



Issued November 24, 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.

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## SOIL SURVEY OF LA CROSSE COUNTY, WISCONSIN.

BY

W. J. GEIB AND CLARENCE LOUNSBURY, OF THE U. S.  
DEPARTMENT OF AGRICULTURE, AND T. J. DUNNEWALD,  
OF THE WISCONSIN GEOLOGICAL AND NATURAL  
HISTORY SURVEY.

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

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



WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
1913.

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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., March 15, 1913.*

SIR: During the field season of 1911 the survey of La Crosse County, Wis., was completed. This work was done in cooperation with the Wisconsin Geological and Natural History Survey, and the selection of this area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this area, and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1911, as provided by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

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

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# SOIL SURVEY OF LA CROSSE COUNTY, WISCONSIN.

By W. J. GEIB and CLARENCE LOUNSBURY, of the U. S. Department of Agriculture, and T. J. DUNNEWALD, of the Wisconsin Geological and Natural History Survey.

## DESCRIPTION OF THE AREA.

La Crosse County is located in west-central Wisconsin and has an area of approximately 481 square miles, or 307,840 acres. It is bounded on the north by Trempealeau, Jackson, and Monroe Counties, the greater part of the Trempealeau County boundary being formed by the Black River; on the east by Monroe County; on the south by Vernon County; and on the west by the Mississippi River. Since the western and a part of the northern boundaries are formed by streams, the county is somewhat irregular in shape.

The topography of the county consists of a thoroughly dissected plain, the stage of development being mature. To define the stage of development of a region, however, does not describe its features in detail. It constitutes only one of the factors which is of determinative influence in this matter.

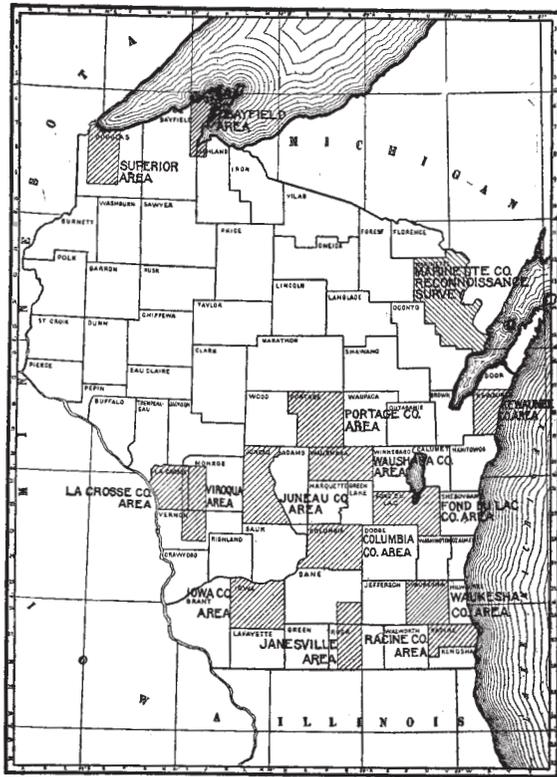


FIG. 1.—Sketch map showing areas surveyed in Wisconsin.

The internal anatomy of an area is of equal or greater importance, being most pronounced in its effect at maturity, the stage reached by the La Crosse County topography.

The simplest case of development, one where the features are least complex, occurs in a region where the rocks are of uniform resistance, where stream grades vary from head to mouth only in accordance with the size of the stream, and where the headward growth of lateral valleys has at maturity invaded uniformly the whole country and streams of adjacent systems interlock along extremely crooked watersheds. In this area, on the other hand, a resistant layer lies immediately beneath the initial upland surface, protecting it from thorough dissection by small tributary streams and permitting destructive erosion to advance on it horizontally rather than vertically, to cut from its sides, whittling from its outer edges and preserving intact the main body rather than by permitting the chopping of the whole area into small bits and then proceeding to whittle these away from their abundantly exposed sides.

The headward growth of tributary streams in such a country advances somewhat as a column of soldiers rather than as a crowd of individuals. The front of the column advances in order, though the central portion moves faster than the flanks. They remove the upland as they advance, leaving behind them a rolling lowland basin, and have in front of them the yet unattacked and unbroken remnant of the plateau retaining its essential features intact until the forward march of the drainage from opposite sides during the later stages of the cycle has annihilated it entirely. The La Crosse County topography is of this type and stands in the early mature stage of development. It consists, therefore, of a high, smooth upland surface, maintaining essentially its early simplicity, existing, however, as narrow remnants on all the main watershed ridges and extending in long, narrowing arms along subordinate watersheds, often advancing to within a short distance of the main streams. Between these narrow remnants of the original surface lie broad, rolling basins, roughly approximating in shape the ends of ellipses, being surrounded at the sides and small end by the remnant of the initial surface and opening at the other end into still larger basins. Along the axial belt of these basins lie the valleys of the streams whose erosion has shaped them and from there the country rises in rounded swells, gently at first, but becoming steeper toward their boundaries until it ends abruptly at the foot of the steep slope marking the edge of the initial surface block. It is a region of three essential elements in its upland topography, these being (1) the smooth initial surface, (2) the steep slope bounding it, and (3) the rolling lowland basins.

With the exception of the flood plains of the largest streams, the county as a whole is naturally well drained. The Black River, which forms the northwestern boundary for about 15 miles, receives the waters from Fleming Creek and a number of smaller streams which drain the northern part of the county. The La Crosse River traverses the county from east to west and receives the waters from Burns, Dutch, Fish, and Bostwick Creeks, and a number of other streams, draining the central and eastern parts of the county. Mormon Creek drains the southern and Coon Creek the southeastern sections. All of these streams empty into the Mississippi River.

La Crosse County was formed in 1851, and its present limits were established in 1857. It was formerly a part of Crawford County. Farming operations were started in 1844 at a point under the bluffs between Mormon and State Road Coulees,<sup>1</sup> though traders had been operating throughout this section of the country for a number of years previously. In 1848 a company of Mormons settled in Mormon Coulee, and settlement began in the upland portion of the county between 1850 and 1855. Most of the early settlers were Americans, who came from the Eastern States. The county is now well settled, and the population, which in 1910 numbered 42,850, is quite evenly distributed.

La Crosse, with a population of 31,000, is the county seat and the largest city in the county and constitutes an important railroad and industrial center. It is situated on the Mississippi at the mouth of the La Crosse River, in the western part of the county. Onalaska, West Salem, Bangor, and Midway are smaller railroad towns.

While there are three important railroad lines in the county, the upland country is so rough that the roadbeds have followed the valleys of the Mississippi and La Crosse Rivers, and as a result some parts of the county are not conveniently accessible to the railroads. The main line of the Chicago, Milwaukee & St. Paul Railway traverses the county along the La Crosse River. The Winona Division of the Chicago & North Western Railway parallels this line to La Crosse and then runs north along the Mississippi River to Winona, Minn. The Chicago, Burlington & Quincy Railroad crosses the county from north to south, following the Mississippi Valley. All of these lines pass through La Crosse, making it an important shipping point. The La Crosse & Southeastern Railway extends south from La Crosse into Vernon County. The Mississippi River affords a water route for shipping, and while not extensively utilized at present, the possibilities of its use account for lower freight rates than could be secured if there were no water connections.

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<sup>1</sup> The word "coulee" is here used in its local sense.

The main dirt roads throughout the upland portion of the county are usually kept in good condition, as the predominating soil material naturally makes a good roadbed, but hills are numerous and the grades are often steep, so that heavy hauling is difficult. Some of the main roads in the valley leading into La Crosse are crowned with crushed rock and are kept in excellent condition. Throughout the sandy portion of the county, where foreign material has not been applied, the roads are naturally sandy. All parts of the county are supplied with rural free-delivery service and telephones are common. La Crosse and the smaller towns within the county afford a market for large quantities of farm produce. Minneapolis is but 137 miles and Chicago 283 miles from La Crosse, with excellent train service over two lines to St. Paul and Minneapolis and over three lines to Chicago.

#### CLIMATE.

The climatic conditions in La Crosse County are typical of a large area extending below the west-central part of the State. The records of the Weather Bureau station at La Crosse show the mean annual temperature to be 46°, with a maximum of 104° and a minimum of -43°. This gives a total range of 147°, which is greater than is recorded for points in the eastern part of the State, where the influence of Lake Michigan is felt. The extremes indicated are seldom recorded, although during the winter months the temperature frequently goes below zero, and during the hottest part of the summer it occasionally reaches 95°. The winters are severe and the snowfall is heavy, the average being 39.9 inches. The summers are comparatively short, but the growth of all vegetation is rapid.

The mean annual precipitation of 30.9 inches is well distributed throughout the growing season. During the months of May, June, July, August, and September the mean for each month is over 3 inches. Thunderstorms are of frequent occurrence and are sometimes accompanied by high winds and hail. Destructive storms, however, are of rare occurrence. The prevailing winds are from the south and their average velocity is 7.2 miles per hour.

Records extending over a period of 37 years indicate that the average date of the first killing frost in the fall is October 1 and that of the last killing frost in the spring April 30. This gives an average growing season of about 142 days free from killing frosts.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation, as recorded at La Crosse:

*Normal monthly, seasonal, and annual temperature and precipitation at La Crosse.*

Month.	Temperature.			Precipitation.			
	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.	Inches.	Inches.	Inches.
December.....	23	61	- 26	1.4	1.3	0.3	7.7
January.....	16	57	- 43	1.1	.2	1.5	9.6
February.....	19	65	- 34	1.1	1.4	1.3	8.9
Winter.....	19			3.6	2.9	3.1	26.2
March.....	31	78	- 23	1.6	.3	1.0	7.5
April.....	48	87	10	2.4	1.9	1.4	1.6
May.....	60	96	29	3.5	.5	3.1	T.
Spring.....	46			7.5	2.7	5.5	9.1
June.....	69	98	33	4.4	1.0	2.8	.0
July.....	73	104	46	4.1	1.8	8.9	.0
August.....	71	101	39	3.3	2.2	5.0	.0
Summer.....	71			11.8	5.0	16.7	.0
September.....	62	97	24	4.0	4.4	10.9	.0
October.....	50	88	6	2.5	1.6	7.6	.2
November.....	34	72	- 21	1.5	.8	1.2	4.4
Fall.....	49			8.0	6.8	19.7	4.6
Year.....	46	104	- 43	30.9	17.4	45.0	39.9

## AGRICULTURE.

Up to 15 or 20 years ago the growing of grains constituted the chief type of agriculture in La Crosse County, with wheat as the principal crop. Owing to the decline in the price of grains, however, and to the realization that constant cropping to such crops would in time impair the productiveness of the soil, their production was curtailed and a gradual change has taken place in the cropping system and cultural methods of the county, until at the present time the principal type of agriculture consists of general farming, with dairying as the main feature. In conjunction with this hog raising is carried on to a considerable extent, and in some sections of the county trucking has been developed to supply local demands.

The crops which are most extensively grown at present, in order of acreage, are hay, oats, corn, barley, rye, wheat, and potatoes. In addition to these, such crops as buckwheat, alfalfa, sugar beets, peas, and some other truck crops are grown to a limited extent.

According to the Thirteenth Census reports there was more land devoted to hay production, including the wild marsh grasses, in La Crosse County during 1909 than to any other crop. A yield of 60,423 tons was secured from 30,465 acres, or an average of nearly 2 tons per acre, 60 per cent of which was mixed timothy and clover. Over four times as much timothy as clover is grown. About 14 per cent of the hay crop consists of grass cut from the swamps and marshes. The production of alfalfa is comparatively small. Timothy and clover are usually seeded with oats, barley, or wheat as a nurse crop, though a good stand may be secured without the use of a nurse crop, provided care is taken in the preparation of the seed bed and the seeding is done at the proper time. Frequent cultivation should be given the field late enough in the season to insure the killing of most of the weeds which might choke out the young plants. Most of the hay is fed to stock on the farms, though some is sold each year.

The acreage devoted to oats is second only to that of hay. From 28,504 acres a yield of 911,685 bushels was secured in 1909, or an average of 31.9 bushels per acre. The yields secured on the Wabash, La Crosse, and Sioux silt loams are larger than those from other types, but during wet years there is likely to be a rank growth of straw, which frequently lodges, and the grain is not of as high quality as that grown upon the Knox silt loam of the uplands. Some of the oat crop is sold, but most of it is fed to stock.

Corn production ranks next in importance. From 19,810 acres a yield of 621,425 bushels of corn was secured in 1909, giving an average of 31.31 bushels per acre. The Wabash, La Crosse, and Sioux silt loams are better adapted to this crop than any of the other types, and yields of 50 to 60 bushels per acre are common, while considerably larger yields are sometimes reported. As the dairy industry increases the acreage devoted to corn also becomes greater each year. Silos are numerous and much of the corn is cut and preserved for stock feeding during the winter months. A large part of the crop is allowed to mature, to be used as feed for hogs, beef cattle, and dairy cows. More attention is being paid now than formerly to the selection and breeding of the varieties of corn best suited to local conditions in this part of the State. Practically all of the corn produced is used on the farms within the county.

Considerable barley is still grown, although the acreage devoted to this crop is gradually decreasing. A yield of 333,538 bushels was secured from 11,329 acres in 1909, or an average of 29.4 bushels per acre. As in the case of oats, a better quality of grain is produced on the upland soils than on the black types of the lower lands and river terraces. A large proportion of this crop is sold, though some is used for feed.

Rye is an important crop on the sandy types of the county, and while the yields on the light soils are low it does better than any of the other grain crops. From 5,944 acres a yield of 65,797 bushels, or an average of 11 bushels per acre, was secured in 1909. In addition to the grain produced, the rye crop also furnishes a late fall and early spring pasture.

Wheat, which was at one time the leading crop in this county, is now only of minor importance. In 1909 a yield of 39,633 bushels was produced from 1,928 acres, averaging 20.5 bushels per acre. About one-third of the production consisted of spring wheat. The yield of winter wheat averages about 3 bushels more per acre than spring wheat. On the best soils of the area, such as the Wabash, La Crosse, and Sioux silt loams, and the Knox silt loam, satisfactory yields are still secured, but other lines of farming have been found to be more profitable and more certain to maintain the productivity of the soil.

Irish potatoes are grown commercially to a small extent, principally on the ridges east of La Crosse. From 1,790 acres 242,130 bushels, or an average of 135.2 bushels per acre, were secured in 1909. Yields of 200 bushels per acre are not uncommon. Potatoes are also grown for market on some of the sandy types. Most of these are early varieties, while on the heavier soil of the ridges the late potatoes are more common.

Sugar beets are grown in the vicinity of Bangor and West Salem, chiefly on the La Crosse, Sioux, and Wabash silt loams. The beets are shipped to the factory at Janesville, which cooperates with the farmers by furnishing labor to do the hand cultivating and thinning, while the landowners provide the horse cultivation. Yields of 20 tons per acre are secured, although this is above the average. The beets bring an average price of \$5 per ton.

Peas are grown for canning, being hauled to the factories at Onalaska and West Salem. The acreage devoted to this crop is gradually being increased. The La Crosse, Sioux, and Wabash silt loam types are well suited to peas, but the crop would probably do better on the Knox silt loam. The dark-colored soils are rich in organic matter and produce a vigorous and sometimes rank growth, while the light Knox silt loam contains less organic matter and would produce a smaller vine but a good quality of peas.

Within a radius of 5 to 10 miles of La Crosse truck crops and small fruits are grown extensively for local markets. The truck crops, including early potatoes, cabbage, melons, radishes, celery, beets, sweet corn, peas, beans, rhubarb, and, mainly on the ridges east of La Crosse, late potatoes, are grown principally on the Sioux sand, Knox fine sand, and the La Crosse and Sioux fine sandy loams, the last two named being the leading truck soils of the county. Large quan-

tities of stable manure are hauled from La Crosse and used in growing these crops.

The fruit industry has not been developed in La Crosse County to any extent. Apple culture has received very little attention, although over a large number of slopes throughout the upland portion of the county the conditions are favorable to the successful development of this industry on a commercial scale. Of the small fruits blackberries, raspberries, and strawberries are being grown on the higher slopes of the La Crosse and Sioux silt loams, on some of the slopes of the Knox silt loam, and on some of the sandy types. The growing of small fruits and berries has been developed on a commercial scale in the vicinity of Sparta, on the adjoining slopes bordering the county, and there is no reason why equal success should not be attained along the valley of the La Crosse River, where the silt from the upland has become mixed with the residual sand of the lower slope terraces, since the conditions in these two areas are practically identical.

Tobacco was formerly grown, principally in the southeastern section of the county adjoining the Viroqua tobacco district, but very little of this crop is now produced.

Dairying in conjunction with hog raising is the most extensive and important agricultural industry now carried on within the county, although it is not as highly developed here as in the southeastern part of the State. When the Thirteenth Census was taken there were 20,046 dairy cows and 26,518 hogs in the county.

Dairying is confined chiefly to the upland portion of the county and to the silt loam areas in the La Crosse River Valley. Throughout the uplands region there is a succession of slopes which are better suited to the development of dairying than to any other type of farming, some of them being too steep for the production of crops but providing a large area of excellent grazing land. The more level ridge tops and the gentle slopes provide sufficient land for the growing of corn and other cultivated crops. The cattle are principally Holsteins, Jerseys, and Guernseys, with some native-grade cows and Shorthorns. Dairy products are sold mainly in the form of butter and cheese. There are 8 creameries and 6 cheese factories in the county. The output of butter made far exceeds that of cheese. The cream is usually separated on the farm and hauled to the creamery by the farmer or by collectors who operate definite routes. Large quantities of milk and cream are delivered daily to the residents of La Crosse and the smaller towns throughout the county.

Hog raising, in conjunction with dairying, constitutes an important feature of the agriculture of La Crosse County. The largest number of hogs are raised on the La Crosse, Sioux, and Wabash silt loams, these types being better adapted to the production of corn

than any of the other soils. The principal breeds are Poland China, Duroc Jersey, Berkshire, and some Chester Whites.

Some beef cattle are raised in the county, although this industry is not extensively developed. More steers and calves are probably shipped from West Salem than from any other point in the county.

While the rougher areas are well adapted to the raising of sheep, there were at the time of the Thirteenth Census only 9,268 sheep in the county. Since there is a large total area of steep, rocky land which can not well be cultivated, but which furnishes good grazing, it would seem that sheep raising could be profitably extended.

The adaptation of the soils to certain crops is recognized to some extent within the area surveyed. It is considered that the Wabash, Sioux, and La Crosse silt loams are better suited to corn than is the Knox silt loam, and that the Knox silt loam produces a better quality of wheat, oats, or barley than either the Wabash, La Crosse, or Sioux silt loams. The sandy types are considered better adapted to rye than to any of the other grain crops grown in the county. The crop rotation most commonly followed consists of corn, oats, barley, and hay.

The question of securing farm labor is sometimes a difficult one. The average wage for a single man is about \$25 per month, with board and laundry work included. It is often stipulated that the farmer shall keep the hired man's driving horse. It is sometimes difficult to find men who are willing to milk. In addition to the regular wages, married men are usually supplied with a house, fuel, a garden patch, etc.

About 89.9 per cent of the land in La Crosse County is in farms. The average size of the farms is 153 acres, 54 per cent of which is reported as improved. Of the farms, 75.9 per cent are operated by their owners, and 53.5 per cent of these are free from debt. In most cases where land is rented the cash system is followed. During the period from 1900 to 1910 the value of farm lands in La Crosse County increased 48.2 per cent.

Farm improvements throughout the area vary with the character of the soil upon which they are located. On all of the heavier types agriculture is well developed, the farmers are prosperous, and the farm buildings are substantial and well cared for. On the sandy soils, especially the Boone fine sand, Knox fine sand, and Boone fine sandy loam, agriculture is not so highly developed, the soil being less productive, and, in general, the farm buildings and improvements are inferior to those on the heavier soils, owing to neglect. Frequently farms on the poorer soils are abandoned, and the buildings soon become dilapidated.

While agriculture is well developed over the greater part of the county, there are a number of lines along which improvements could

be made. Suggestions are given in connection with the descriptions of individual soil types as to the best methods for bringing them to a higher state of productivity. In general, however, much of the land is better suited to dairying than to any other type of agriculture, and where such is the case this industry should be given more attention. Hog raising may be carried on to a greater extent in connection with dairying. The growing of alfalfa should also receive careful attention and an effort made to produce this crop on every dairy farm. By inoculating, liming, and manuring the soil a good stand can be secured when the seed bed has been properly prepared and good seed sown.

The slopes throughout the upland portion of the county comprise good orchard sites, and the fruit industry, especially the culture of apples, could be developed on a commercial scale. While it is generally recognized that the soil and climatic conditions are favorable for apple growing, this industry has not received the attention it deserves. The growing of small fruits, such as strawberries, raspberries, currants, etc., should be extended.

In the vicinity of La Crosse and along the railroads the trucking industry could be profitably enlarged. The growing of sugar beets and of special crops, such as peas for canning, cucumbers for pickling, and cabbages, could also be extended with profit. The selecting, breeding, and growing of different varieties of the various farm crops for seed could be developed into a profitable industry.

Among the weed pests common to the region, quack grass and Canada thistle are the worst with which the farmer has to contend. In general the methods of farming followed by the leading farmers on the heavier soils are fairly well adapted to present conditions. The soil of the heavier types is usually plowed deep and receives ample tillage. Manure spreaders are in common use. Most of the progressive farmers have silos and more are being built each year. Over the sandy areas, however, the methods of farming could be generally improved.

#### SOILS.

La Crosse County lies within the unglaciated portion of Wisconsin, and in its geological formations, soil conditions, and topography it is representative of a very large area in the southwestern part of the State. The topography throughout this region is comparatively old and was well developed before the materials constituting the majority of the present soils were laid down.

Throughout the greater part of the county, the uppermost rock consists of the lower Magnesian limestone. This occurs on the tops of the hills and ridges throughout the upland. The formation is

thinner, shows more erosion, and is less continuous in the northern than in the southern part of the county. It outcrops along the upper slopes and forms a large part of the Rough stony land type. Directly under this formation lies the Potsdam sandstone, which outcrops on many of the lower slopes and forms the uppermost rock over a large area in the northern part of the county, where the limestone formation has been eroded. The outcrops of this rock also form a small part of the Rough stony land type.

The surface of nearly all of the upland is covered to a depth of from 10 feet or more with a mantle of silty material, the greater part of which is undoubtedly much like loess. It is extremely silty at the surface, the clay content gradually increasing with depth, and in cuts a laminated structure is often observed. At one time the entire area seems to have been covered with this material, which has been removed by erosion in places, especially where the deposit was thin, as appears to have been the case in the northern part of the county. The soil derived from this material, which is the most extensively developed in the county, has been classified as Knox silt loam, with its phase. It has a light-colored surface soil with a yellowish subsoil. The same type is found over large areas throughout the southwestern part of the State.

On many of the lower slopes the Potsdam sandstone outcrops from beneath the lower Magnesian limestone. In the northern part of the county the limestone has been entirely removed over a considerable area, and where the sandstone is thus exposed it has disintegrated and weathered into a sandy material from which the Boone series of soils is derived. Two types, the Boone fine sand and the Boone fine sandy loam, have been recognized and mapped as belonging to this series.

A large quantity of material from the silty uplands and the sandy areas has been washed down the slopes, transported by streams, and deposited as silty or sandy terraces. These terraces range from 10 to 70 feet above the present level of the water in the rivers and mark stages in valley making by the streams. Distinct terraces are developed in both the Mississippi and La Crosse River Valleys. A large number of those within the valley of the La Crosse River have a predominance of silty material, with comparatively little sand, while in the Mississippi Valley the greater proportion, if not all, of the material outside of the present flood plain is of a very sandy nature. Along the La Crosse River the terraces are occupied by a series of dark-colored soils, in which three types are represented, the La Crosse silt loam, sandy loam, and fine sandy loam. Some members of this series are also found to a limited extent within the valley of the Mississippi River.

Narrow strips of bottom land, a large part of which is above the present flood plain, occur along the smaller streams of the county, especially throughout the uplands. The soil material is dark in color and gives rise to two types in the Wabash series, the loam and the silt loam.

Within the valley of the Mississippi and Black Rivers are several distinct terraces. On the highest of these the material is mainly of fine texture and light color, and has been classed as Knox fine sand. A small development of La Crosse silt loam occurs at a lower level than the Knox fine sand. On the lower terraces the soil material is coarser in texture and darker in color, and has been classed as Sioux sand. Associated with this sand on Brices Prairie is a small occurrence of dark gravelly soil, which was mapped as Sioux gravelly sandy loam.

Along the La Crosse River there are limited areas of sand within the present flood plain which is being reworked somewhat by floods. This material has been classed as Riverwash.

There are large areas along the Mississippi and Black Rivers and smaller patches along the La Crosse River which are subject to periodical overflow and in which the soil material is so mixed that a division into types would be impossible. The land is too wet to be cultivated, except in a few places, and can not be reclaimed except by expensive diking. These areas have been classed as Meadow.

A few low-lying areas occur, in which the soil material consists of vegetable matter in varying stages of decomposition. These have been mapped as Peat.

The following table gives the actual and relative extent of the various soil types mapped:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Knox silt loam.....	36,672	} 42.6	Knox fine sand.....	6,528	2.1
Rolling phase.....	94,336		Sioux fine sandy loam.....	4,544	1.5
Rough stony land.....	31,936	10.4	La Crosse fine sandy loam....	3,072	1.0
Meadow.....	31,360	10.2	Plainfield sandy loam.....	2,624	.9
La Crosse silt loam.....	19,264	} 7.7	Peat.....	2,176	.7
Coarse phase.....	4,160		La Crosse sandy loam.....	1,856	.6
Heavy phase.....	354		Riverwash.....	960	.3
Wabash loam.....	14,464	4.7	Sioux silt loam.....	768	.2
Boone fine sandy loam.....	14,400	4.7	Sioux gravelly sandy loam....	256	.1
Wabash silt loam.....	14,272	4.6			
Sioux sand.....	14,144	4.6			
Boone fine sand.....	9,664	3.1			
			Total.....	307,840	.....

## KNOX SILT LOAM.

The surface soil of the Knox silt loam consists of a grayish-brown, friable silt loam, extending to an average depth of 10 inches. When dry it has a floury feel. It is low in organic matter, which in part accounts for its light color. The subsoil is a yellowish-brown silt loam, heavier than the surface soil, in which the clay content gradually increases, until at a depth of 16 to 24 inches the material becomes a silty clay loam. The subsoil has a compact structure and extends to an average depth of 12 feet, though in many places it is considerably deeper than this, while in others it is much shallower. Both soil and subsoil are free from stones, gravel, or other coarse material. On account of the heavy subsoil and the uniformly silty character of the soil, the type is commonly referred to throughout the area as a clay.

On account of its texture, structure, heavy subsoil, freedom from stones, and its low content of organic matter it is especially subject to severe erosion where the slopes are steep. Fortunately such slopes are rare on the uplands, where the type occurs typically. It is only around the heads of the steep hollows which have been extended back into the type from the main creeks that they occur. As a whole the proportion of the area subject to severe erosion is relatively low. In such places, however, erosion removes the soil and exposes the heavier clay loam subsoil.

In order to obtain the best results with this soil, it should be tilled only under proper moisture conditions. If handled when too wet it is likely to puddle, and some difficulty may be experienced in pulverizing the clods which subsequently form. Where the clay is near the surface on the tops of narrow ridges and on some of the steep slopes cultivation is more difficult than on the tops of the broad ridges, where the silty covering is deeper. If the type is cultivated under the most favorable moisture conditions a good seed bed can be secured with but little difficulty. Because of the low organic-matter content the type is less loamy than some of the other silt loams, especially the Wabash, and a little more difficult to handle.

The Knox silt loam, with its rolling phase, is the most extensive and important type in the county. The typical soil, however, occurring as it does only on the high rolling plateau, mainly in the southern part of the county, is relatively unimportant in area. It has a smoother topography, a slightly darker color, and on the whole is slightly heavier than the rolling phase.

This soil differs slightly from the typical Knox silt loam in Iowa, Illinois, and Missouri in its heavier subsoil and slightly darker or grayer color with relatively less yellow than in those States. Its

topography is smoother also than is a large part of that occurring along the Mississippi and Missouri River bluffs in those States.

Since this soil is underlain by the lower Magnesian limestone in this area, it is not at all improbable that its heavy subsoil is due to a derivation, in part, from the limestone. A layer of unquestioned residual material from the limestone occurs in occasional small areas on the slopes immediately above the rock. It is a brown to reddish-brown clay.

Owing to the uneven surface, the natural drainage of the type is good. Occasionally, on slopes where springs originate from the Potsdam sandstone, there may be small areas of wet land. There are also a few places on the broadest ridges where the surface is nearly level for short distances and where tile drains might be installed to advantage. On account of the high percentage of silt, the low organic-matter content, and the steep character of the slopes, the type is subject to erosion and has been badly damaged in many places. Erosion has been most active, and the ridges are narrower in the northern part of the county. On some of the lower slopes below the Rough stony land the surface is frequently badly dissected by ravines, which are being extended by each heavy rainfall.

The crops commonly grown on this type are corn, oats, barley, wheat, clover, and timothy. Corn yields on the average from 35 to 40 bushels per acre, and as high as 60 bushels have been secured. The yield of oats varies from 25 to 50 bushels per acre. Wheat was at one time the leading crop, but at present only a comparatively small acreage is grown each year. It averages 25 bushels per acre, and yields of 30 to 35 bushels are not uncommon. Hay yields from 1 to 1½ tons per acre. Sometimes there is difficulty in getting a stand of red clover because of winter freezing. In such places it is usually possible to get a catch of alsike clover. Alfalfa is not grown to any extent. Potatoes are grown chiefly for home use, though near La Crosse some are grown for market. If the ground is carefully prepared and the crop properly cultivated yields of 200 bushels per acre can be secured. This, however, is somewhat above the average for the type.

Some tobacco is grown in the southeastern part of the county on the Knox silt loam adjoining the Viroqua tobacco district, but the crop is not receiving the attention it did in former years. Cucumbers, melons, peas, beans, strawberries, etc., are grown in a small way as garden crops, and small quantities are marketed, but the trucking industry has not been developed to any extent on the Knox silt loam. Apples and berries are grown for home use.

The most extensively practiced rotation on this type is as follows: Corn for one or two years, followed by oats or barley one year; then rye or wheat for one year, followed by clover and timothy for two

or three years; after which the land is again planted to corn. It is recognized that the Knox silt loam is better adapted to small grains than to corn. The yields of both the small grains and corn are somewhat lower than on the Wabash, La Crosse, and Sioux silt loams, but the quality of the grain is better.

Dairying is the chief type of farming followed on this soil, and hog raising is also an important industry. The crops grown are generally selected with the idea of supporting these industries. The manure secured from the stock is usually applied to the corn crop, and no commercial fertilizers are in common use.

*Knox silt loam, rolling phase.*—In general physical character and appearance of the soil this phase is essentially like the typical soil. It is as a whole somewhat lighter in color, and a little lighter in texture. Its principal variation from the type is in its topography. Because of this its agricultural use and possibilities are not the same in all respects as the type. It is underlain by sandstone, shaly sandstone, and shale. The extent to which this material has entered into the composition of the soil is unknown. That it is not wholly absent is shown in places by the occurrence of a small amount of fine sand in the soil. The correlation of the soil as Knox is based on its color and silty texture. The latter is thought to be due to its origin as a wind-deposited silt, but the only evidence of such origin is its highly silty texture.

This phase of the Knox silt loam constitutes the predominant soil in the county. In the northern part it occupies more than a third of the total upland area, while in the northern half of the southern part it is almost equally important. It is only in the southern part of the county that its area is unimportant.

The topography of its occurrence is much more uneven than is that of the type. In the northern part it occurs as a hill-land soil, extending to the tops of the hills in most places, and downward to the valley level, or near it. There is no considerable area of relatively smooth upland plateau north of the La Crosse River, such as exists in the southern part of the county; hence there are fewer areas of the typical Knox soil to break the continuity of the phase than occur in the southern part.

South of the La Crosse River the rolling phase occurs only in broad, open, but rolling valley basins or coves, which extend from the river valley, into which they open, backward into the plateau as progressively narrowing basins, with strongly rolling topography. In general, therefore, the phase south of the La Crosse River occurs only in valleys and well below the upland level, while in the northern part of the county it occupies a much larger percentage of the whole country, hilltops and slopes as well; but where remnants of

the high plateau occur in this part of the county they carry typical soil just as in the southern part.

The drainage of the phase is good, except in small areas along the slopes where springs and seeps occur. The greater part of it is so rolling that too large a percentage of the rainfall runs off, so that crops often suffer from lack of moisture. The rolling surface renders the soil liable to more or less severe erosion also. Along the higher border of the belts, near the boundary with the Rough stony land, the slopes are often so steep that erosion is a serious problem in the fields. Over the whole area it is a factor that must be considered. It is due to the topographic factor mainly, though the rather heavy subsoil tends to increase the effect of the topography rather than to reduce it. The topography is the dominant factor, and can not be remedied by man. The character of the subsoil is likewise a factor that can not be profoundly changed by him, so that the difficulty can not be overcome. Its effects can be reduced by the use of grass crops, deep plowing, and the incorporation of abundant vegetable matter in the soil. The steeper, rougher areas should be kept in permanent pasture as much as possible, and when broken up inter-tilled crops should not be grown for more than one year. On the steeper slopes, the field may be plowed in narrow bands, leaving strips of sod running at right angles to the slope. On more gentle slopes or ridgetops the cultivation may be at right angles to the slope without the sod strips. The paths of the drainage water down the slope may be left in sod, and cultivation may be carried on between these shallow sod ditches. As dairying, when properly conducted, will build up the soil rapidly by adding humus, this industry should be more extensively developed. The practice of plowing under green manuring crops, especially the legumes, should also be extended. The acid condition of the soil may be corrected by the application of ground limestone at the rate of 1,000 to 1,200 pounds per acre. It is thought that the growing of fruits, especially apples, could be profitably developed on this type of soil. Small fruits and berries should also be grown to a greater extent.

The steepest areas of this soil are used for pasture and for woodlots. The rest of the area is in cultivation. The crops grown on this phase and the general type of agriculture are essentially the same as on the typical soil.

Land values on the rolling phase of the Knox silt loam are subject to considerable variation. Taking the area as a whole they will average probably about \$50 an acre, but on the steeper slopes only about \$20 an acre.

The following table gives the average results of mechanical analyses of typical samples of the soil and subsoil of the Knox silt loam:

*Mechanical analyses of Knox silt loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
311201, 311211, 311238...	Soil.....	0.1	0.6	0.5	1.2	5.3	80.8	11.6
311202, 311212, 311239...	Subsoil.....	.0	.1	.1	.6	5.4	72.2	21.4

## KNOX FINE SAND.

The surface soil of the Knox fine sand is a light-brown or yellowish fine sand, 10 inches deep, loose and incoherent in structure, and containing only a very small percentage of organic matter. The subsoil consists of a light-brown fine sand, which becomes lighter in color with depth and grades into a yellow fine sand at from 20 inches to 3 feet. The material is loose and incoherent, and the individual grains are for the most part sharp and angular. Throughout the soil section no coarse material is found except along the margin of the terrace toward the stream course, where fine gravel occurs in small quantities, usually well distributed. The type as a whole is quite uniform, the most marked variation being found in the low places between knolls, where the surface is darker and the soil slightly loamy, owing to a higher percentage of organic matter, resulting from the decay of a luxuriant vegetation due to a high moisture content.

Owing to the loose, open structure and sandy texture of this soil it is easily cultivated, and no heavy teams or machinery are necessary.

The Knox fine sand is confined entirely to the valleys of the Black and Mississippi Rivers, where two areas are developed. One of these extends north from Onalaska to Midway and the other begins about a mile north of Midway and extends to New Amsterdam.

The surface is rolling or billowy and in a few places undulating. On account of the uneven surface and the loose, open character of the soil, drainage is excessive and, as a rule, crops suffer from lack of moisture during the growing season.

The Knox fine sand occurs as an elevated terrace along the outer margin of the valley where the Black River joins the Mississippi. The terrace has an elevation of 60 to 80 feet above the level of the flood plain, and at Onalaska and north for some distance the slope is very abrupt. Where the terrace borders the upland there is a depression which apparently marks an old channel. The irregularity of the surface of this terrace formation is doubtless due to wind action. The sand drifts freely over bare fields, resulting in considerable damage to growing crops. Sections in the knolls or dunes show stratification, and the lines are parallel with the curve of the slopes, indicating that the material has been windblown. The

material was doubtless influenced by the action of water and originally laid down by the river when the streams were higher than at present.

The original timber growth consisted of a scrubby stand of black, bur, and white oak. Some of this is still standing, but has only a low commercial value.

The Knox fine sand is considered a poor soil. Only about one-third of the type is under cultivation, and yields are so low that there is no incentive for the development of the remainder. Corn yields from 15 to 20 bushels per acre and rye from 5 to 15 bushels. Oats and clover do not thrive. Near Onalaska some peas are grown for canning. Cucumbers, melons, strawberries, potatoes, and some other truck crops are grown to a limited extent. Dairying is carried on only in a small way, owing to the scarcity of feed. The blowing sand frequently destroys all of the young corn and also does great damage to other young crops.

Rye is often sown in the fall to serve as a late pasture and also to provide grazing early in the spring. About May 15 this crop is plowed under and the field planted to corn. This practice prevents some blowing by having the ground covered in the spring, when winds are usually highest. Sand drifting may also be held in check by plowing alternate strips and keeping the remainder in grass or grain.

The content of organic matter in this soil should be increased. This may be done by applying Peat, as a portion of the type lies adjacent to such material, and where this material is not available by growing and turning under leguminous crops. Potash and phosphoric acid should also be supplied. If early truck crops are grown and forced by fertilization they may approach maturity before the dry weather comes on. Even under the most favorable conditions, however, the management of soil of this character is a difficult proposition.

The following table shows the average results of mechanical analyses of samples of the soil and subsoil of the Knox fine sand:

*Mechanical analyses of Knox fine sand.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
311213, 311233. ....	Soil.....	0.1	1.0	7.7	69.2	13.2	4.4	4.5
311214, 311234.....	Subsoil.....	.0	1.2	8.1	70.9	13.5	2.9	3.3

LA CROSSE SILT LOAM.

The surface soil of the La Crosse silt loam consists of a black silt loam to an average depth of 12 inches, having a very smooth feel and

containing a high percentage of organic matter, which imparts a loamy character to the material. The subsoil is a chocolate-brown silt loam, which grades at from 16 to 20 inches into a yellowish-brown, compact silty clay loam. Occasionally the subsoil is drab or mottled. On the higher slopes and tops of knolls the soil is lighter in color than elsewhere, often being brown or dark brown, and the texture is heavier, owing to the fact that a portion of the silty covering has been removed by erosion. Frequently in such places the subsoil is exposed over small areas. In places the dark surface soil extends to a depth of 18 to 20 inches. At West Salem sand is encountered at 3 to 4 feet.

Owing to the high percentage of organic matter present and the silty character of the soil, cultivation is comparatively easy and no difficulty is experienced in securing an excellent tilth.

The La Crosse silt loam is second in agricultural importance among the types of the county. The largest area is found in Hamilton Township. Beginning about 2 miles east of Bangor, this soil extends east along the south side of La Crosse River to a point about 2 miles southwest of West Salem, where it swings south, extending up the valley of Bostwick Creek for a distance of 6 miles. At West Salem the type is well developed, being  $1\frac{1}{2}$  miles in width. On the north side of La Crosse River the soil is found in Hoyer, McKinley, and Jordson Coulees, Adams Valley, and in a number of smaller valleys. There is an important and quite extensive tract in Lewis Valley, in the vicinity of Stevenstown. Smaller patches are found along Mormon, Halfway, and a few smaller creeks throughout the upland portion of the county.

Where typically developed, as in the vicinity of West Salem, the surface is level to undulating, and the type frequently extends up the adjoining valley slopes until it merges into the Knox silt loam of the upper slopes and ridges. A part of the type, as found in Lewis Valley and in the triangle formed by the La Crosse River and Bostwick Creek, is decidedly more sloping, and even rolling in places. Throughout almost the entire extent of this soil it borders the Knox silt loam, and on the higher slopes and the tops of knolls the two types grade into each other so gradually that the soil boundary is necessarily arbitrary. The natural drainage over the greater part of the type is good, but the level tracts would be benefited by tile drains. None of the slopes are sufficiently steep to be affected by erosion.

The La Crosse silt loam seems to be both alluvial and colluvial in origin, the greater part of it occurring on what seems to be a terrace. In the vicinity of West Salem this terrace is over a mile wide, and at a depth of 3 feet or more layers of sand are encountered in places, indicating that the material, at this point at least, is alluvial. The

terraces are distinct at a number of places, but along the border of the type which joins the Knox silt loam this soil extends up the slope for a considerable distance, and even over some fair-sized knolls. In such places the origin is probably similar to that of the Knox silt loam, though being somewhat lower it has at some time been more poorly drained, which condition favored the accumulation of organic matter in the presence of moisture resulting in the dark color characteristic of the type. Some of the slopes are partly colluvial.

The La Crosse silt loam resembles the Wabash silt loam in many respects. The color and texture of the surface soil is practically the same in both types, except that on the slopes and knolls the La Crosse silt loam is lighter in color. In many places the subsoil is very much the same, though the Wabash type is more often drab and mottled than is the case in the La Crosse soil. The La Crosse silt loam usually occupies the second terrace above the stream and some higher land, and is not subject to overflow, while much of the Wabash lies within the present flood plain or a very little above it, and is occasionally flooded over a part of its extent. In natural productiveness the types are about equal, though probably more of the Wabash silt loam is in need of drainage than the La Crosse, and for this reason there is some difference in the value of farms on the two soils.

Originally the La Crosse silt loam supported a sparse growth of oak timber, and intervening treeless areas were spoken of as "oak openings." It thus appears that a semiprairie condition prevailed. At present there is no timber on the La Crosse silt loam except the trees which have been set out about the farm buildings.

A larger proportion of this type is under cultivation than of any other in the county, and as a whole it is considered the best general farming soil. Practically all of the type can be cultivated. This type and the Wabash silt loam are the best corn soils in the county. Other crops commonly grown are oats, barley, hay, alfalfa, sugar beets, and some wheat. Corn makes an excellent growth, acquires a healthy green color, and yields from 60 to 80 bushels. While only a small quantity of wheat is grown, yields of 30 to 35 bushels are frequently obtained. The small grains do well, but the quality is not as good as that produced on the Knox silt loam of the upland. During wet years the growth of straw is likely to be so rank that lodging results. The hay crop consists of clover and timothy, yields of 1 to 2 tons per acre being secured. But little trouble is ever experienced in getting a catch of clover. When wheat is grown it is sometimes seeded with this crop, though seeding may be with oats or barley as a nurse crop. Alfalfa is grown to some extent, usually with fair success. Sugar beets are successful on this soil and yields of 15 to 20 tons per acre are secured. The sugar content is not as high as that

of beets grown on soil having a lower organic-matter content, but the tonnage is greater and the net returns show a margin in favor of the black soils of this character. Potatoes are grown for home use, yields of 150 bushels per acre being secured.

Little attempt has been made by the majority of farmers to select a crop rotation especially adapted to this type, but the one commonly followed is corn for one or two years, then small grain for about two years—or three years if wheat is grown—and then clover or clover and timothy mixed. After this the field may be pastured for a year or two before being again plowed for corn. Dairying is the most extensive type of farming followed, and the soil is well adapted to this industry. The silo is in common use. Hog raising is also carried on to a considerable extent in conjunction with dairying. Bush berries, small fruits, and strawberries are grown successfully on the higher slopes and knolls, though not to a very great extent.

The general prosperity of the farmers is indicative of the high value of the land over this type. There are, however, some changes which could be made in the practice followed which would increase the producing power of the soil and tend to bring the community to a still higher stage of development. Although very good crops are grown, owing to the high organic-matter content and the natural productiveness of the soil, an acid condition prevails over practically all of the type. This condition could be corrected by an acreage application of 1,000 to 1,200 pounds of ground limestone, which would not only increase the yields, but make possible the profitable production of a wider range of crops. With such treatment of the soil, success with alfalfa would be more certain. Most of the type is very well located with respect to transportation facilities, and it would seem that advantage should be taken of this condition in selecting the crops. Peas for canning and cabbage could be grown successfully on a much larger scale. Sugar beets could be grown more extensively, and on the high slopes and knolls the production of small fruits and berries could be extended.

Farms on this type of soil range in value from \$80 to \$125 an acre, depending on condition of the land and buildings and the location.

*La Crosse silt loam, coarse phase.*—The surface soil of the La Crosse silt loam, coarse phase, is a light-brown or grayish silt loam, extending to a depth of 10 inches and containing a higher percentage of fine and very fine sand than is found in the other silt loams of the area. The subsoil consists of a light-brown, yellowish, or sometimes chalk-colored, rather compact silt loam, somewhat heavier than the surface soil and extending to a depth of 24 to 30 inches, where a fine sand is frequently encountered. The type as a whole is variable, and

the underlying sand appears at the surface in a few small areas. The area north of Bangor, on the east side of the road, is quite sandy. In the lower valley of the La Crosse River the soil is a typical silt loam, being locally referred to as a clay, and is similar to the type mapped in Iowa County as Lintonia silt loam. The areas between Bangor and West Salem usually have sandy material at a depth of 30 to 36 inches. This soil is comparatively easy to cultivate, especially where a large quantity of fine sand is incorporated with it, and a good seed bed can be secured with a minimum amount of labor. The heavy phase is somewhat more difficult to handle, but if cultivated under proper moisture conditions little difficulty will be experienced in establishing good tilth.

The coarse phase of the La Crosse silt loam is of comparatively small extent in La Crosse County. The largest area occurs on the north side of the La Crosse River between Bangor and Neshonoc, extending up the valley of Burns Creek. Smaller patches are found farther down the valley of the La Crosse River in Mormon Coulee and in the valley of a few of the smaller creeks throughout the upland.

The type occurs as bench or terrace formations. Its surface is level to gently sloping. Toward the river there are several long, narrow ridges or bars of fine sand around which the silty material was deposited when the waters of the stream were at a higher level than at present. The type is doubtless alluvial, in part having been laid down over a sandy valley bottom. Some of the slopes, however, are colluvial. On account of the underlying sand and the gently sloping surface, the drainage of much of the type is fairly good, although some of the level tracts, where the heavier phase predominates, would be benefited by tile drains.

The original timber growth consists chiefly of oaks, with occasional small "openings," as in the case of the La Crosse silt loam.

The type constitutes a good general farming soil, and a large proportion of it is under cultivation and highly developed. In productiveness it is somewhat inferior to the La Crosse silt loam. The usual crops grown are corn, oats, barley, hay, and some wheat. Corn averages 50 bushels, oats 40 bushels, and barley 35 bushels, and hay from 1 to 2 tons per acre. The crop rotations and methods of farming followed are the same as on the La Crosse silt loam. Dairying is the leading industry.

The organic-matter content of this phase is lower than that of the La Crosse silt loam, and an effort should be made to increase this by plowing under green crops, especially legumes, and by extending the dairy industry, which will supply a larger amount of barnyard manure. The acid condition which exists over much of the type could

be corrected by the application of 1,000 to 1,200 pounds of ground limestone per acre.

Land of this type ranges in value from \$60 to \$100 an acre, depending upon location, condition of the soil, and improvements.

*La Crosse silt loam, heavy phase.*—The surface soil of the heavy phase of the La Crosse silt loam consists of a dark-brown, dark-gray, or black heavy silt loam or clay loam, extending to a depth of 12 inches. The subsoil is a brown, puttylike clay, over 3 feet in depth. The type is referred to locally as “gumbo.” The soil is heavy and is more difficult to handle than the silt loams of the survey.

Most of this phase is found in two areas, one on each side of the La Crosse River, east and southeast from Onalaska.

The material is alluvial in origin, and is developed as a terrace along the La Crosse River.

The surface is level and the natural drainage deficient.

The heavy phase more closely resembles the Wabash silt loam than any other soil in the county, and the yields given and methods suggested for that type are applicable.

#### LA CROSSE FINE SANDY LOAM.

The surface soil of the La Crosse fine sandy loam consists of a dark-brown fine sandy loam. The material is somewhat compact and has an average depth of 10 inches. The subsoil is a fine sandy loam, somewhat lighter in color than the surface soil, which grades into a yellow fine sand at 30 inches. In local areas the surface may consist of a fine sand, and the subsoil may also be a yellow fine sand over small areas. Ridges or low dunes are encountered in a few places. On account of the extremely sandy nature of the soil no difficulty is experienced in preparing a good seed bed.

In this county the La Crosse fine sandy loam, although more extensive than the Wabash loam, is of minor importance. It is confined entirely to the valleys, the whole of the type being found along the La Crosse River. It occurs directly west and east of Bangor, bordering the Meadow land on both sides of the stream for several miles. An area of some importance is located 2 miles southeast from Onalaska, lying on the Mississippi-La Crosse boundary but within the La Crosse rather than the Mississippi Valley lines.

The topography of the type is level, with the exception of a few dunes on the area southeast of Onalaska. The natural drainage is fair, except in the very low area where the type adjoins the Meadow land. In these places the water table frequently approaches the surface and the soil is flooded at times.

In origin the type is alluvial, and a considerable part of it occurs as a terrace between the Meadow land and the La Crosse silt loam and

other soils of the terraces along the La Crosse River. It has an elevation of from 4 to 10 feet above the Meadow. The areas on Brices Prairie and southeast of Onalaska are somewhat higher than this.

On the low, wet phase there were some willows, soft maple, etc., while the higher and dryer portions supported some oak.

The greater part of the type is under cultivation and produces fair returns. Truck crops, including peas, cabbage, rhubarb, sweet corn, and potatoes, are grown, especially on the areas within hauling distance of La Crosse. Yields of 200 bushels of potatoes per acre are frequently obtained, although this is above the average. On the area between Bangor and West Salem some wheat of good quality is grown. General farming is also carried on upon this soil and the tendency seems to be to extend this industry. A number of farmers southeast of Onalaska report the reduction of acreage devoted to trucking, with a concurrent development of dairying. Yields of corn and small grains are somewhat lower than on the silt loam soils. The type is deficient in organic matter, and this constituent should be supplied by the plowing under of green crops, especially legumes, and by the application of manure whenever it can be obtained. With the growth of the dairy industry, the supply of stable manure will naturally be increased and much plant food will be added to the soil. The acid condition which exists over most of the type could be corrected by the application of ground limestone.

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

*Mechanical analyses of La Crosse fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
311209, 311231.....	Soil.....	0.1	0.7	4.5	57.7	15.5	15.7	5.5
311210, 311232.....	Subsoil.....	.0	.7	4.8	62.3	15.3	12.9	4.0

LA CROSSE SANDY LOAM.

The surface soil of the La Crosse sandy loam has an average depth of 10 inches and consists of a dark-brown medium sandy loam. It is a continuation of the type mapped in the Viroqua area as Sioux sandy loam. The dark color of the soil is due to the organic matter present, which, together with the silt and clay, accounts for the loamy character of the material. The subsoil is a sandy loam having a somewhat lighter brown color than the soil and gradually becoming still

lighter in both color and texture until at 30 inches the material consists of a yellow or whitish sand. This light-colored sand is very clean, containing almost no silt or clay. In the vicinity of Bangor the texture of the soil is finer than typical.

On account of the sandy nature of the soil, it is easily cultivated and no difficulty is experienced in securing a good seed bed.

The La Crosse sandy loam occupies a total area of less than 3 square miles and is confined to the valley of La Crosse River and its tributaries. One area extends from Bangor eastward through Rockland into Monroe County and a few small areas occur north of Bangor.

In general the type is level, but near the foot of the upland slope the topography is sloping or gently rolling. The natural drainage is good and seldom excessive.

In origin the type is largely alluvial, and the greater part of it occurs as a terrace formation. Along the upper margin, where this type borders the residual sandy types, some residual material from the Potsdam sandstone is incorporated with it. Where it borders the silt types some of the silt from the higher slopes has been mixed with it. The type lies from 10 to 25 feet above the level of streams.

The original timber growth consisted chiefly of bur, black, and white oak. Most of the type has been cleared and is now under cultivation. Sand bur is common on this soil.

All of the general farm crops common to the locality are grown on the La Crosse sandy loam with fair success. Some prefer this soil to the heavier types, since it is easier to cultivate, is early, and responds readily to good treatment. Under favorable conditions corn yields 50 bushels, oats 35 bushels, barley 30 bushels, rye 22 bushels, and potatoes 150 bushels per acre. Hay does not give very satisfactory yields. Trucking has not been extensively developed, although it is carried on to some extent. There is a wide range in the relative productivity of different areas of this type, probably owing to different methods of farming. The areas along Black River are less productive than those along the La Crosse River, although the texture of the soil is essentially the same. Soils of this kind require careful management and care is necessary in maintaining the organic-matter content. If a supply of stable manure is not available, green crops, especially legumes, should be plowed under. The acid condition which exists over most of the type could be corrected by the application of ground limestone.

The trucking industry could be profitably extended and dairying should be more highly developed.

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

*Mechanical analyses of La Crosse sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
311225.....	Soil.....	0.3	9.2	27.3	38.2	3.4	14.3	7.1
311226.....	Subsoil.....	.1	11.2	30.1	36.6	4.3	12.1	5.5

SIoux SAND.

The surface soil of the Sioux sand is composed of a dark-brown, somewhat loose and incoherent, medium sand, having an average depth of 14 inches. The subsoil consists of a brown sand of medium texture, which is lighter in color than the surface soil and extends to a depth of 24 to 30 inches, where a yellow sand is often encountered. The material is loose and incoherent. The soil and subsoil of a large part of the type contains an appreciable amount of coarse material. In some small areas the type could be classed as a coarse sand. The subsoil frequently grades into coarse sand and fine gravel at 20 to 30 inches. The sand grains are rounded, and rounded pebbles frequently occur in both soil and subsoil. On Brices Prairie the texture of the type is variable, and both soil and subsoil contain gravel. At North La Crosse and on toward Onalaska and on French Island the sand is coarser than typical. In a few low places the soil is slightly loamy.

As the soil is loose and open, its cultivation requires only a light farming equipment.

The Sioux sand is confined entirely to the valley of the Mississippi River, where it occupies a terrace from 10 to 20 feet above the level of the river. The city of La Crosse is situated on a terrace of this soil. The type comprises a part of French Island. An area of 2 miles in extent lies to the southwest of Midway and another occurs in the western part of Holland Township.

The surface of the type is level, with occasional undulating or billowy areas. In a few places the remnants of higher terraces form small elevated plateaus. Old sloughs have cut through in places, leaving an irregular, uneven surface. On account of the loose, open character of the soil and subsoil, the drainage is excessive, and the type suffers from drought during a part of almost every growing season.

A large part of the Sioux sand was originally a prairie. The city of La Crosse is situated on Prairie La Crosse. French Island and

the portion of Brices Prairie occupied by this type were originally almost treeless. On some areas there was a growth of scrubby oaks.

Taken as a whole the Sioux sand is considered a poor soil. A large part of the type is under cultivation, but the farm buildings and improvements are poor and indicate a condition far from prosperous, while many houses are vacant. Some truck crops are grown near La Crosse, but owing to its coarse texture and loose, open structure, the soil is so droughty that yields are unsatisfactory. Even during favorable years corn seldom yields over 20 bushels and rye over 15 bushels per acre. Oats and hay can not be grown successfully. Most of the hay is cut from the sloughs, which also furnish pasture, the land being too wet to be cultivated. The present methods of farming do not tend to increase the productivity of the soil. Dairying is carried on to a limited extent, but as hay and corn do not yield well, the industry is not as successful as on heavier soils.

In order to improve this soil more vegetable matter should be added by plowing under green crops, especially legumes. Manure could be secured from La Crosse, to be applied to areas within hauling distance. Crops should be grown which mature early in order to avoid the droughts of late summer. Peat may be added to the soil to increase the nitrogen content, while commercial fertilizers will furnish potash and phosphoric acid. The acidity of the soil can be corrected by the application of ground limestone. Farms on this type range in value from \$8 to \$15 an acre.

The following table shows the results of mechanical analyses of samples of the soil and subsoil of the Sioux sand:

*Mechanical analyses of Sioux sand.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
311229.....	Soil.....	0.0	20.8	41.7	26.7	2.7	3.9	3.8
311230.....	Subsoil.....	.0	20.5	45.0	27.4	3.0	1.8	2.0

SIoux FINE SANDY LOAM.

The surface soil of the Sioux fine sandy loam is dark brown in color to a depth of about 10 inches. The subsoil is somewhat lighter in color than the soil, becoming yellow at about 30 inches. The type includes small areas of sand too small to map. In places the sand has been blown up into low dunes.

The Sioux fine sandy loam occurs in the Mississippi River Valley entirely, occurring as terraces lying up to 40 feet above the present

flood plain. The largest area is in the northern part of the county, but small areas occur as far south as La Crosse.

The topography is level, except when made somewhat uneven by dune building and by the slight erosion to which the terrace has been subjected.

This soil was considered by the field man as identical with the La Crosse fine sandy loam. So far as the color, texture, and general character of the soil is concerned it is yet considered essentially the same. It differs only in being a Mississippi River deposit, its material coming possibly in part from a long distance away and from a wide range of material, while the La Crosse fine sandy loam came wholly from the local material occurring in the basin of the La Crosse River. This material is the same in character as that occurring in La Crosse County. The somewhat different derivation of these materials made it necessary to separate them, although the necessity is mainly a theoretical one.

Agriculturally this soil is like the La Crosse fine sandy loam, and the reader is referred to the discussion of agriculture under that soil. Since a considerable part of the type lies close to the city of La Crosse, a larger part of the area is devoted to the growing of truck crops than is the case with the La Crosse soil. This is especially true of the area known as Brices Prairie.

#### SIoux SILT LOAM.

The soil of the Sioux silt loam was mapped and considered by the field men as the same soil as the La Crosse silt loam. It has the same texture, color, and structure, but differs slightly in topography. The Sioux silt loam occurs as a well-defined river terrace, occurring near New Amsterdam, in the valley of the Mississippi River. Its surface is level or essentially so; therefore the soil does not occur on colluvial foot slopes, which are conspicuous features in the area of the La Crosse silt loam.

There is only one area of this soil in the county, the location of which has already been given.

The material composing the type was derived largely from glaciated regions and carried to its present location by stream action. It differs in this respect from the La Crosse silt loam, which has been derived entirely from the unglaciated regions.

Agriculturally it is essentially the same as the La Crosse silt loam. The reader is referred, therefore, to the discussion of agriculture on the La Crosse silt loam.

#### SIoux GRAVELLY SANDY LOAM.

The surface soil of the Sioux gravelly sandy loam consists of a dark-brown, gritty, or sandy loam, the sand being of the coarser

grades. There is enough clay present to make the material slightly sticky when wet. The subsoil is encountered at 12 to 18 inches, and consists of fine, rounded gravel, about the size of corn kernels. This material extends to a depth of 4 to 6 feet. The gravel subsoil is uniformly developed throughout the type, and owing to its presence a droughty condition prevails during dry periods.

The Sioux gravelly sandy loam is of limited extent, occupying less than 1 square mile. The soil is encountered on Brices Prairie, about 2 miles west and a little north of Midway. The surface is level to undulating, and on account of the gravel subsoil the natural drainage is excessive.

In origin the type is alluvial. It occupies a terrace within the valley of the Mississippi River, elevated about 15 feet above the present flood plain of the river, and has been worked by currents which were swifter than those which deposited the finer material composing other soil types.

All of the type occurs as a prairie soil. During favorable years corn yields 50 to 60 bushels, oats 40 bushels, and hay about 1 or 1½ tons per acre. During dry seasons the yields are considerably lower.

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

*Mechanical analyses of Sioux gravelly sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
311240.....	Soil.....	7.2	18.9	3.7	10.1	19.6	25.5	14.7
311241.....	Subsoil.....	19.1	27.6	4.2	9.3	14.1	15.8	9.7

PLAINFIELD SANDY LOAM.

The surface soil of the Plainfield sandy loam has an average depth of 10 inches and is dark brown in color, due to the organic matter that has accumulated in it. The subsoil is a sandy loam having a somewhat lighter-brown color than the soil, becoming progressively lighter with depth to a yellow or whitish color at 30 inches. It becomes lighter in texture in the deeper subsoil, being practically a pure sand at 36 inches. In the vicinity of Burr Oak the soil is lighter in color, contains less organic matter in the surface, and is somewhat finer in texture than in the other areas. It is also rather low in fertility. In exposed places there is a tendency for the sand to drift more or less.

The type occurs only in the northern part of the county, in the valley of Black River. There are two main areas, one near Burr Oak, the other in the northern part of Holland Township.

The topography is about level; the southern borders, however, extend up the gentle colluvial foot slopes of the uplands for a short distance. The drainage is good, inclined to cause a tendency to droughtiness on account of the open subsoil.

The Plainfield sandy loam is alluvial in origin, except the narrow fringes of colluvial material adjacent to the boundaries with the other types.

The native tree growth consisted chiefly of bur, black, and white oak. Practically all of the type is cleared and in cultivation. A rather common weed is sand bur.

The Plainfield sandy loam in this area is essentially the same as the La Crosse sandy loam, the separation of the two being advisable solely on theoretical grounds. The crops and soil management of the type is therefore the same as for that type and does not need repetition here.

#### BOONE FINE SAND.

The surface soil of the Boone fine sand consists of a brown, loose, incoherent fine sand extending to an average depth of 10 inches. The subsoil is a light-brown, loose and incoherent fine sand, which becomes lighter in color with depth until at 24 to 36 inches it is a yellow or light-yellow fine sand. In some instances the underlying rock is encountered at 3 feet, although it usually lies at a depth beyond the reach of the auger, except on the steeper slopes and tops of ridges.

The soil is so loose and open that it can be cultivated without difficulty and with very light stock and tools. Owing to its low content of organic matter and its loose character the surface soil is subject to more or less wind action.

The Boone fine sand extends in broken areas entirely across the northern end of the county, where it occupies the slopes along the Black River, and frequently reaches a width of 2 miles. A small area is also found directly south of Rockland, on the county line.

The topography of most of the type varies from level to gently rolling, and a part of it occupies slopes with varying degrees of steepness, on which the underlying rock often outcrops. Where the latter condition prevails to any extent the material has been classed as Rough stony land. Here and there throughout the type are knolls and ridges, some of which reach an elevation of 100 feet above the surrounding soil. The natural drainage is excessive and the soil suffers from drought, except during seasons of excessive rainfall.

The Boone fine sand is of residual origin, having been derived from the disintegration of the Potsdam sandstone. In freshly cultivated fields considerable damage to growing crops results from the drifting of the surface material, but no recent dunes were observed.

The original timber growth consisted of scrub, bur, black, and white oak, and jack pine. A large part of the type is still in scrub timber, which has but little value.

The Boone fine sand is probably the poorest type of soil in the county, and for this reason has not been developed to any extent, probably less than half of it being under cultivation. The type as a whole is droughty. Stock is often pastured in the timbered portion, but the wild grasses do not thrive and the grazing is very poor. Clover succeeds only in a few of the low, fertile places, and even there the yields are only fair. The range in crops grown is narrow, and corn and rye seem to give the best results, though even these are not highly profitable. During the most favorable years corn may yield 20 bushels and rye from 10 to 15 bushels per acre, but during dry years and sometimes during an average season these crops fail. Oats are seldom grown with success. On a few marshy places some hay and pasture can be secured. No truck crops are planted, as there are no shipping points near by. Where the type adjoins areas of Peat this material could be profitably applied to add organic matter and nitrogen. Phosphoric acid and potash could be supplied in the form of commercial fertilizers. Legumes should be grown and plowed under. The acid condition which exists quite generally over this type could be corrected by applying ground limestone.

Land values on the Boone fine sand average about \$8 to \$10 an acre.

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

*Mechanical analyses of Boone fine sand.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
311217.....	Soil.....	0.1	4.8	16.6	55.8	8.6	9.3	4.3
311218.....	Subsoil.....	.2	4.9	17.0	58.4	8.6	6.6	4.4

BOONE FINE SANDY LOAM.

The surface soil of the Boone fine sandy loam is a brown or light-brown fine sandy loam, extending to an average depth of 8 inches and containing considerable silt, which makes the material somewhat compact in places. The subsoil consists of a light-brown fine sandy loam, becoming yellow with increased depth, and extending to about 30 inches, where a yellow fine sand is encountered. Over small areas the subsoil approaches a sandy clay, while in other places the underlying sand bed may be encountered at unusually shallow depths. Where the type borders the Boone fine sand it is lighter in texture and grades almost imperceptibly into the lighter soil, and where it borders

the Knox silt loam the soil contains a high percentage of silt. The type may be considered a gradation from the purely residual sand, on the one hand, to the purely loessial silty material on the other.

On account of its sandy nature, this soil is easily cultivated, and no difficulty is experienced in securing a good seed bed.

The most extensive development of the Boone fine sandy loam is in the northern part of the county, which it crosses in an irregular belt, overlooking the valley of the Black River and varying in width from one-fourth of a mile to 2 miles. An area of this type occurs in the eastern part of the county, in Burns Township, and another east of Bangor. A number of small patches are scattered throughout various parts of the upland country, generally occupying the lower slopes of the ridges.

The topography of most of the type is rolling to somewhat hilly, though the surface in a few localities is nearly level. It is found on the steep lower slopes of bluffs and on long gentle slopes at the ends of secondary lobes of sandstone which project downward from the higher limestone bluffs and ridges. On account of the sandy nature of the soil and its uneven topography, the natural drainage is good, and in a number of places excessive. During dry seasons practically the whole type suffers from lack of moisture. Erosion is active on a number of the slopes which are not timbered.

The Boone fine sandy loam is chiefly of residual origin, having been formed from the disintegration of the Potsdam sandstone, which it overlies throughout its extent. On the steep slopes the underlying rock is encountered at shallow depths and frequently outcrops. Where the rock outcrop is pronounced the type is classed with the Rough stony land. The silty material incorporated with the soil has undoubtedly been transported from the higher lying slopes, which are occupied by silty, loessial material.

The original timber growth consisted chiefly of white, bur, and black oak. Many of the steep slopes are still in timber, though all of the best trees have been removed.

The Boone fine sandy loam is extensively cultivated. The heavier phase is a fairly good soil and satisfactory yields are secured, but where the type approaches the Boone fine sand conditions are not so favorable and yields are lower. All of the crops common to the region are grown. During favorable seasons corn yields 30 bushels, oats and barley from 20 to 25 bushels, rye from 15 to 20 bushels, and hay about 1 ton per acre, but during dry seasons yields are often considerably lower. Except on the heavy phase, hay does not do well. Dairying is not as extensively developed as on the Knox silt loam, and as most of the type is located at a considerable distance from shipping points, truck crops are not being grown. As

a whole the soil is deficient in organic matter and requires careful management to be made productive of best results. The organic-matter content could be increased, where a sufficient supply of stable manure is not available, by the plowing under of green crops, especially legumes. An acid condition exists, which should be corrected by the application of ground limestone.

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

*Mechanical analyses of Boone fine sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
311215, 311235.....	Soil.....	0.2	5.9	13.5	54.9	5.8	14.7	5.1
311216, 311236.....	Subsoil.....	.2	6.3	14.9	54.2	5.7	13.0	5.2

WABASH SILT LOAM.

The surface soil of the Wabash silt loam is a black silt loam, having a smooth feel and containing a high percentage of organic matter. This is underlain at 14 inches by a heavy, compact silt loam subsoil. A silty clay loam is encountered at about 2 feet. In color the material may be yellow, yellowish-brown, or drab, with frequent mottlings in the deep subsoil, especially where the drainage is deficient.

Where this type is encountered at the mouth of a valley the surface soil frequently extends to a depth of 16 to 18 inches. In some localities the color of the surface soil is dark brown instead of black. Over large areas, especially where the type adjoins outcrops of sandstone, the subsoil may grade into a heavy fine sandy loam at from 26 to 30 inches.

This soil is not difficult to cultivate, especially if tilled under the proper moisture conditions. Its high organic matter content imparts a loamy character, so that it works up readily into a mellow seed bed.

The Wabash silt loam is an important soil from an agricultural standpoint. The largest area is found in the valley of Fleming Creek, in the vicinity of Mindoro. Other areas of fair size occur in the valley of Burns Creek, in Burns Township, along Bostwick Creek, in Barre Township, immediately to the northwest of Midway, and as small, narrow strips along many of the smaller streams throughout the upland region.

The type is of alluvial origin and consists largely of silt carried down from the loess-covered hills. The dark color is due to the accumulation of organic matter in the presence of moisture. It occurs

chiefly as first-bottom land, though in a few instances it occupies benches considerably above the present flood plain of the streams. The surface is level to slightly undulating and usually has a gentle slope upward from the stream, which insures fair drainage. Drainage conditions over most of the type could be improved by the installation of tile drains.

While a part of the type is subject to overflow, the danger is not great, and it is seldom that crops are severely damaged.

By far the greater part of the type is under cultivation and highly developed. It is one of the most productive soils in the county and gives good yields of all the farm crops grown upon it. It is better adapted to corn than any of the other types, with the possible exception of the La Crosse and Sioux silt loams, which it very much resembles, average yields of 60 bushels per acre being secured. Oats yield 40 to 50 bushels, barley 35 bushels, and hay 1 to 2 tons per acre. The quality of the grain produced on this type is a little below that grown on the Knox silt loam. During dry seasons the grain stands up well, but with an excess of moisture the straw is likely to lodge. Sugar beets are grown upon this type and yields of 20 tons per acre are frequently obtained. Potatoes do not do as well as on the ridge land, yielding not over 150 bushels per acre.

The rotation most commonly used consists of corn for one or two years, followed by oats or barley, or both, for one year, after which the land is seeded down and cut for hay, usually for two years. As there are but few farms composed entirely of this type, and since it is inextensive, no definite system has been worked out for this particular soil.

The Wabash silt loam often shows marked acidity, especially on the better-drained fields. Being naturally a very fertile type, it has been over-cropped on some of the well-drained areas, and this condition, together with the fact that it has a large content of organic matter, would tend to promote acidity in the dryer portions. This acid condition, however, does not materially interfere with the production of large crops, since the productivity of the type as a whole is still high. The acidity could be corrected by the application of ground limestone, after which the soil would be adapted to a wider range of crops, including alfalfa, on the best-drained fields. Farms of this type range in value from \$60 to \$100 an acre.

#### WABASH LOAM.

The surface soil of the Wabash loam is a dark-brown loam from 14 to 18 inches deep, containing varying quantities of silt, fine sand, and very fine sand. Over a greater part of the type the subsoil is a black or dark-brown silt loam. The type is subject to considerable

variation. In some places the silt is present in sufficient quantities to make the type a silt loam, while in others the fine sand predominates. On some of the higher slopes of the valleys the surface is brown in color, while in some of the low-lying areas it is black. In some of the more poorly drained areas the subsoil material is drab or slightly mottled. Lenses and beds of sand are frequently encountered. Some stony areas are found adjoining steep slopes where rushing currents have carried down rocks from the ledges above. On account of the limited extent of these variations, they could not be separated. While the type represents a condition rather than material of uniform texture, it is more nearly a loam than any other class of soil, and has, therefore, been mapped under this head. The type is of limited extent, occupying a total area of approximately 4 square miles. It occurs in the narrow valleys along the upper courses of the streams throughout the rough upland country. The most extensive developments are found along Dutch, Coon, Bostwick, and Mormon Creeks in the southern part of the county, and along Fleming Creek in the northern part. Small patches occur along a number of small streams throughout the county.

The surface of the type is level in the valley floor, with slopes extending up from the margin of the valley to the higher land of the hills. Some of the type is very low and marshy, while much of it is subject to annual overflow. With the exception of the highest margin of the slope bordering the rough stony land or the Knox silt loam, the drainage of the type is naturally poor.

In origin the Wabash loam is alluvial and colluvial. The black subsoil is undoubtedly largely of alluvial origin, the valley floors having become covered with a lighter colored material by the increase of the wash from the steep slopes after the settling of the country and the removal of much of the timber. A large quantity of this wash is composed of silt from the loessial material and some of it is sand from the exposures of the Potsdam sandstone on many of the steep slopes.

The original forest growth on this type consisted chiefly of willows and marsh grass in the lowest places and soft maple, elm, and a few oaks on the higher, better drained slopes.

On account of its poorly drained condition and the occurrence of sloughs, only a small part of this type is under cultivation. Most of it is used for pasture, and some wild hay is cut from the marshy places. Although much of the type is not arable, it is valuable for stock raising because of the good pasture it affords and the abundant supply of water from the streams. On some of the better drained margins of the type, or where the danger from overflow is not great, small areas are being cultivated and the yields obtained compare favorably with those from the Wabash silt loam. The acreage of

tillable land could be increased by the establishment of tile drainage where there is sufficient fall.

#### ROUGH STONY LAND.

Rough stony land includes steep, rocky areas and land otherwise unfit for cultivation. It may be considered nonagricultural and is of value only for the small amount of timber and grazing which it supplies. This type occupies a large part of the steep walls bordering the valleys and coulees and forms a border between the valley bottoms and the high lands of the ridges. The type is developed as narrow bands many miles in extent, winding in and out of the valleys and coves, but always confined to the steepest slopes. A part of the type occurs as narrow ridges, upon which areas of soil too small to be mapped are sometimes encountered.

The type is well distributed throughout the upland portion of the county. The rock consists of sandstone and limestone. In the southern part of the county the lower Magnesian limestone forms the surface rock and this is underlain by the Potsdam sandstone. On many of the slopes both formations outcrop. In the northern areas much of the limestone has been removed, leaving more extensive sandstone outcrops.

The timber growth on the Rough stony land consists of white oak, red oak, hickory, and a few birch and elm trees. The best of the timber has been removed and the remainder should be left to protect the slopes from washing.

Over some of the slopes there is a shallow covering of soil which is utilized for pasture. In the southern part of the county this soil consists largely of silt, with some sand from the Potsdam sandstone. In the northern part a larger proportion of the soil material is of a sandy nature.

The presence of Rough stony land reduces the value of better land and renders the fields on the ridges less accessible. It makes hauling to market difficult, as many of the roads from the valleys to the upland cross steep strips of the type.

#### PEAT.

The material classified under Peat consists of vegetable matter in varying stages of decomposition, the greater part of it being in a fibrous condition. It extends to a depth beyond the reach of the auger and is known to be 10 feet deep in places. The marshes are underlain by sand. There is only a small amount of this type in the county, and it occurs in scattered areas. The largest area is about  $1\frac{1}{2}$  square miles in extent and lies between Onalaska and Midway. The material here is very fibrous. This marsh was always treeless,

but is covered with a dense growth of marsh grass, which can be cut for hay over part of the area when it is dry enough to support a team. The southern part, next to the Black River, is so low that ditching would not benefit it greatly. Farther north, near Midway, where the elevation is a few feet higher, ditching would lower the water table and improve the condition of the marsh. The whole area is subject to overflow from the slough north of Brices Prairie.

The area 3 miles southwest of Mindoro has 1 foot of reddish material on the surface resembling bog iron ore. The subsoil below 18 to 24 inches is a bluish clay, somewhat mottled. In the marsh east of Bangor the material is quite thoroughly decomposed and is more mucky, except in a number of places where it appears to consist largely of decayed logs, which are easily penetrated by the soil auger. This material has a reddish color. A few other areas of smaller extent occur in the valley of the La Crosse River, chiefly in old sloughs.

The only use made of the Peat marshes is for cutting wild hay, but frequently it is so wet that horses can not be used without danger. In some localities the Peat could be drained and used for cultivated crops, but no extensive drainage projects have been undertaken. Land of this character is low in potash and phosphoric acid, and these elements must be added before satisfactory yields can be assured for any length of time.

#### MEADOW.

The material classified as Meadow is so variable in texture that a division into separate types would be impossible on the scale of a mile to an inch. It lies entirely within the flood plains of the Mississippi, La Crosse, and Black Rivers.

The flood plain of the Mississippi, which varies in width from 2 to 3 miles, is divided into two parts by the sandy prairie at La Crosse. That part of the Meadow south of La Crosse is mostly a grayish, mottled, sandy clay. It includes small knolls and ridges of sand, some of which are cultivated. Where the surface soil is a clay or sandy clay it extends to a depth of from 10 to 30 inches, and is underlain by a sand which grades into coarse gravel at from 3 to 6 feet. The flat knolls usually consist of a dark-brown medium to fine sand, underlain at 18 to 34 inches by a lighter colored, coarser sand.

The area west and north of French Island is somewhat similar, though superior, to that south of La Crosse. The soil here is also underlain by sand, and some areas have been cultivated during favorable seasons. The proportion of the type which has been farmed, however, is very small.

The surface of Meadow is level except for the low ridges of sand and the old channels which have been cut through it by flood waters. All of the type except the highest of the sand bars are inundated several times each year, and even the ridges are flooded when the river is extremely high. Inundation occurs both in the spring and the fall, and depends upon the precipitation about the headwaters of the Mississippi.

The material composing the Meadow type is entirely of alluvial origin, having been carried down by the streams and deposited in times of overflow. The difference in the texture of the soil is accounted for by the swiftness of the current by which it was deposited, the slower currents having permitted the finer particles to settle to the bottom, while from the more rapid currents only the coarser particles were deposited.

The timber growth consists of willows, birch, elm, soft maple, and a few scattered oaks. Some areas support only a few bushes and a growth of wild grass. Rushes and marsh grass usually cover the heavy soil, and where the grass is not cut for hay a thick growth of tall weeds occurs.

The crops grown on the sandy knolls consists of corn, rye, potatoes, a few melons, and some other truck. As a rule, the yields are not satisfactory and the danger from flooding makes farming an uncertain proposition. The only way in which the type as a whole could be developed would be by the construction of levees and the establishment of a system of drainage ditches. Even then it would be difficult to carry off excess storm water, since the land would be lower than the flood level of the river. Pumping plants could be installed to lift the drainage water over the levees, but this would be an expensive undertaking and would not be profitable except under a very intensive system of cultivation.

#### RIVERWASH.

The material mapped as Riverwash consists of white or grayish sand of medium to fine texture, more than 3 feet in depth.

This type is found along the La Crosse River in three areas between La Crosse and West Salem. It is of recent alluvial origin, and is being added to or moved about by high waters from year to year. The topography is level, with numerous ditches cut by flood waters. The type lies at about the same level as Meadow, and is naturally poorly drained, although during dry seasons the water in the stream is low and the soil dries out so that the surface will drift where not covered with vegetation.

On the area nearest West Salem fair crops of corn are frequently grown. Only a small proportion of the type is cultivated, however, and its agricultural value is very low.

## SUMMARY.

La Crosse County is located in the western part of Wisconsin, and comprises an area of 481 square miles, or 307,840 acres. It may be divided broadly into two divisions, the valleys and the uplands. The Mississippi River borders the county on the west; the La Crosse River traverses it from east to west, and the Black River forms a part of the north and northwestern boundary. Along all of these rivers there are valleys, varying in width from 1 to 5 miles, within which distinctly formed terraces are developed, the highest being about 70 feet above the Mississippi River. The topography of the valleys is level to undulating, the highest terraces having a rolling surface due to wind action. The upland country consists of a series of ridges with an elevation of 200 to 500 feet above the streams which traverse the region. The slopes are usually steep and rocky. On the ridge tops and gentle slopes are found the most extensive areas of highly developed soil in the area.

La Crosse, the county seat, is situated on a sand flat in the valley of the Mississippi River at an elevation of 681 feet above the valley floor.

Farming operations were begun in 1844. The county attained its present limits in 1857. It is traversed by three railroad systems and one short-line railway, and these, together with the opportunity for shipping afforded by the river, afford excellent transportation facilities. La Crosse is 137 miles from Minneapolis and 283 miles from Chicago.

The mean annual temperature at La Crosse is 46° and the precipitation is 30.9 inches. The rainfall is well distributed. The average length of the growing season free from killing frosts is about 142 days.

Over the greater part of the county agriculture is well developed, and the well-kept farmsteads indicate the general prosperity of the farmers. The leading type of agriculture is general farming, with dairying as the main feature. The crops most extensively grown, in the order of their acreage, are hay, oats, corn, barley, rye, wheat, and potatoes. In addition to these, some alfalfa, sugar beets, peas, and truck crops are grown. Small fruits and berries are successfully produced to a small extent, but apple culture has not been developed commercially. There are only a few orchards in the area. It is recognized that the silty upland soils produce a better quality of grain, though smaller yields, than the dark-colored soils of the river terraces, the grain plants being likely to lodge on the latter soils, especially in wet years. These soils are better adapted to corn than any of the upland types. The most common rotation followed consists of corn, followed by a small-grain crop, such as oats, barley, wheat, or rye, for one, two, or sometimes three years, when the field is seeded

to clover and timothy, to be cut for hay for two years, after which it is again plowed for corn. The steep slopes afford excellent pasture and are usually kept in grass to prevent erosion. Trucking could be more extensively developed and dairying could be profitably enlarged. Alfalfa should be tried by all dairy farmers, and such crops as sugar beets, cabbage, peas, for canning, and cucumbers, for pickling, should be grown to a greater extent where conditions are favorable.

La Crosse County lies within the unglaciated portion of the State and the soils have been derived from the mantle of loess which covers a large part of the area, from the disintegration of the underlying rocks and from the material washed down from the slopes, transported by the rivers, and deposited as terrace formations.

Including Rough stony land, Riverwash, Peat, and Meadow, 18 types of soil have been recognized and mapped in the county.

The Knox silt loam, with its rolling phase, is the most extensive type and is found throughout the upland portion of the county, occupying the tops of hills and ridges and extending down the slopes. It is a good general farming soil and dairying is carried on quite extensively. It produces a better quality of grain than any of the other types in the area.

A second type in this series, the Knox fine sand, was also mapped. It occurs as a high terrace along the Mississippi River and the surface has been influenced by wind action. It is considered a poor soil agriculturally.

The La Crosse series is found chiefly on the terraces along La Crosse River. The heavier types are brown to dark-brown or black in color, very productive, and highly developed. The sandy types are somewhat lighter colored but constitute good farming soils. Three types in this series, the silt loam, sandy loam, and fine sandy loam, were mapped.

The Sioux series includes dark-colored terraces in the Mississippi Valley where the material was derived partly from glacial regions to the north. The types mapped were the silt loam, fine sandy loam, sand, and gravelly sandy loam. Agriculturally the fine sandy loam and silt loam types are similar to these members of the La Crosse series. As a whole the Sioux sand is considered a poor soil.

The Plainfield series includes light-colored terrace material derived chiefly from Potsdam sandstone and transported and deposited by streams. One type, the sandy loam, was recognized and mapped. The crops and soil management of this type are the same as for the La Crosse sandy loam.

The Boone series is derived from the disintegrating of the Potsdam sandstone in place and the soils are not very productive. Two types, the fine sand and the fine sandy loam, were mapped.

The Wabash series consists of alluvial material and occurs as narrow, low-lying strips chiefly along the streams which traverse the upland region. The soils are black or dark brown, and when drained are very productive. Two types, the loam and the silt loam, are mapped.

Rough stony land includes the steep, rocky slopes throughout the upland portion of the area, which are generally nonagricultural. Its chief value lies in the pasture which it affords and the timber which is found upon it.

Meadow consists of the low-lying land within the present flood plain of the Mississippi, Black, and La Crosse Rivers. It is subject to overflow, very poorly drained, undeveloped, and so complicated that no separation into types could be made on the scale used.

Peat includes the partially decomposed vegetable matter which occupies low, poorly drained areas, chiefly along streams. This material is very limited in extent and of but little importance in La Crosse County.

Riverwash consists of the sandy material which is flooded each year and moved about somewhat by each high water. Areas of this material are inextensive and of little value for cultivated crops.



[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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