 to 25 bushels, wheat (rarely grown) 10 to 15 bushels, rye 12 to 20 bushels, buckwheat 12 to 16 bushels, and potatoes 100 to 150 bushels per acre. Potatoes form the chief cash crop and do better than any of the other crops grown. A little hay, consisting of clover and timothy, is produced, but the stand is thin and the yield seldom equals 1 ton per acre. Some sorghum is produced and yields about 24 gallons per acre. The type as a whole has a slightly higher agricultural value than the low phase of the Boone fine sand, but is not quite equal to the loamy phase of the Boone fine sand or the Plainfield fine sand.

The Plainfield sand is easily cleared and cultivated and for these reasons some persons are led to believe that it is to be preferred to the heavier, higher-priced land. The methods of cultivation, crop rotation, and fertilization followed are not those best suited to a

soil of this character. As stated above, the soil is acid and it is difficult to obtain a good stand of clover. But little stock is kept, therefore very little manure is available, and since the plowing under of green crops is not a common practice the soil is not improved. When a piece of new land is first cultivated fair crops are secured for a few years, but as each crop is removed and nothing returned the soil gradually becomes poorer. The best farmers on this type make a living from their farms, but the majority merely exist. The larger portion of the population on the Plainfield sand consists of foreigners, mostly Poles and Bohemians, many of whom know little or nothing about farming and ultimate failure is almost certain. Some of this land has been disposed of through sales and exchanges for as high as $50 an acre, when its real value is considerably less than half this amount.

At best this type has a low agricultural value and to make farming profitable the most practical and efficient methods of farm management must be followed. Since the soil is acid, low in organic matter, and unretentive of moisture these conditions must be corrected before the most satisfactory crops can be produced. If possible, a stand of clover should be secured. The land may be limed to correct the acidity and the clover seed sown in the spring without a nurse crop after the field has been thoroughly cultivated and as many weeds killed as possible. If available, a top dressing of manure should be applied, but, if not, about 200 to 300 pounds of acid phosphate and 100 pounds of sulphate of potash should be applied at the time of seeding to clover. The following year the first crop may be cut for hay and the second plowed under. Potatoes may be planted the next year, followed by rye to be seeded to clover. One can afford to spend considerable in getting a stand of clover, for when this is once obtained the productivity of the soil can be more readily increased. More stock should be kept and all manure saved and returned to the fields. Alfalfa may be grown if conditions are made favorable, but in the growing of all crops and in improving the soil some capital is necessary to tide over the poor years. If no capital is available the attempt should not be made. Improved farms are valued at about $20 an acre. Uncleared land is worth about $5 an acre.

PLAINFIELD FINE SAND.

The surface soil of the Plainfield fine sand consists of 10 inches of a gray loamy fine sand or light fine sandy loam, which contains sufficient silt, clay, and organic matter to impart the loamy characteristic. The surface of the type is heavier than any of the other sandy soils of the sand plains region. The subsoil consists of a loose, incoherent yellow fine sand, which extends to a depth greater than 3 feet.

The largest area, covering nearly 2 square miles, is found about 8 miles northeast of Necedah, on the Wisconsin River.

Where the type occurs as a terrace along streams the topography is level. Back from the streams it is undulating or gently rolling. A few dunes have been formed, but the silt and clay content in the surface tends to check blowing and there are fewer dunes than on the loamy and low phases of the Boone fine sand. Except in a few low places along streams the natural drainage is somewhat excessive and crops suffer from drought at times.

The parent rock from which most of this material was originally derived consisted of Potsdam sandstone. This has been transported varying distances and influenced more or less by water action.

The original timber growth consisted of black and red oak, with some Norway and a little Jack pine. The timber showed a more thrifty growth than on the loamy or low phases of the Boone fine sand.

A considerable proportion of this soil is under cultivation and fair crops are secured during seasons of normal rainfall. The yields are slightly above those obtained on the loamy phase of the Boone fine sand and the methods followed are about the same. In the improvement of this soil the same methods may be followed as were suggested for the Boone fine sand, loamy phase.

SUPERIOR CLAY LOAM.

The surface soil of the Superior clay loam consists of 8 inches of a grayish-brown compact silty clay loam. On drying the surface becomes quite hard and frequently cracks. The organic matter content is comparatively low. The subsoil to a depth of 36 inches or more consists of a heavy, red, tenacious clay, which shows fine laminations and a joint structure where exposed in cuts. A silty phase consists of 9 to 10 inches of gray silt loam, underlain to a depth of about 16 inches by a yellow silt loam, which is in turn underlain by heavy red clay or silty clay. In depressions there has been an accumulation of organic matter and the color is darker than typical. In areas of limited extent a small amount of fine sand may be mixed with the soil and upper subsoil.

The Superior clay loam is of comparatively small extent, though it is a distinct type and readily recognized. All of this soil is found to the north of the rough portion of the county and lies within or bordering the valley of the Lemonweir River and the small creeks flowing into it. The most northerly area is found 3 miles west of Cranberry Center. A number of small, irregular patches occur north of Mauston and also to the southeast of this place. A number of smaller areas are found in the intervening region.

The surface of this type is level to gently undulating, with occasionally a few shallow depressions where the soil is darker than typical. On account of the level topography and the heavy character of the subsoil, the natural drainage is defective and tile drains could be installed to advantage over a considerable portion of the type.

The Superior clay loam is doubtless of lacustrine origin and was laid down at a time when this region was covered by standing water, probably during an interglacial period. Where there is a silty covering over the heavy red clay and this lies adjacent to the high silty country to the south it is probable that some of the silt has been washed down from the higher-lying soils. The material composing this type is naturally somewhat calcareous, but most of the lime carbonate has been leached from the surface soil and frequently a slightly acid condition is found. The subsoil, however, shows the presence of considerable lime.

The orginal timber growth consisted chiefly of oak, maple, elm, and a little hickory, with some white and Norway pine. Practically all of the timber has been removed and most of the type is now cultivated.

The Superior clay loam is a strong soil. The crops grown consist of corn, oats, barley, hay, a little wheat, a few potatoes, and some tobacco. The type is considered better for small grains than for corn. Corn yields from 30 to 45 bushels, oats average about 40 bushels, barley about 30 bushels, and wheat 20 to 25 bushels per acre. Where the drainage is deficient, planting is often delayed and the yields reduced. Hay does well on this soil and yields from 1½ to 2 tons per acre. The type is considered too heavy for potatoes, though yields of 75 to 150 bushels are obtained. Tobacco does not do as well as on some of the lighter soils.

The heavy phase of the Superior clay loam is the most difficult soil to cultivate in the county. Unless worked when moisture conditions are the most favorable, lumps form, which can be pulverized only with considerable effort. As the type is limited in extent and the surrounding soils are of a sandy nature, the methods followed are as a rule better suited to sandy soils than to heavy soils. Fall plowing is advisable, since the fields will then work up better in the spring and the crops can usually be planted earlier. The rotation most commonly followed consists of corn, oats, wheat or barley, and hay. The type is well adapted to grasses, and general farming and dairying are the chief lines of agriculture practiced.

Except in depressions, the organic matter content of this soil is low and the methods of farming followed should aim to increase this by supplementing the stable manure with the plowing under of green manuring crops. Tile should be installed to drain the depressions, and even the higher portions of the type would be benefited by thor-

ough drainage. When the type is well underdrained and organic matter is supplied the soil becomes more loamy, is more easily worked, and also more productive. In order to obtain the best results on such a soil, very thorough cultivation must be practiced and a definite rotation followed. A rotation which has proven successful on similar soils consists of small grain one year, such as oats, barley, or wheat, seeded down with clover and a little timothy; the second year clover, the first crop being cut for hay and the second left for seed; the third year mixed clover and timothy hay, the sod being manured either before plowing in the fall or on the plowed land in the winter; the fourth year a cultivated crop should be grown, consisting of corn, potatoes, mangels, rutabagas, or turnips. Peas are a profitable crop on this soil.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Superior clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23664.....	Soil.....	1.2	4.0	4.6	18.8	5.9	44.9	20.6
23665.....	Subsoil.....	.0	.8	1.1	3.4	3.6	40.3	50.9

SUPERIOR FINE SANDY LOAM.

The soil of the Superior fine sandy loam, to a depth of 10 to 16 inches, consists of a grayish fine sandy loam, grading into a yellowish fine sandy loam. The supply of organic matter is low, which accounts in part for the light color. The subsoil to a depth of 36 inches consists of a heavy red clay, similar to the subsoil of the Superior clay loam. The depth to the clay is somewhat variable, ranging from 6 to 30 inches. Where the type occurs adjacent to the slopes from the high land to the south there is sometimes enough silt mixed with the sand to make it approach a silt loam. Such areas, however, are of limited extent.

The type is closely associated with the Superior clay loam and is usually found lying between this type and other soils mapped as sand. There are no areas over one-half square mile in extent. A number of small patches are found from 2 to 4 miles northeast and about the same distance southeast of Mauston.

The surface of the Superior fine sandy loam varies from gently rolling to level. On the higher elevations the sand is usually deeper than on the flat areas. It frequently occupies gentle slopes adjoining areas of Superior clay loam. Where the surface is undulating or a little rolling the natural drainage is good, but where it is level the type is in need of tile drains.

The subsoil is a lacustrine deposit, the same as the Superior clay loam. The surface soil is largely sand which has been blown or washed over the clay, and with which some fine material has become incorporated. The parent rock from which the sand came is the Potsdam sandstone. The sandy material is slightly acid, while the underlying clay loam contains a considerable amount of the carbonate of lime.

The original timber growth consisted of oak, maple, and some pine, with a little elm and ash on the poorly drained portions. Practically all of the timber has been removed.

A large proportion of the type is under cultivation, but it is of very limited extent, and no system of cultivation or cropping has been developed. Where found on the gentle slopes the soil is very productive, but on the level areas it is in need of drainage and crop yields are lower. Corn, oats, barley, wheat, hay, and some tobacco are grown. It is considered a good tobacco soil, and during normal seasons gives satisfactory yields of the ordinary farm crops. In the management of the Superior fine sandy loam an effort should be made to increase the content of organic matter, and the wet places should be tile drained.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Superior fine sandy loam:

Mechanical analyses of Superior fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
23662	Soil	0.3	14.4	19.9	28.6	5.9	23.6	6.9
23663	Subsoil	.0	3.2	4.1	6.1	1.3	46.3	38.4

SUPERIOR SAND.

The surface soil of the Superior sand consists of 8 inches of a grayish-brown fine sand to loamy sand. The poorer-drained areas contain a larger amount of organic matter than typical and in such places the color of the soil is darker. The subsoil consists of a yellow fine sand, which becomes lighter in color with depth, in places almost white. At about 24 inches the material often takes on a pinkish hue and at an average depth of 30 inches a compact, red silty clay is encountered. Where the drainage is the most defective the sand of the subsoil may be bluish in color in its lower depths and the silty or sandy clay may also be blue, drab, or slightly mottled. The most characteristic feature of the type is the light-colored sandy subsoil, which grades into the Superior silt or silty clay loam. The type is subject to considerably variation and the depth at which the

silt or clay is found ranges from 18 inches to 5 feet. The areas underlain by the clay at 18 inches were of small extent. Land of this character, when in large enough patches to warrant separation, was classed with the Superior fine sandy loam. When the clay was over 5 feet below the surface its effect upon the agricultural value of the soil was so small that such material was excluded from this type. The texture of the subsoil frequently becomes coarser with depth and at 24 to 30 inches it may be a medium sand. The sand of the sandy clay may also be of medium texture.

This is the most extensive type of the Superior series. The largest area lies directly north of Camp Douglas, where it occurs along both sides of the Lemonweir River for over 6 miles. An area several miles in extent is found directly northwest and another directly northeast of New Lisbon. Other smaller patches occur along the Lemonweir River. But little of the type is found north of the new line of the Chicago & North Western Railway and only a few small areas are found to the south and east of New Lisbon. The Superior sand is closely associated with the Superior clay loam and the Superior fine sandy loam.

The surface of the type is flat to very gently undulating. No very pronounced ridges or depressions occur, though there are a few narrow ridges on which the sand is of sufficient depth to exclude it from this type, but for the fact that they are too small to be indicated. The differences in elevation over the type as a whole are not more than several feet at most. On account of the flat topography and the underlying, impervious clay loam or silty clay loam, the natural drainage of a great deal of the Superior sand is poor. The type seldom suffers from drought, as the heavy subsoil keeps the water within reach of the roots of growing crops. During the spring and fall there is usually an excess of moisture. A few tile drains have been installed and the results obtained more than justified the expenditure.

The clay subsoil of the Superior sand is of lacustrine origin. The surface sandy material has doubtless been deposited by water also, but at a later date and under different conditions. The Potsdam sandstone is the parent rock from which most of the sandy material was originally derived. Litmus tests indicate that the surface soil in places is in an acid condition, though the heavy subsoil contains a considerable amount of the carbonate of lime.

The original timber growth consisted of elm, bur oak, black oak, maple, and willow, with some white and Norway pine. The timber was considerably better than on any of the other sand types not underlain by the clay. Practically all of the merchantable timber has been removed.

A large proportion of the type is under cultivation and better returns are secured than from any of the other sand types in the area.

It is considered a fairly good soil. The chief crops are corn, oats, timothy, and clover, with potatoes as a cash crop and buckwheat a frequent crop on new land. Where the drainage conditions are the most favorable or where artificial drains have been installed corn yields 35 to 50 bushels per acre, with a very good yield of silage, which is much in excess of the yields on the other sands. Oats yield 40 bushels, hay 1½ to 2 tons per acre, buckwheat from 10 to 30 bushels, and potatoes from 150 to 250 bushels per acre. The type produces excellent pasture of bluegrass and clovers. On account of the sandy nature of the soil it is easy to cultivate, and when wet weather does not interfere there is no difficulty in getting a good seed bed with a minimum expenditure of labor. The rotation of crops most often followed consists of corn or potatoes one year, followed by oats seeded to clover and timothy. The hay is cut for two years, and the field is pastured for a year before being again plowed for corn. The manure is usually applied to the pasture land. The growing of potatoes in conjunction with dairy farming appears to be about the best combination that has been tried on this soil. When dairying is followed the poorly drained areas can always be utilized for pasture. Potatoes supply a cash crop better suited to the land than any of the grains which can be grown. By installing tile drains a much larger proportion of the type could be improved and made to yield profitable returns. Cucumbers have been successfully grown to a limited extent, and it would seem that the trucking industry might be profitably extended. Peat has been successfully used as a fertilizer by a few farmers. One report indicates that the effect of one application could be noticed for 11 years. This subject is worthy of study by all interested in this type of soil.

DUNNING SAND.

The surface soil of the Dunning sand consists of black, medium, or fine sand, 12 inches deep, containing a high percentage of organic matter, which imparts to the soil its dark color. The subsoil consists of a grayish or whitish fine to medium sand, which has a leached or washed appearance, and extends to a depth considerably beyond 3 feet. In places the subsoil is stained yellow by iron oxide and a bluish mottling is not uncommon. The depth of the surface soil varies considerably, but in other particulars the type is uniform.

The Dunning sand is confined to the sand plains portion of the county and in mapping it was frequently made to include some of the land lying between the marshes and the low phase of the Boone fine sand. One of the most extensive areas is found along the Iron Creek Ditch, which it borders for several miles. There is an area 2 miles west of Necedah and another about 7 miles north of Mauston. Other smaller patches occur scattered throughout the sandy region adjoin-

ing the marshes or bordering stream courses. The total area is not extensive, but it is quite widely distributed.

The surface of the soil is low and always level. It is very little higher than the level of the marshes and slightly lower than the bordering sands of light color. On account of its low position and the nearness of the water table to the surface, the natural drainage is poor, and as a result the type is too wet for ordinary farm crops, except during the dry portion of the summer. Where the big, open ditches traverse this soil it is drained sufficiently to produce cultivated crops.

The Potsdam sandstone is the parent rock from which the Dunning sand was derived. It has been reworked, transported, and deposited by the action of water, but to what extent it is impossible to say. The soil was doubtless formed in the same way as the low and loamy phases of the Boone fine sand, but since it occupies a lower position and has been under moist conditions it has acquired a black color through the growth and decay of vegetation. The whitish color of the subsoil may be due to the leaching of organic acids. All of the soil is in a very acid condition at the present time.

The native vegetation consists of Jack pine, poplar, sweet fern, common ferns, mosses, blue stem, and several species of marsh grass. There is no timber of any value on the type at the present time.

As the type is low, poorly drained, and very acid, it is not cultivated except in a few places. It is devoted chiefly to the production of wild marsh hay and to pasture. Where cultivated corn and buckwheat are the crops most grown. One farmer reported a yield of 40 bushels of corn and 150 bushels of potatoes per acre. Before this type can be farmed extensively it must be drained. The acid condition should then be corrected by the application of ground limestone. It would doubtless be found advisable to apply commercial fertilizers to supply the potash and phosphorus required by the crops.

PEAT AND MUCK (UNDIFFERENTIATED).

The material included in Peat and Muck (undifferentiated) consists of decaying vegetable matter in varying stages of decomposition, with which there has been incorporated in places a small amount of mineral matter. It is of a black or brown color and extends to a depth varying from a few inches to over 15 feet. The material underlying the greater portion of such areas consists of fine sand. In the sections where the Superior soils are found the underlying material is usually a silt or clay. Throughout a considerable portion of the marshes there are a number of sand islands varying in area from a few square rods to a couple of acres. Where less than 25 per cent of the land is occupied by these islands they have been

included with the Peat and Muck (undifferentiated). Where the islands occupy more than 25 per cent of the area and are not large enough in themselves to be mapped, such regions have been classed under a separate type.

Nearly all of the peat beds have been burned over. Where this is the case and where the fire has been rather recent a layer of yellowish ash from one-half inch to 3 inches deep is found upon the surface. Beneath this for a variable depth of 8 to 20 inches the material is usually quite thoroughly decomposed, while below this, where the peat is deep, it is only slightly decomposed and is still in a fibrous condition. Where the peat is shallow there is a larger amount of mineral matter present than where the material is deep.

Areas of Peat and Muck (undifferentiated) are distributed throughout the sand plains section of the county. Extensive areas are found north of Camp Douglas, north of Cranberry Center, along Little Yellow River, and in various other localities, chiefly along the Lemonweir River.

The surface of the Peat and Muck (undifferentiated) is level, but the sand islands which occur throughout a portion of the type vary from 1 to 2 feet higher than the level of the marshes and give the region where they are the most plentiful a gently undulating appearance. Being flat, occupying a low position, and having the water table near the surface, the natural drainage is very poor. A number of large open ditches have been constructed and portions of the marshes drained. The area north of Camp Douglas is perhaps the best example of marsh drainage in the county. In this case an outlet was near at hand, but in some instances it is necessary to go a considerable distance to secure an outlet and sufficient fall.

The material making up the Peat and Muck (undifferentiated) consists of vegetable matter in varying stages of decomposition. The underlying sand and that forming the sand islands is undoubtedly from the Potsdam sandstone and has been influenced more or less by the action of water. The clay and silt underlying some of the Peat and Muck (undifferentiated) is probably of lacustrine origin, the same as the Superior clay loam. Peat marshes are practically all in an acid condition.

The native vegetation consisted of sedges, cattails, wire grass, marsh grasses, sphagnum moss, cranberries, willows, etc.

Peat and Muck (undifferentiated) is devoted chiefly to the production of marsh hay, wire grass, moss, and cranberries. The marsh hay consists of wild grasses and yields on the average about 1 ton per acre. The price received varies with the supply, quality, and whether baled or not, the range being from $3 to $9 per ton. The yield of wire grass is about the same, and the price received is usually about $14

per ton f. o. b. in bales. This wire grass is used in the manufacture of rugs.

Where drainage systems have been installed the greater portion of the marshes is still devoted to marsh hay and pasture, but some areas in close proximity to the ditches have been cultivated with varying degrees of success. Timothy and alsike clover are grown to a limited extent, and the yields average about 1 ton per acre, though 1¾ tons are sometimes secured, while the crop is often a complete failure. Oats were seen growing in a few places, and yields of 20 bushels per acre are reported as the average, though much larger yields are sometimes obtained. Some corn has been grown and a few patches of onions were seen. The cultivated crops, however, are all uncertain.

The growing of cranberries was at one time an extensive industry, but many of the marshes have been destroyed by fire and the acreage greatly reduced. Practically all of the marshes remaining have been set out. A successful cranberry marsh must be so situated that the water supply can be controlled. The crop is subject to damage from frosts, and during the dry summer months there is great danger from fires. The industry is, therefore, a speculative one. The cost of establishing cranberries is considerable. Scalping a peat bed costs from $30 to $75 per acre, sanding about $90, and setting about $32. Vines are usually secured from trimmings, but if bought they cost about $100 per acre. The weeding for the first year on sanded marsh costs $10 and on Peat $50 per acre. Weeding the second and third year on sanded marsh costs $10 and on peat $20 per acre. Full crops are seldom received until four years after setting. It costs about $1 per bushel to pick and prepare the berries for market. One bog this year (1911) yielded 555 bushels per acre. When $2 per bushel is secured such a yield is very profitable. Yields of this size are seldom secured oftener than once in five years, and many marshes never produce such large crops.

From 20 to 30 cars of sphagnum moss are shipped from Mather each year. The moss is collected by long-toothed rakes operated by hand, cured, and packed in bales weighing about 30 pounds each. The price per bale is 50 cents in Chicago. The moss is used by nurserymen and florists. It takes from three to four years for a marsh to renew itself after moss has been collected. Since the drainage of the marshes much of the moss has been destroyed by fires. The owner of the marsh usually receives 50 cents per ton for the moss, and the work is done by men who make a business of gathering moss.

The improvement of the Peat and Muck (undifferentiated) presents a difficult problem. Where the peat is deep, or where it is underlain by silt or clay and adequate drainage is possible, the

marshes can be cultivated profitably. Where the surface has been burnt over sufficient mineral fertilizer has been made available to grow one or two good crops without the application of any fertilizer. It must be remembered, however, that peat beds are low in mineral plant foods, and these must be supplied. There is an abundant supply of nitrogen, and so the application of manure which is high in nitrogen is not advisable. Commercial fertilizers containing phosphoric acid and some potash should be used. Most of these peat marshes are acid, and this condition should be corrected by the application of ground limestone.

Where the peat is shallow and underlain by sand, as is the case over the greater portion of the areas mapped, the improvement of the marshes is a very difficult problem and has not been sucessfully solved. From the information at hand it would seem that the production of marsh hay, the cutting of wire grass, and pasturing are the most profitable uses to which land of this character could be put.

In large tracts Peat and Muck (undifferentiated) sells for $5 to $6 an acre. Some of it is being sold in small tracts for $25 an acre.

SANDS AND PEAT (UNDIFFERENTIATED).

The material mapped as Sands and Peat (undifferentiated) is subject to a wide variation and consists of shallow peat and black sand in a low, marshy condition, with numerous small islands of light-colored sand occurring throughout its entire extent. None of these variations are of sufficient extent in themselves to be mapped as a separate type. Peat consists of vegetable matter in various stages of decomposition, with which there is incorporated varying amounts of mineral matter. It extends to a depth of 1 to 20 inches and in a few instances to 30 inches. The underlying material consists of fine or medium sand, usually white, though it is frequently stained with iron or slightly mottled. The black sand corresponds to that mapped as Dunning sand, though the depth of the surface soil may vary from 1 to 18 inches. The sand on the islands is usually identical with the low phase of the Boone fine sand, though in some sections it is coarser and corresponds more closely to the Plainfield sand. The islands range in size from a fraction of an acre to about 5 acres and in elevation from 1 to 2 feet above the level of the marsh. In a few places, where ridges occur, an elevation of 20 feet is attained. The black sand is found surrounding the islands, usually as a narrow belt, while the peat occupies the larger spaces between the islands. Where the islands are close together there may be no peat between them. The islands occupy from 25 to 75 per cent of the total area, but taken as a whole the type will average about 50 per cent sand islands and 50 per cent marsh.

The most extensively developed areas of this type are in the northwestern part of the county, where it occurs along the Lemonweir, Little Yellow, and Yellow Rivers, and occupies most of the intervening country as well. The main body extends south for about 4 miles below the new line of the Chicago & North Western Railway, in the vicinity of Cranberry Center, and a belt extends to the southeast nearly to the Wisconsin River. Other areas are found throughout the sand-plains country.

The surface of the Sands and Peat (undifferentiated) is level, with slight undulations due to the low islands, which rise only a few feet above the level of the marsh. In places an elevation of 20 feet is attained, but this is exceptional. The islands in themselves are usually sufficiently drained and become droughty each summer. The intervening areas of black sand and shallow peat, however, are poorly drained. The water table is close to the surface and cultivated crops can not be grown until drainage systems have been installed. Even where such systems have been established they are not always sufficient to properly drain the extensive areas of lowland and comparatively little of the type has been improved so as to make the growing of cultivated crops successful. Other conditions aside from drainage, however, must be met before success will be assured.

The material forming the sand islands and the subsoil of the marshes has been derived from the Potsdam sandstone, but has been influenced more or less by the action of water. The sand on the islands has also been acted upon by the winds, and low dunes are quite common. In fact, the islands themselves may be largely of dune origin. Some of the depressions between the islands are considered by some to be erosion channels formed when the water from shallow floods was receding or when this entire region was occupied continuously by an expansion of the Wisconsin River. The Peat consists of vegetable matter in varying stages of decomposition with which there is mixed different amounts of sand. The black sand contains a considerable amount of vegetable matter, but not enough to form a Peat. The surface material of this type is in an acid condition.

The growth on the islands consisted chiefly of Jack pine, Norway pine, scrub oak, poplar, and birch, with a considerable stand of underbrush comprising several varieties of shrubs and a scattering growth of prairie grasses, sweet fern, etc. On the Peat and black-sand areas the growth consists of marsh grasses, wire grass, moss, etc.

With a few exceptions, the production of marsh hay, wire grass, and the furnishing of pasture is the only use made of this type. Large drainage systems have been established throughout the region, with the idea of improving the land by drainage and making pos-

sible the growing of cultivated crops. For various reasons the ditches have frequently not fulfilled the expectations of those interested. In some sections the assessments on the land to cover the cost of the ditches have been as high as $10 per acre, yet the drainage afforded is seldom sufficient, and as a result but few efforts are made to cultivate the land. Marsh hay cut from the Peat and black sand will frequently yield 1 ton per acre. The harvesting of wire grass is quite an important industry. The usual price received is $14 per ton, in bales, delivered at the shipping point. The shipment from Cranberry Center has been as high as 154 carloads in one season. In 1911 sixty cars were shipped. Wire grass is used in the manufacture of rugs and mattings. The islands do not support a growth of grass sufficient to cut for hay, but in conjunction with the lowland they furnish some pasture.

In the improvement of land of this character it should be borne in mind that even when the drainage conditions are properly established there are a number of other conditions which must be changed before cultivated crops can be profitably produced. The soil on the sand islands is of little value, and while some sorghum, corn, oats, buckwheat, and rye are grown on small fields, the yields are never large enough to be profitable. The black sand and peat areas contain enough vegetable matter to supply nitrogen for a few crops, but the covering of peat is shallow and other plant foods must be supplied in commercial fertilizers. Where the peat was formerly deep much of it has been run over by fire, and in places all of the peat has been burnt off.

This land has a very low agricultural value, and its successful improvement is a difficult problem. From the information at hand it would seem that the most profitable way to handle this type is to have tracts of considerable size, cut some marsh hay, and pasture as many cattle as the land will carry. The idea is to sell the steers as feeders and keep the cows for milk production. The stock should be yarded at night and the manure saved and applied to the islands and the best-drained portions of the marsh, where sufficient grain and corn for silage could be grown for winter feed.

On a tract of land of this character east of Sprague an effort is being made to produce cultivated crops, but the enterprise has not gone far enough to insure either success or failure. The plowing is done with a gasoline traction engine, and such crops as flax, wheat, oats, corn, and alsike clover are being tried with varying degrees of success. Some alsike clover was seen, and over parts of the fields there was a good stand.

Some points to be kept in mind in connection with this land are that the drainage is not sufficient in many places, even where ditches have been installed, and that the soil is extremely low in mineral

plant food and is usually in an acid condition. In large tracts this land sells for $6 an acre up. It is being retailed at $20 to $25 an acre.

MEADOW.

The material mapped as Meadow consists of the low-lying areas along streams and drainage channels, where the texture of the soil is so variable as to make classification into different types impossible. Meadow is poorly drained and subject to frequent overflows, making the growing of cultivated crops very uncertain. The texture of the soil varies from a medium sand to silt loam, depending upon the character of the soil within the drainage basin of the water course along which it occurs. Frequently mucky or peaty areas are found along with sandy spots.

Meadow is most extensively found along the Wisconsin, Lemonweir, and Yellow Rivers, where it varies in width from one-eighth to over 1 mile. The surface is level, except where there are a number of old stream channels, which give it an undulating topography.

The type is of alluvial origin, having been carried down and deposited by the streams along which it occurs during times of high water. Most of the material comes from the Potsdam sandstone, though the silt present owes its origin to the same source as the silt of the upland soils.

The timber growth consisted of oak, maple, river birch, ash, willows, elm, aspen, a few pines, hazel, alder, and blackberry bushes. Much of the type is still in timber, but all of the best trees have been removed.

As Meadow is very low, it would be difficult to drain it sufficiently to make the cultivation of crops safe at all times. A portion of the soil is naturally quite productive, and if it could be drained would yield good crops. Some marsh hay is cut, and a portion of the type is used for pasture.

ROUGH STONY LAND.

The areas mapped as Rough stony land include regions which are too steep and rocky to be of agricultural value. The rock consists for the most part of Potsdam sandstone and may be in the form of extensive outcrops or as rock fragments of various sizes thickly strewn over the surface and mixed with the soil on steep slopes. At Necedah and in a few other places the rock consists of quartzite.

Rough stony land occurs most extensively in the southern part of the county, in the hilly country, where it occupies the steep slopes and narrow ridges. It is also found in a number of places as precipitous bluffs, which are the most conspicuous features of the landscape in the sand plains country.

The timber growth consisted of scrub oak, birch, and some Jack pine in a few places. Land of this character is never cultivated, but much of it is used as pasture, though the grazing afforded is very limited. Most of the type is still in timber.

SUMMARY.

Juneau County is located a little south of the center of Wisconsin, and comprises an area of 796 square miles. About one-third of the area is rolling to hilly and rough, while the remainder consists of nearly level sand areas and low marshy tracts.

The county is well supplied with railroads, which provide excellent transportation facilities.

Mauston, a city of 2,400, is the county seat and the largest city in the area. It is 214 miles from Chicago, 128 miles from Milwaukee, and 209 miles from Minneapolis, over the Chicago, Milwaukee & St. Paul Railroad.

The mean annual temperature at Mauston is 44.1° and the mean annual precipitation 31.54 inches. The average date of the last killing frost in the spring is May 17 and of the first in the fall September 24, giving an average growing season of about 130 days at Mauston.

The type of agriculture most extensively followed in the southern and southwestern parts of the county, where the soils are heavier than elsewhere, consists of dairying in conjunction with general farming. The chief crops grown are hay, oats, corn, barley, and potatoes, with some rye, buckwheat, and tobacco. In the low, wet areas marsh hay and wire grass are cut and the sphagnum moss is gathered and sold. The deep sand soils of the central and northeastern parts of the area have a low agricultural value and are only slightly improved. But little trucking is carried on, and the fruit industry is not developed on a commercial scale in any part of the county.

Juneau County lies within the unglaciated portion of Wisconsin, and comprises two distinct physiographic divisions, consisting of a sand plains and marsh region covering the northern two-thirds and a rough, hilly section covering the southern one-third of the area. The northern section is usually referred to as a part of the old Wisconsin River Valley, in which the soils are largely of alluvial origin and very sandy. In the southern portion the soils are heavier and probably of loessial origin. In the survey of Juneau County 8 soil series and 16 soil types, including Meadow, Rough stony land, Peat and Muck (undifferentiated, and Sands and Peat (undifferentiated), have been mapped.

The Knox series includes the most highly improved farming land in the county and is characterized by a rolling to hilly topography

and light-colored silty soils subject to erosion. The Knox silt loam and Knox silt loam, shallow phase, were mapped.

The Baxter series includes residual soils from the Lower Magnesian limestone and is represented here by only one type, the silt loam. This has a light-colored silty soil and a red clay subsoil, with large quantities of chert present. It is of limited extent.

The Lintonia silt loam, the only member of this series mapped, represents colluvial material washed down the slopes from higher areas of the Knox soils, and varies in color from light to dark brown. The natural drainage is sometimes deficient. It is of limited extent.

One member of the La Crosse series, the La Crosse silty clay loam, was mapped. It consists of dark-brown to black alluvial material along the streams in the rough portion of the county. It is deficient in drainage, but is naturally a strong soil.

The Boone series includes residual soils from the Potsdam sandstone. This rock is exposed on many of the steep slopes, and comes near to the surface over a part of the sandy region. Two types were mapped. The Boone fine sandy loam is a fair sandy soil of limited extent. The Boone fine sand is quite extensive, but a poor agricultural soil. A loamy and a low phase of this type were also mapped.

The Superior series includes lacustrine material, over a part of which varying amounts of sand have been deposited. The Superior clay loam is a strong soil and a good general farming type, though somewhat difficult to cultivate. The Superior fine sandy loam is easy to cultivate, having a sandy soil and a heavy subsoil. It is therefore more retentive of moisture than the deep sand types. The Superior sand has from 2 to 3 feet of sand over red clay. It is the most extensive of the Superior soils, and is fairly productive.

The Plainfield soils as found here have a relatively low agricultural value. They are low in organic matter and are acid and droughty. The types mapped are the Plainfield sand and fine sand.

The Dunning sand is the only member of this series encountered. It is similar to the sands of the Plainfield series in origin, but is slightly lower lying, and has a quantity of organic matter in the surface which gives it a black color. It is poorly drained and but slightly improved.

Peat and Muck (undifferentiated) consists of vegetable matter in varying stages of decomposition. There are several extensive tracts in the county. Cranberries are grown on the peat bogs.

Sands and Peat (undifferentiated) represents a vast number of very small sand islands scattered through extensive tracts of low, wet land. These islands are too small to be mapped separately, yet they form approximately half of the land surface in such areas. The value of such tracts is chiefly in the marsh hay which can be

cut. Extensive drainage districts have been organized and ditches dug, but the drainage has not been sufficient, and but few cultivated crops are being tried. All such tracts are underlain by sand, and at best the land has a very low value.

Meadow includes the low-lying land along the rivers where the surface is flooded several times each year, and the soil is so mixed that a separation into types would be impossible.

Rough stony land includes the steep rocky slopes, rock outcrops, and rough sections, which are of no agricultural value and afford only a limited amount of pasture. Many of these steep areas are still in timber.

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[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.]

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