

Issued October 23, 1915.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

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

SOIL SURVEY OF BUFFALO COUNTY,
WISCONSIN.

BY

W. J. GEIB, CLARENCE LOUNSBURY, AND L. CANTRELL, OF
THE U. S. DEPARTMENT OF AGRICULTURE, AND T. J. DUNNEWALD
AND O. J. NOER, OF THE WISCONSIN GEOLOGICAL
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W. E. McLENDON, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1913.]



WASHINGTON:
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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., April 10, 1915.

SIR: In the extension of the soil survey in the State of Wisconsin a survey was made of Buffalo County during the field season of 1913. This work was done in cooperation with the State of Wisconsin and the selection of the 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 1913, as provided by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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FIGURE.

Fig. 1. Sketch map showing location of the Buffalo County area, Wisconsin.. Page. 5

MAP.

Soil map, Buffalo County sheet, Wisconsin.

SOIL SURVEY OF BUFFALO COUNTY, WISCONSIN.

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

DESCRIPTION OF THE AREA.

Buffalo County, Wis., borders the Minnesota State line about midway between the south State line and Lake Superior. It is bounded on the north by Pepin and Eau Claire Counties and on the east by Trempealeau County, the southern part of the eastern boundary line following the Trempealeau River. The south boundary line runs in a southeast and northwest direction, and the county is separated from Wabasha and Winona Counties, Minn., by the Mississippi River. The northwestern part of the county is separated from Pepin County by the Chippewa River. The county is about 27 miles wide in the northern part and gradually tapers to a point at the southern extremity. It is about $38\frac{1}{2}$ miles long, and has an area of 687 square miles, or 439,680 acres.

Topographically, Buffalo County consists of two plains, a lower and a higher. The latter covers nine-tenths or more of the total area of the county, the former occurring only in the northeastern part as belts of lowland, one of them being followed by Buffalo River to Mondovi and continuing in about the same direction northwestward to the county line and beyond, and another, followed by Elk Creek. These are connected by a belt along Buffalo River south of Mondovi. This is a rolling and undulating plain lying about 300 feet below the level (1,100 feet) of the higher plain. It is the extreme western part of an extensive plain lying to the east, and has been formed on a soft sandstone of Paleozoic age. It is bounded by an escarpment terminating in a rather abrupt slope from the higher plain. The two branches of the lower plain are separated by an outlying remnant of the upper plain. The lower plain is the product of erosion in an advanced stage of development, and lies now at low relief.



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

The topography of the upper plain is hilly, due to complete dissection, and it now stands in a stage of maturity. The watershed ridges are narrow, the slopes are moderately steep to steep, and all permanent streams have reached grade level and have developed flood plains corresponding in width to the size of the streams.

With the exception of the flood plains of the largest streams, the county is naturally well drained. The drainage of the entire area is into the Mississippi River. The Chippewa River, which forms the western boundary for a distance of about 13 miles, just before joining the Mississippi, receives the drainage from the northwestern corner of the county. Buffalo River, the largest stream, traverses the county in a southwesterly direction to the Mississippi River, which it joins near Alma. The Buffalo River receives the waters of a number of tributary streams and drains all the northeastern part of the county in the vicinity of Mondovi and Gilmanton and in addition a strip of country reaching through the central part of the county to Alma. Big Waumandee Creek with its tributaries drains most of the southern part of the county, and a narrow strip of country in the extreme southeastern part is drained into the Trempealeau River.

The first permanent settlements in the territory now included in Buffalo County were made between 1845 and 1850. A land office was opened at La Crosse in 1852 and much public land was soon afterwards taken up within this region. By 1855 the population had grown to 832. The open valley land was occupied first in preference to the forested regions. Most of the early settlers were Americans, chiefly from the Eastern States. Later, however, large numbers of alien immigrants took up land. Frequently people of each of the nationalities represented would form a community, and thus at the present time there are sections in which the population consists largely of some one nationality. Fountain City, Alma, and the southern part of Nelson Township are largely inhabited by people of German descent; the townships of Waumandee, Montana, Milton, and Belvidere by Scotch and Irish, and Dover, Modena, Naples, and part of Nelson Townships by Norwegians. The population of Gilmanton and Modena, and of other parts of the county, is largely American. In some communities all these nationalities are represented. According to the census of 1910, the population of Buffalo County is 16,006. The rural population is evenly distributed through the county.

Alma, with a population of 1,011, is the county seat. It is situated on the Mississippi River and has the advantage of both railroad and water transportation. Fountain City, with a population of 1,031, is also on the Mississippi River in the southern part of the county. Mondovi, with a population of 1,325, is the largest incorporated town in the county. It is situated on the Buffalo River, in the north-

eastern part of the county, and is the center of a prosperous agricultural community. Nelson and Cochrane are smaller places on the railroad, while Gilmanton, Montana and Waumandee are small villages off the railroads.

All the railway lines thus far built have kept to the valleys. There are thus considerable areas which are at some distance from shipping points. The Chicago, Burlington & Quincy Railroad, running from Chicago to Minneapolis and St. Paul, traverses the county, following close to the Mississippi River and passing through Fountain City, Cochrane, Alma, and Nelson. The Chicago, St. Paul, Minneapolis & Omaha Railway from Fairchild reaches into the northeastern corner of the county and terminates at Mondovi. A branch of the Chicago, Milwaukee & St. Paul Railway follows the Chippewa River to the Mississippi on the Buffalo County side, but is of little service to the county, since for most of its extent it lies within the flood plain of the Chippewa River, and is very difficult to reach. The extreme southern end of the county is crossed by a branch of the Chicago & North Western and also by the Green Bay & Western Railroad. The distance from Alma to Minneapolis over the Chicago, Burlington & Quincy Railroad is 89 miles and to Chicago 353 miles. From Mondovi to Chicago over the North Western line the distance is 327 miles, and to Milwaukee 246 miles. The Mississippi River affords water transportation, but at present is used to a comparatively small extent.

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. Throughout sandy portions of the county, where foreign material has not been applied, the roads are naturally sandy. All parts of the county are supplied with rural mail-delivery service, and telephones are common throughout the country districts.

Local towns provide a market for varying quantities of farm produce and supply shipping points from which produce is shipped to outside markets. Winona, Minn., just across the Mississippi River, constitutes a market for produce from the southern part of the county. Minneapolis, St. Paul, Chicago, and cities within the State receive produce from Buffalo County.

CLIMATE.

Buffalo County lies partly within the Mississippi Valley and partly within the Southern Highlands, which are recognized as forming two of the eight climatic provinces in Wisconsin.¹ The Mississippi Valley

¹ Bul. No. 223, Wis. Agr. Expt. Sta., The Climate of Wisconsin and Its Relation to Agriculture.

is a rather deep depression, the warm influence of the lower altitude being apparent from Dubuque, Iowa, as far north as Grantsburg, Wis. This narrow valley is much cooler and has drier winters than the Lake Michigan shore. The mean summer temperature averages about 78° F., and is similar to that of New Jersey, southeastern Pennsylvania, Ohio, or southern California. The mean winter temperature in the northern part of this valley resembles that of northern Vermont, northern Michigan, or eastern Montana. On an average of seven days during the winter the thermometer drops to -10° F. or lower, while during summer afternoons a temperature of 95° may be expected. The growing season in this valley ranges from 150 to 175 days, about the same duration as that of the Hudson River Valley, nearly all of Ohio, the northern half of Illinois, western Kansas, or the Columbia River Valley.

The Southern Highlands includes the rough and rolling region, generally over 1,000 feet in elevation, extending from Clark County south to the Illinois line, and lying between the Mississippi Valley on the west and the Wisconsin and Rock River Valleys on the east. It is characterized by a cooler temperature than the adjoining valleys, the summer temperature (66° to 69° F.) being similar to that along the Michigan shore, while the mean winter temperature is only 2° higher than along the Superior shore. The growing season, averaging 145 days, is apparently 20 to 30 days shorter than on the lower lands of the State in the same latitude, while in the river valleys and ravines in this section the frost danger is still greater.

The first of the following tables gives the mean monthly and annual temperature and precipitation at Wabasha, Minn., and at Whitehall, Wis. Wabasha is situated just across the Mississippi River from Buffalo County, and Whitehall is located in Trempealeau County, which borders Buffalo County on the east.

The station at Wabasha has an elevation of 681 feet above sea level and the station at Whitehall is 675 feet above sea level, so that these records indicate the weather conditions of the Mississippi Valley and the Trempealeau River Valley rather than of the whole region surveyed. The greater part of the county is from 200 to 400 feet higher than the river valleys, and varies somewhat in the length of growing season, as indicated above.

The second table gives the normal monthly, seasonal, and annual temperature and precipitation and the average dates of first and last killing frosts at Eau Claire, about 14 miles north of the north county line. This station has an elevation of 800 feet. A comparison with the tables from the other points mentioned may be of interest.

Normal monthly and annual temperature and precipitation at Wabasha, Minn., and Whitehall, Wis.

Month.	Wabasha, Minn., 14 years.		Whitehall, Wis., 17 years.	
	Tempera- ture.	Precipita- tion.	Tempera- ture.	Precipita- tion.
	°F.	Inches.	°F.	Inches.
December.....	20.2	1.12	18.8	1.34
January.....	14.4	.99	14.1	.84
February.....	16.7	.95	14.2	.96
March.....	30.5	1.77	30.5	1.58
April.....	47.5	2.52	46.2	2.41
May.....	59.3	4.28	57.0	4.06
June.....	67.8	4.12	66.2	4.30
July.....	72.3	3.54	70.2	3.45
August.....	70.0	3.43	68.3	3.63
September.....	62.4	3.56	61.6	3.80
October.....	49.7	2.84	49.2	2.46
November.....	33.1	1.56	33.9	1.39
Annual.....	45.3	30.68	44.2	30.22

Normal monthly, seasonal, and annual temperature and precipitation at Eau Claire, Eau Claire County.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December.....	18.7	54	-28	1.48	0.27	0.84
January.....	13.1	54	-34	1.00	0.32	0.32
February.....	14.3	59	-40	1.28	2.26	0.87
Winter.....	15.4			3.76	2.85	2.03
March.....	28.7	75	-18	2.04	2.85	2.10
April.....	45.6	88	11	2.58	2.22	3.72
May.....	57.0	94	20	4.37	1.96	7.03
Spring.....	43.8			8.99	7.03	12.85
June.....	66.8	97	25	4.66	1.50	2.44
July.....	70.7	103	41	3.47	1.27	8.78
August.....	69.2	98	36	3.26	0.23	5.09
Summer.....	68.9			11.39	3.00	16.31
September.....	61.1	99	20	3.93	0.77	9.12
October.....	48.6	86	10	3.22	5.13	1.99
November.....	32.1	72	-15	1.67	1.79	0.65
Fall.....	47.3			8.82	7.69	11.76
Year.....	43.9	103	-40	32.96	20.57	42.95

Average date of first killing frost in autumn, October 1; of last in spring, May 10.

The extremes in temperature show a wide range. The highest ever recorded was at Wabasha, where 105° F. was reached, while the lowest was at Whitehall, where a temperature of -46° F. was once recorded. Such extremes are very rare, however, and of short duration.

The average date of the last killing frost in the spring at Wabasha is May 1 and at Whitehall May 6. The average date of the first killing frost in fall at Wabasha is October 5 and at Whitehall October 4. This gives an average growing season at these two stations of approximately 150 to 155 days. On the higher elevations and in small valleys and ravines the season is somewhat shorter than at the stations where the records were taken. It is very seldom, however, that corn is damaged by early frosts, even where the growing season is the shortest. At Eau Claire the growing season appears to be a few days shorter than at the other two stations. The records from these three stations may be considered as representing fairly well the respective portions of Buffalo County having about the same elevations as the stations.

Good water is available in nearly all parts of the county, though on the higher ridges it is often necessary to drill to considerable depth. While there is overflow land along the larger streams, swamps are rare and healthful atmospheric conditions prevail throughout the region.

AGRICULTURE.

Agriculture in Buffalo County dates back to the first settlements of this region, which were made between 1845 and 1850. As was the case in other parts of Wisconsin, the production of grain early became the chief branch of farming, and for a considerable time wheat was grown more extensively than all other grains combined. As late as 1885 wheat still constituted about 50 per cent of the grain produced, while oats made up about 27 per cent and corn about 16 per cent. The history of grain growing in this region is similar to that of other parts of the State. Fields were cropped to grain continuously for such a long period that the productiveness of the soil was gradually reduced, and when the prices began to decline and insect pests became troublesome the crop was not very profitable. During the last 25 or 30 years there has been a gradual falling off in the production of wheat, and in 1910 the total acreage for the county was only 4,575 acres. With the decline in wheat growing there has been an increase in the production of oats, hay, and corn, and the system of farming which is followed at present is a much better one than that practiced a half century ago.

The present agriculture consists of general farming, with dairying as the most important and highly specialized branch, and the tendency throughout the county is toward a still greater development of dairy farming. With this industry are coming better methods

of farming, improved grades of live stock, and a greater interest in all lines of agricultural development.

The general farm crops most extensively grown, in the order of their acreage, are oats, hay, corn, barley, rye, and wheat.

Oats are grown more extensively than any other crop in the county, and in 1909, according to the census reports, 1,377,555 bushels were produced from 46,304 acres, or about 30 bushels to the acre. Part of the crop is marketed through elevators at Fountain City, Alma, Mondovi, and Winona, Minn., but the greater part is fed to stock on the farms. Oats form the bulk of the grain fed to horses and are ground as part of the ration for feeding cattle and hogs. The crop is grown mainly on the Union silt loam and the Boone silt loam. It is grown quite extensively also on the Lintonia silt loam, Boone fine sandy loam, Bates silt loam, and La Crosse silt loam, on all of which good yields are obtained. On the more sandy types yields are considerably lower. The quality of all small grains is best where grown on light-colored soils, and the Union silt loam and Boone silt loam are considered to be the best small-grain soils in the county. On dark soils the growth of straw is apt to be too rank and the plants frequently lodge. Also, the grain is slightly inferior in quality, and is lighter in weight than that grown on the lighter-colored silt loam types.

Hay is the second crop in importance. In 1909 hay was cut from 40,709 acres, producing 75,059 tons, or an average of about $1\frac{1}{4}$ tons per acre. Clover and timothy constitute the greater part of the hay grown. There is a considerably greater acreage devoted to timothy alone than to clover alone. Much wild hay is cut from areas of Peat and Meadow and some from wet areas of Wabash loam. There are a few fields of alfalfa in the county, but this crop is grown only to a very small extent at present.

Corn ranks third in acreage. From 25,043 acres in 1909 a yield of 838,441 bushels was obtained, or an average of over 33 bushels per acre. The La Crosse and Bates silt loams are the best corn soils in the county and on these types yields of 50 to 60 or even 70 bushels per acre are obtained under favorable conditions, and the average is always considerably above the average for the county. A large quantity of corn is cut and put into the silo each year, and the quantity is gradually increasing as the dairy industry develops. Practically all of the corn allowed to mature is fed to hogs or other stock on the farms where it is produced, and comparatively little is sold. Dent varieties are grown most extensively, and improvement is being made through the use of more carefully selected seed.

Barley ranks fourth in acreage, 24,911 acres in 1909 giving 632,422 bushels, or an average yield of slightly over 25 bushels per acre. Barley is grown on most of the soils of the county, except the ex-

tremely sandy types. It appears to do better than oats on sandy and fine sandy loam soils. The acreage on the Union silt loam has been decreasing more rapidly than on some of the other types, probably because of the growth of the dairy industry on this type. As in the case of oats, grain of the best quality is produced on light-colored soils.

Rye is one of the most important crops on the light-textured soils of the county, though it is grown to some extent on practically all of the cultivated types. The acreage in 1909 was 4,663 acres and the production 67,511 bushels, or slightly over 14 bushels per acre. This crop is better adapted to sandy soils than the other grains grown in the county.

In 1909 wheat was grown on 4,575 acres, with a production of 88,302 bushels, or about 19 bushels per acre. The crop is grown mainly on the Union, Boone, Lintonia, and Bates silt loams. Some of the fine sandy loams also are used for the production of wheat. The Union and Boone silt loams produce a very good quality of wheat, as well as of other small grains.

Potatoes are not grown on a commercial scale, except in a few instances. The potato patch seldom covers more than an acre or two. According to the census, 1,423 acres were devoted to the crop in 1909, producing 177,849 bushels, or about 125 bushels per acre. In favorable seasons yields of 250 bushels an acre are obtained from fields which have received special attention.

In the vicinity of Alma and Fountain City small fruits and grapes are grown successfully, and the trucking industry has been developed to a small extent. In the southern part of the county about Marshall and also in the northeastern part about Mondovi there is a little trucking carried on, and it would seem that this industry might be profitably extended. Peas and beans are not extensively grown, but cucumbers, chiefly for pickling, are grown in various parts of the county, Alma and Fountain City having pickling stations. Raspberries, currants, strawberries, etc., do very well. Many farmers have small apple orchards from which fruit of good quality is usually obtained, but apples are not grown on a commercial scale. There are a large number of excellent orchard sites throughout the county, the climatic conditions are favorable, and it would seem that apple growing might well be developed on a commercial scale.

In 1913 there were 17 cheese factories and 10 creameries in Buffalo County, and the output of dairy products is gradually increasing. Dairying is carried on in all parts of the county, but is most highly developed on the silt loam and fine sandy loam soils. Considering the county as a whole, dairying is probably better adapted to the Union and Boone silt loams than to any other type. These types are excellent grain, grass, and clover soils, fair corn soils, and have

associated with them considerable steep land and Rough stony land which provide an abundance of excellent pasturage.

Most of the dairy herds in the county are made up of grade animals, with occasional herds of purebred Holstein, Guernsey, and Jersey. The use of purebred sires is gradually bringing the dairy stock of the county to a higher standard. Beef cattle are raised to some extent. Among the beef breeds the Shorthorn and Aberdeen Angus are represented most largely. There is some Hereford blood in the county also, and the number of all purebred animals is gradually increasing, though most of the beef cattle are grade stock. A considerable number of calves and young stock are shipped out of the county each year.

On the dark, level soils of the valley corn is grown more extensively than in the upland regions, and therefore in these sections hog raising is carried on to a greater extent than elsewhere, though some hogs are raised in all parts of the county in connection with dairying. More hogs and other stock are raised in the Waumandee Valley and in the vicinity of Mondovi than in other portions of the county.

There are more horses raised in Buffalo County than in any other section of the State, and purebred Percheron, Morgan, Clydesdale, and Belgian horses are to be seen throughout the county. Most farmers raise their own work stock, and many plan to have a heavy draft team to sell every few years. There are a few farmers who make a business of raising horses.

Sheep raising is carried on to some extent, and there are a number of farmers raising purebred sheep in various parts of the county.

The adaptation of soils to crops is recognized to some extent. The dark La Crosse and Bates soils are known to be better corn soils than the lighter colored types, and the Union and Boone silt loams are held better adapted to small grains than are the dark soils. Rye and buckwheat are confined principally to the sandy types of soils, because experience has shown that these soils can be used profitably for this crop.

While crop rotations vary on the different soils throughout the county, probably the most common rotation consists of corn followed by a small grain, such as oats, barley, rye, or wheat one year, or possibly two years, and then seeded to timothy and clover. Hay is usually cut for two years. Very often the hay field is not pastured, since there is a large area of rough land on most farms which is devoted largely to grazing. On the sandy soils the ordinary rotation is somewhat different, and may consist of one year corn, followed by one year rye seeded to clover, followed by corn. On some farms but little thought is given to the selection of crop rotations best suited to the conditions, but more attention is each year being given to such mat-

ters, with the result that farm methods are gradually improving and yields increasing.

Stable manure is about the only fertilizer generally used at present within the county. Some green manuring is practiced, but it is not at all common, and commercial fertilizers are seldom used, except in a small way for special purposes. The methods of cultivation followed by the majority of the farmers are thorough, and agriculture is highly developed in nearly all parts of the county. The Waumandee Valley is considered to be one of the richest sections of the county, chiefly because of the rather extensive areas of level, black silt loam which are to be found there. On the Bates silt loam and fine sandy loam, as well as on the Union, Boone, and Lintonia silt loams, very fine farms are to be found. Special methods of cultivation are frequently required in this county, because of the danger of erosion on the steep hillsides. These special methods of hillside cultivation are covered under the discussion of the various soil types to which they refer.

Of the weed pests which are found in Buffalo County the Canada thistle and quack grass are probably the most troublesome.

Farm improvements vary with the character of the soil, but as by far the greater proportion of the soil in the county is productive most of the farms are well improved, and the buildings are substantial and kept in good repair. The best farms and buildings are found on the Union, Boone, La Crosse, and Lintonia silt loams, and on the Bates silt loam and fine sandy loam. On the extremely sandy soils the poor quality of the soil is reflected in the buildings, fences, crops, and farm machinery.

Obtaining farm labor is sometimes difficult, and on account of this condition the systems of agriculture followed are often more extensive than would otherwise be the case. In many instances all of the work is done by the farmer and his family. When a man is hired for the entire year the monthly wage is about \$25, with board and washing free. When employed only for the summer or the growing season or for haying and harvesting the wage is higher. When married men are employed, a house, fuel, and garden patch are often supplied in addition to the regular wage.

According to the census of 1910, 92.8 per cent of the land in Buffalo County is in farms, and of this 49 per cent is classed as improved. The average size of farms is given as 189 acres and the average amount of improved land on each farm is 92 acres. Eighty-one per cent of the farms are operated by their owners, and considerably over half of these are free from mortgage debt. In most cases where land is rented, cash rather than share payments are made.

During the period from 1900 to 1910 the value of lands in Buffalo County increased 67.7 per cent. Values vary greatly, depending upon the soil, location, improvements, etc. The best farms in the

county have a selling value of \$100 to \$150 an acre. The poorest farms, on the extremely sandy soils, could probably be bought for \$10 to \$15 an acre. Farms on the La Crosse silt loam, Bates silt loam, Bates fine sandy loam, Union silt loam, and Lintonia silt loam have a higher value than those on other types. These are recognized as the best soils of the county. The Boone and Union silt loams are the most extensive types, but some of the others mentioned, while of small area, are highly improved. In Waumandee Valley, for example, farms on the La Crosse silt loam are as highly developed as, or possibly more highly developed than, those in any other section, and Waumandee Valley is considered one of the richest agricultural sections of the county.

In general, it may be said that the methods of farming and agricultural practices followed in the county are fairly well adapted to the existing conditions.

SOILS.

Buffalo County lies in the unglaciated part of Wisconsin and in its geologic formations, topography, and soil conditions is representative of a very large area in the southwestern part of the State. Three general physiographic divisions are easily recognizable: (1) The uplands proper, which are gently undulating to strongly rolling and in places even steep and rough in topography; (2) the terraces and level valley areas occurring in the position of terraces; and (3) the overflow plains of the present streams.

The soils in the last two divisions have been derived to a very large extent, if not wholly, from the soils of the first division and represent wash material transported by the streams and deposited in their flood plains. The materials of the first bottoms are of recent deposition and the process is still going on; but those in the terraces are much older, some probably dating back to glacial time or before, with the result that through weathering the surface has come to be more like that of the uplands than that of the first bottoms.

The upland soils are predominantly silty, as is the case throughout the unglaciated area of the State. The great extent of silty soils has led some to believe that a blanket of loess originally overspread most of the region and that the soils are derived for the most part from this deposit and are not residual from the underlying formations which in an undecomposed state are now usually found at a depth of less than 15 feet from the surface and outcrop in many places. The silty material is of a rather smooth texture and comparatively free from stone or other coarse material, but it is just such material as would be expected to result from the mature weathering of the country rock, consisting of fine and cherty limestones, shales, and sandstones. It is noticeable that where limestone is the underlying rock the soils

are uniformly silty and the subsoils are a compact silty clay loam, whereas in those underlain by sandstone and shale the texture of the soil mantle varies directly with the rocks over which it lies, being distinctly silty over the shales and thin-bedded, fine-grained sandstones and sandy over the massive phases of the sandstone, and that, unlike the conditions in areas over limestone, the subsoils are not any heavier and in places are lighter in texture than the surface soils.

Over a large part of the county the uppermost rock consists of the lower Magnesian limestone. Once the limestone was continuous as the surface formation, but as the result of erosion which has deeply dissected and worn away much of the old plain, it is now found only as remnants capping the higher hills and ridges and giving way in all the lower levels to the Potsdam sandstone, the immediately underlying formation. The limestone and a massive phase of the Potsdam sandstone outcrop along the upper slopes and give rise to steep stony slopes and cliffs. At lower levels the principal rock is a thin-bedded sandy shale or shaly sandstone with occasional layers of a heavier shale.

In the upland group of soils three series of soils are recognized. The areas underlain by limestone, characterized in general by a brownish-gray to brown silty soil underlain by a yellowish-brown or buff-colored silty clay loam subsoil, are classed in the Union series. The sandstone and shale soils vary in color from grayish and light brown in areas originally supporting a medium or heavy growth of timber to dark brown and black in areas that existed in a prairie or semiprairie condition. The light-colored soils, which are by far the most extensive, have been classed in the Boone series and those that are distinctly dark in color in the Bates series. The brown silt loam with a steep phase is the only member of the Union series mapped, and is one of the most extensive and highly prized soils in the county. The Boone series includes a silt loam, which is an extensive and valuable soil, a fine sandy loam, and a fine sand. The Bates series, of which the area is small, includes a silt loam and a fine sandy loam.

Distinct terraces are developed in the Mississippi Valley and also in the larger tributary valleys. The terraces in tributary valleys are occupied largely by soils which are predominantly silty, with comparatively little sand, while in the Mississippi Valley the greater part of the material outside of the present flood plain is of a sandy nature. This terrace material is classed with three series—the La Crosse, which is black or dark brown; the Lintonia, which is light colored and not underlain by gravel or other coarse material; and the Plainfield, which is light colored and rests upon a substratum of sand and gravel. In the La Crosse series four types are mapped, the La Crosse silt loam, fine sandy loam, fine sand, and gravelly sandy loam. In the Lin-

tonia series three types are recognized, the Lintonia silt loam, fine sandy loam, and fine sand, and in the Plainfield series two types, the sand and the fine sandy loam.

In many of the valleys tributary to the Mississippi Valley the present flood plain consists of a dark-colored material, variable in texture and color, and poorly drained. This material has been carried down from the unglaciated higher lands, transported by streams, and redeposited. Such material is classed with the Wabash series, and in the present survey one type, the Wabash loam, is recognized and mapped.

On the steep slopes throughout the upland part of the county there are extensive tracts where the outcrops of rock are so numerous or the surface so steep and broken that the land is of no agricultural value except for the little pasturage it affords. Such land has been classed as Rough stony land and may be considered as nonagricultural.

Through the present flood plain of the Mississippi, Chippewa, and part of the Trempealeau River Valleys, and in some of the tributary stream valleys, there are extensive tracts of land which are subject to overflow at least once each year. The soil in these places is so variable that on the scale of the present map the soils of different texture can not be separated. Such material is classed as Meadow. The land is too wet to be cultivated, except in a few places, and can not well be reclaimed except by expensive diking.

A few low-lying areas occur in which the material consists of vegetable matter in various stages of decomposition. Such tracts are mapped as Peat.

The following table gives the name and the actual and relative extent of each of the soils mapped in Buffalo County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Boone silt loam.....	41,920	31.3	Boone fine sand.....	6,656	1.5
Rolling phase.....	95,744		Peat.....	6,400	1.5
Union silt loam.....	62,836	16.3	La Crosse fine sandy loam.....	4,096	.9
Steep phase.....	9,472		Lintonia fine sandy loam.....	3,904	.9
Rough stony land.....	62,912	14.3	La Crosse fine sand.....	3,776	.9
Wabash loam.....	36,480	8.3	Plainfield sand.....	3,776	.9
Meadow.....	31,872	7.3	Plainfield fine sandy loam.....	1,984	.5
Boone fine sandy loam.....	27,200	6.7	Bates fine sandy loam.....	1,344	.3
Rolling phase.....	1,984		La Crosse gravelly sandy loam.....	1,088	.2
La Crosse silt loam.....	19,520	4.4	Lintonia fine sand.....	640	.1
Lintonia silt loam.....	9,408	2.1			
Bates silt loam.....	7,168	1.6	Total.....	439,680

UNION SERIES.

The soils of the Union series are brownish gray to brown in color, smooth in texture, and friable in structure. The subsoils typically are yellowish brown, but vary to grayish brown or gray and yellowish brown mottled in the flatter areas not perfectly drained, and to a dull reddish brown in some of the well-drained areas where limestone forms the bedrock and lies at a depth of 3 or 4 feet below the surface. The subsoils are of a rather compact, friable structure and heavier in texture than the surface soils. They may be slightly calcareous, but the soils usually are in an acid condition. The members of this series are residual in origin from limestone, modified to some extent in places by material from sandstone interbedded with the limestone. It may be that they are derived in part at least from loessial material, particularly the surface silt, but if such is the case the evidence is not conclusive. These soils are typically developed in the northeastern part of the Ozark Plateau and through the unglaciated sections of Wisconsin and adjoining States. They are undulating and rolling to hilly in topography and naturally well drained except in local flat areas. Erosion is active in the steeper areas.

UNION SILT LOAM.

The surface soil of the Union silt loam to an average depth of 10 inches consists of a light-brown or grayish friable silt loam. When dry it has a smooth, floury feel. The quantity of organic matter present in the soil is rather small, and this accounts, in part, for the light color. The subsoil consists of a yellowish-brown or buff-colored silt loam, which becomes heavier, more compact, and claylike with increased depth, until, at about 18 to 24 inches, it is a silty clay loam. The soil mantle extends to an average depth of probably 8 to 12 feet. The underlying rock was not reached with the soil auger except in local spots on a narrow ridge, at the edge of a bluff, or at the head of a ravine. Both soil and subsoil are practically free from stone, gravel, or other coarse material, although occasional fragments of chert are to be seen on the surface. On account of the heavy subsoil and the uniformly silty character of the soil, the type is commonly referred to by farmers throughout the county as a clay.

The most important variation in this soil has been designated as the steep phase, on account of its steep slopes and rough, uneven topography. This phase is described in greater detail following the description of the typical soil.

Minor variations in the typical soil occur, chiefly on the narrow ridges, where the surface soil has in places been removed and the heavy subsoil exposed. In such places the depth to the underlying

rock is also less than over the more extensive areas of this type and in some instances it can be reached with a 3-foot auger. On some of the lower slopes the wash from adjoining higher land has accumulated to a small extent, and the surface soil in such places is somewhat deeper than the average. On some slopes the soil is somewhat darker in color and contains more organic matter than typical. While a number of such minor variations occur, this soil, taken as a whole, is remarkably uniform.

The Union silt loam, with its steep phase, is one of the most important soil types in Buffalo County. It occurs in all parts of the county and occupies the limestone ridge tops of the entire upland portion of the survey. It lies at a higher level than any other type and includes all of the lands above the rough stony escarpments.

The topography of the Union silt loam as it occurs on the ridge tops may be classed, in most cases, as undulating to gently rolling. On the narrower ridges and at the heads of valleys it becomes more rolling and grades into the steep phase, while over portions of the broader ridges the surface is nearly level. That part of the typical soil occupying the lower slopes and lower outlying ridges is gently rolling, but often grades abruptly into strips of Rough stony land.

On account of the fine texture and the peculiar structure of this soil a considerable proportion of the type is subject to erosion, and care must be exercised in selecting crop rotations and in the cultivation of all slopes, even though the slope is gentle. Some erosion will take place even on rather gentle slopes where intertilled crops are grown or where the ground is left bare and not cultivated for a considerable time. Wherever the surface is so steep that intertilled crops can only be grown at intervals, or where no crops other than grass can be grown without danger of serious erosion, the slopes have been included with the steep phase.

Owing to the character of the topography, the natural surface drainage of the type is good, so that tile drains will doubtless never be necessary except possibly on some of the broader ridges, where the surface is more nearly level than elsewhere.

The Union silt loam has the uniform silty texture, the buff-colored subsoil, and other field characteristics of a loessial formation, though it is considered that the greater proportion of the material has been derived from the underlying rock, the lower Magnesian limestone. The material forming this soil is sometimes found to be in a slightly acid condition. The subsoil is less acid than the soil, and frequently shows no acidity at all.

The original timber growth on this type consisted chiefly of white, black, and bur oaks. Maple, poplar, hickory, white birch, and basswood are also commonly seen, and hazel brush is frequently abundant. Some of the older settlers state that most of the timber was

originally on the ridges, and that many of the valleys were treeless, being burned over annually by the Indians, who used some of the land for grazing. Some of the wider valleys, with dark-colored slopes, were covered sparsely with oak and were called "oak openings." Most of the timber which is now standing is confined to the steepest slopes and associated chiefly with the Rough stony land. Small woodlots are also seen on top of some of the narrow ridges.

By far the greater part of the typical Union silt loam is under cultivation and highly improved, while much of the steep phase is still in timber or pasture land. The leading type of agriculture followed consists of dairying in conjunction with general farming. As the growing of wheat, which was a very important industry 20 to 25 years ago, declined, the raising of live stock and the dairy industry gradually developed.

The principal crops grown at the present time and the average yields obtained are as follows: Corn, 40 to 45 bushels; oats, 35 to 45 bushels; barley, 30 to 35 bushels; wheat, 20 to 25 bushels; and hay, 2 to 2½ tons per acre. Oats are grown more extensively than any other grain crops. The acreage of barley is considerably smaller than that of oats and the acreage devoted to wheat is still less. The quality of the small grains grown on the Union silt loam is excellent, and this soil is generally held to be a better grain soil than any of the other soils of Buffalo County. Corn, on the other hand, does not do so well on this type as on the darker colored soils of the Wabash or La Crosse series, though the crop is successfully grown wherever this soil occurs. Most of the grain and corn grown is fed to stock on the farms, though elevators at Alma, Fountain City, and Mondovi still ship much oats and barley and some wheat. Where the land is well farmed but little trouble is experienced in growing clover. When the snowfall is light the alternate freezing and thawing of the ground sometimes kills out clover. Pasturage, in general, is excellent, being scant only in very dry weather, or on shallow slopes or knolls exposed directly to the sun.

Buckwheat, rye, and sorghum are produced on this soil, but their acreage is never large. Alfalfa is successfully grown by a few farmers and the acreage will no doubt be gradually increased, as the crop provides excellent feed, which is of great value, especially to the dairy farmers. Potatoes are grown for home use on practically every farm, but seldom on a commercial scale. Tobacco is grown to a small extent, but the crop is not increasing in favor. Beans and peas are not extensively grown on this type, being confined chiefly to soils of lighter texture. Garden crops, such as strawberries, tomatoes, lettuce, radishes, and cucumbers, and bush berries all do well and are grown for home use, but seldom on a commercial scale.

Fruit growing is not an important industry on this soil, though many farmers have small apple orchards.

The farms and farm buildings are usually in first-class condition, and silos are rapidly coming into general use. This is especially true on Belvidere Ridge, east of Alma, and on others of the wider ridges in the western part of the county.

A large number of calves and hogs are raised and sold in conjunction with the dairy industry, and some beef cattle are raised, though the feeding of fat cattle is not engaged in extensively. A large number of horses are raised, especially in the northern part of the county.

The rotation of crops most commonly followed on the Union silt loam consists of a small-grain crop, such as oats, barley, or wheat, with which clover and timothy are seeded, hay being cut for two years, after which the land is plowed for corn. A field may be pastured for a year, but on account of the large extent of steep land on most of the farms such land is used for pasture and the hay fields are not often grazed.

When the soil is cultivated under the proper moisture conditions but little difficulty is experienced in securing a good seed bed. If handled when too wet there is danger of puddling. Where the clay loam subsoil is near the surface or exposed on the narrow ridge tops, cultivation is more difficult than on the broad ridges where the surface soil has a good depth. Because of the rather low organic-matter content, the type is somewhat less loamy than some of the other silt loams. Practically the only fertilizer used on this soil is stable manure. A second crop of clover may be plowed under, but the practice of green manuring is not at all common. Fall plowing is practiced to some extent, and this is advisable where there is but little danger from erosion, but on slopes which are apt to wash it is better to plow in the spring.

While farming is well developed on this type and most farmers are prosperous, there is considerable room for improvement.

Land of this type has a considerable range in value, depending upon location, improvements, and the character of the surface. The best improved farms, conveniently located, and with a large proportion of their acreage on the broadest ridge tops, range in value from \$75 to \$100 an acre. Most farms include land of the steep phase of this type, and many include some Rough stony land, which detracts from their value. In some remote parts of the county, and where there is a large proportion of the steep land on the farms values range from \$30 to \$60 an acre.

Union silt loam, steep phase.—In general physical character and appearance the soil of the steep phase is essentially like the typical

soil, the basis of separation being one of topography. As a whole the color and texture of the soil may be slightly lighter than the typical soil, and the average depth to rock is less. Because of its steep, broken character, this phase has a lower agricultural value than the typical soil.

The steep phase of the Union silt loam occurs in all parts of the county intimately associated with the main type and frequently grading into it in such a way as to make the drawing of a definite boundary line difficult. It occupies steep slopes generally about the heads of small streams heading in the limestone areas above the Rough stony land. On these slopes, which form the more or less steep sides of the valleys, the silt soil is subject to erosion and careful methods are often necessary to prevent destructive gulch formations while these slopes are under cultivation. When the steep slopes are not wooded, or in pasture, or covered by a growing crop to protect them the soil washes badly and ditches are quickly and deeply cut into the hillsides. When erosion has once started in this way it is difficult to check, so that methods of prevention are very important.

The natural drainage of the steep phase is good, except in small areas along the slopes where springs and seeps may occur. The greater part of it is so rolling that too large a percentage of the rainfall runs off, and crops often suffer from lack of moisture.

The Union silt loam, steep phase, has practically the same origin as the typical soil, though as a rule there is less depth to bedrock, and chert fragments occur on the surface and through the soil mass in greater abundance. As with the typical soil, it is residual from a cherty magnesian limestone.

The original timber growth consisted of the same trees as on the typical soil, oak predominating. Most of the standing timber outside of the bottom lands is now found on this phase and on the Rough stony land with which it is associated, though a considerable proportion of the steep land is cleared and either in cultivation or pasture land.

The same crops are grown on the steep phase as on the typical soil, but less corn and other intertilled crops are grown and more of the land is in grass and pasture than on the main type. The ordinary yields of all crops are somewhat lower. Because of the steep character of the surface the phase is more difficult to work than the typical soil. The steepest portions of the phase are now in timber or pasture land and the remainder is devoted to general farming.

Land values on the steep phase of the Union silt loam are subject to considerable variation. The phase usually forms only a portion of the farms, occurring in association with the typical soil and in some cases also with Rough stony land. It is estimated, however,

that the value of this class of land alone would range from \$25 to \$50 an acre, depending upon the degree of slope and the area under cultivation, as well as upon the location and improvements.

BOONE SERIES.

The Boone series consists of light-gray soils, containing a small quantity of organic matter, underlain by pale-yellowish to slightly reddish yellow and often mottled, porous subsoils. A bedrock substratum is frequently encountered at shallow depths. The soils of this series are of residual origin, being derived from sandstones and shales. The topography is rolling to steeply sloping, and the soils are usually timbered. This series is closely associated with the Bates series, but differs from it in containing smaller quantities of humus, with consequent lighter color. The soils are often thin and unproductive.

BOONE SILT LOAM.

The surface soil of the Boone silt loam, to a depth of 8 to 12 inches, is a brownish-gray to brown, smooth-textured, mellow silt loam. The subsoil typically is a yellowish-brown friable silt loam of about the same texture as the soil, extending to a depth of 3 feet or more, but varies in color to a dull yellowish brown or a grayish brown with a slight tendency to mottle, as is apparent in areas not perfectly drained, and in texture from a smooth silt loam to a very fine sandy loam in which there is a high percentage of silt. Often within the 3-foot section there are layers of a distinctly sandy material alternating with very silty layers, and in exposed sections, as in road cuts, there is a distinct lamination in the material which is due to differences in the parent rock which have not been entirely obliterated by weathering.

The Boone silt loam in its typical development is not very extensive, but it is one of the most desirable soils of the area. It is gently undulating and smoothly rolling in topography and naturally well drained, except in local spots affected to some extent by seepage and surface run-off from the higher lands. It occurs for the most part in the lower upland areas along the slopes adjoining the terraces and bottoms, but also extends to broader stretches where the topography is irregular, giving way in the higher rolling areas to the rolling phase of the type, which is much more extensive.

The type is residual in origin from a shaly phase of the Potsdam sandstone formation. Where the underlying rock tends more to the massive, the soil and subsoil approach the texture of a fine or very fine sandy loam, while in the areas where the rock is distinctly shaly the soil material carries a much higher percentage of silt and a correspondingly lower percentage of sand. In most areas the parent rock has weathered to a depth of 10 feet or more, and the soil is entirely free from stone except in areas near the stony bluffs, where

fragments of both sandstone and limestone may be found scattered over the surface.

The Boone silt loam is nearly all under cultivation and gives good yields of all of the general crops of the region. On the average, corn yields from 40 to 50 bushels, oats 30 to 45 bushels, wheat 20 to 25 bushels, and hay $1\frac{1}{2}$ to $2\frac{1}{2}$ tons per acre. The farm practices and improvements on the type are very much the same as on the Union silt loam.

The value of the type ranges from \$60 to \$100 an acre.

Boone silt loam, rolling phase.—The rolling phase is much more extensive than the typical soil and about as extensive as the higher Union silt loam. Its chief difference from the typical soil is in its more rolling topography, which ranges from moderately smooth to rather steep broken slopes and irregular rolling areas, erosion being active in many places. A much larger proportion of the rolling phase is pastured than of the typical soil or any of the other types of comparatively smooth topography, and some of the rougher areas are still forested. Under cultivation it gives nearly as good yields of the grains and other crops grown as are obtained on the leveler areas of the type. However, it has to be handled with considerable care to prevent destructive erosion. The value ranges from \$30 to \$75 an acre.

BOONE FINE SANDY LOAM.

The surface soil of the Boone fine sandy loam to an average depth of 8 to 10 inches consists of a grayish-brown fine sandy loam, which in some places contains a considerable quantity of medium sand. The quantity of organic matter present is not large, but a slightly acid condition is found to exist over most of the type. The subsoil consists of a brown to yellowish-brown fine to medium sandy loam, which usually extends to a depth of over 3 feet.

Both soil and subsoil of this type are subject to considerable variation, though none of the variations are found of sufficient extent or importance to be mapped as a phase, except the more rolling tracts, which are usually shallow. This variation has been termed the rolling phase and shown separately on the soil map. In smaller sandy areas in the valleys of Bygolly and Little Bear Creeks the subsoil is a brown sandy loam, becoming lighter in color with depth and containing a few small bits of sandstone. Bordering Buffalo River in T. 24, R. 11 in the northern part of the county the soil is slightly finer and heavier than usual, varying from a fine sandy loam to a loam, and often grading into a compact sandy clay loam layer at 18 to 24 inches. This heavy material is again underlain by a yellow sand at 24 to 40 inches. The differences in texture are due in part to the presence of a shaly sandstone layer, and also to the proximity

of heavier and higher lying soils from which finer particles are often washed. Outcrops of sandstone are not uncommon, though they are not extensive and seldom interfere to any marked extent with cultivation. The depth of the underlying rock is variable, and while it averages considerably over 3 feet, there are places on the tops of ridges and on knolls where there may be as little as 2 or 3 inches of soil. There are also places over gently rolling tracts where the soil has a depth of only 2 or 3 feet, but such areas are not extensive.

The Boone fine sandy loam is one of the important types in the county, though there are several which are more extensive. The largest area occurs in the northeastern part of the survey in Naples and Mondovi Townships, lying mostly south of the Buffalo River. A number of smaller tracts are found in the vicinity of Gilmanon along the slopes on the south side of Elk Creek and its two chief branches. Other small tracts are scattered throughout the northwestern corner of the county, and to a more limited extent through the southern part.

The surface of the Boone fine sandy loam, including the rolling phase, varies from undulating to rolling, and in places it becomes quite steep, though there are but few small areas where the surface is too steep to prevent the growing of the ordinary farm crops. Where the limestone cap remains with sandstone outcropping below, a rather steep, narrow belt of fine sandy loam following the contour is produced, as at the base of the river bluffs at Cochrane and Fountain City. Where the limestone covering is thinner, and where more of the sandstone is exposed, as in Little Bear Creek and Spring Creek Valleys and a few other places, long gently rolling or undulating slopes are found, being rather steep or rolling only near the limestone ridge. In the largest area in the northeastern part of the county, where the limestone capping has been entirely removed, the topography is nearly level in places. The surface rises with a gentle gradient up to long, gently rolling slopes, culminating in low, rolling, oak-covered knolls, which slope away again to the next valley. The surface of this soil becomes rolling also and even rough in places along the southern edge of the area bordering the outliers of the limestone ridges which project into this type. South of Gilmanon, bordering Elk Creek Valley, is an irregular area of this type covering 3 or 4 square miles where the topography varies from gently rolling to rough and broken.

On account of the sandy nature of this type and its absorptive capacity it withstands erosion fairly well. On some of the steeper slopes, however, and over long, more gentle grades, where the run-off from an extensive area converges, there is some danger from erosion.

Another position where this type is in danger of destructive erosion is where a Boone fine sandy loam slope grades gently into a terrace remnant of Lintonia fine sandy loam or silt loam bordering

some of the creeks which empty directly into the Chippewa, Buffalo, or Trempealeau Rivers. Extensive ditches formed under such conditions may be found in the valleys of Bygolly, Little Bear, Ripers, and Kammuler Creeks. These terraces, as explained under Lintonia fine sandy loam, have a loose, stratified subsoil and are subject to erosion. Ditches started in these terraces rapidly eat their way back considerable distances to where the Boone fine sandy loam occupies a position adjoining the terrace but on a gentle slope somewhat more elevated. When a ravine has been cut across the terrace it continues to cut away the slope, as a considerable volume of water converges in such places during heavy spring rains.

On account of the sandy character of the soil and the surface features, the natural drainage of this type is excellent. Where the soil is shallow and where the slopes are steep the type frequently suffers from lack of sufficient moisture, though as a whole it retains moisture fairly well.

The original Boone fine sandy loam is largely residual, having been derived from the weathering of the Potsdam sandstone and from a shaly phase of this formation. On some of the slopes it is probable that some of the sandy material has been moved short distances down the slope by washing. Where there is silty material incorporated with the soil it is probable that a part of this has been washed down from higher lying silt loam types. Thus it will be seen that the type may also be partly of colluvial origin, though this phase is of minor importance. In a few places sand dunes have been formed, but these are also of small extent.

The original timber growth consisted partly of black and scrub oak covering the shallow knolls and the lighter portions of the type. On the heavier portions there was some birch and maple. Sumac, hazel brush, poplar, and wild cherry form the second growth in uncultivated places.

By far the greater proportion of the type is put to some form of agricultural use, and most of it is cultivated. The wooded portion is confined chiefly to the steeper slopes and shallow knolls, which are covered mainly with small oak. As is the case with the county as a whole, most of the type is devoted to general farming, with dairying as the most important branch. In connection with dairying quite a number of hogs are raised. The chief crops grown and the ordinary yields are as follows: Corn, 40 to 50 bushels; oats, 30 to 40 bushels; barley, 35 to 40 bushels; and hay from 1 to 2 tons per acre. Some rye is also grown and it gives fair yields. On some of the level portions of the type some farmers report an increasing difficulty in getting a good stand of clover. Others on the gently rolling phase report no trouble whatever, no clover having been lost in the last seven or eight years. Very fine stands of clover appear on

some of the lighter portions of the type, even though the soil showed a slight indication of acidity in response to the litmus-paper test.

When the county was first settled wheat was grown extensively on this soil, but very little is now produced. It is considered a fair corn soil, and the yields are practically the same as on the Boone silt loam. Potatoes can be grown successfully, though the acreage is not large.

The rotation of crops most commonly practiced consists of corn, followed by oats or barley, with which clover and timothy are seeded. Hay is cut for one or two years, and the field may be pastured for a year before being again plowed for corn. Cultivation of this soil is not difficult, and a lighter class of implements and stock can be used than on the silt loam type.

The selling price of land of this type is quite variable, depending upon location, character of the surface, texture of the soil, and improvements. In the area near Mondovi the gently sloping and nearly level portions of the type sell for \$60 to \$100 an acre. The rougher places which are more distantly removed from towns are held at \$40 to \$50 an acre. In Little Bear and Spring Creek Valleys the price of land of this class ranges from \$25 to \$50 an acre.

Boone fine sandy loam, rolling phase.—The rolling phase of the Boone fine sandy loam is separated from the typical soil for two reasons. In the first place the topography is more rolling than the typical soil and in the second place the depth of the soil material to the underlying rock is less than the average for the type as a whole. Because of these two conditions the agricultural value of the phase is considerably lower than that of the typical soil. In fact a considerable proportion of the rolling phase has been left wooded because of its lower value.

In texture the rolling phase is a somewhat lighter fine sandy loam than the main portion of the type, and the depth to rock, which is mostly the Potsdam sandstone, ranges from 1 foot to 3 feet. A few rock outcrops occur, but these are not extensive. The surface of the phase is nowhere found to be so steep as the steep phase of the Union silt loam, but may be described as consisting of rather low ridges with gentle slopes and as regions where the topography is gently rolling to rolling. Some of the narrow areas of this type found bordering Boone silt loam or Rough stony land have been included with the rolling phase.

The rolling phase has the same origin as the typical soil and the original vegetation is the same. Where this class of land has been cleared the yields are lower than usual for the type, the soil is more subject to drought, and as a whole is less desirable for farming. That which is now in timber should be allowed to remain so, and where cultivated the most careful methods of soil management should be practiced in order that the productivity may be increased.

BOONE FINE SAND.

The surface soil of the Boone fine sand consists of a brown to yellowish-brown or grayish-brown fine to medium sand extending to an average depth of about 8 inches. This is underlain by a fine sand of a lighter yellow color than the surface, extending to a depth considerably below 3 feet. The quantity of organic matter present is very small. There is some variation in the texture of both soil and subsoil and portions of the type might be classed as medium sand, but as the type is inextensive and as the fine sand seemed to predominate it was considered advisable to include all of the material in one type. In section 19 and vicinity in Manville Township the soil is slightly heavier than typical. A portion of it is also somewhat loamy, and as a result more productive than the typical soil.

The largest area of this soil, covering about $3\frac{1}{2}$ or 4 square miles, occurs in Spring Creek Valley, in T. 24, R. 13. Most of the medium sand was found in this region. South of Mondovi and along the south side of the Buffalo River wind-blown areas occur. A few other patches of small extent are found associated with the Boone fine sandy loam in the northern part of the county.

The surface of this type varies from very gently undulating to gently rolling. There are a few low ridges and some low sand dunes, and where the type borders Rough stony land or other types occupying the steep slopes the surface near the boundary frequently has considerable slope. On account of the surface features and the loose, open character of both soil and subsoil, the natural drainage is excessive and the type is droughty. None of the slopes is sufficiently steep to make the prevention of erosion an important factor in the management of this soil.

In origin the Boone fine sand is largely residual, having been derived from the weathering of Potsdam sandstone. There is but little organic matter present and such a small quantity of silt and clay that the loose surface material is readily blown by the wind, and in a number of places low sand dunes have been formed. The material composing the type is in an acid condition, as indicated by the litmus-paper test.

The original timber growth on this type consisted chiefly of scattered scrubby oak. Coarse grasses and sand burs are also found growing on the type, though there are a number of places where the surface is bare of vegetation and the soil is now drifting.

On account of its loose, open character and the resulting droughty condition, its low content of organic matter, and the fact that it is subject to drifting, this soil has a low agricultural value. While most of it is cleared, there is a considerable proportion which is not farmed because of the small yields. Corn produces 20 bushels per acre where

the rainfall is well distributed, but the crop is often a failure. Rye produces 8 to 12 bushels, and buckwheat 10 to 12 bushels an acre. Grass and clover are not successfully grown, and the coarse, wild grasses supply little pasturage. Potatoes are not grown extensively, and the yields are small. A portion of the type in section 19, Manville Township, is better than the average. Here corn frequently produces 30 bushels and buckwheat as much as 30 bushels an acre in favorable years.

The selling price of most of the land of this type ranges from \$10 to \$15 an acre. The heavy phase, indicated above, has a somewhat higher value.

BATES SERIES.

The soils of the Bates series are dark gray. The subsoils are yellowish and mottled red or yellowish or buff in the upper part and mottled with yellow and red in the deeper section. The series is of residual origin, and is derived from sandstone and shale rocks. The soils of this series are distinguished from those of the associated Oswego series by their more pervious subsoils, and from the Boone series by the darker color of the surface soils. They are usually well drained, are treeless, and have a level to undulating topography.

BATES SILT LOAM.

The surface soil of the Bates silt loam to an average depth of 12 to 14 inches consists of a heavy, black to dark-brown silt loam. The quantity of organic matter in the surface soil is large, and the material has the smooth feel characteristic of silt. Litmus-paper tests indicate that the soil is in an acid condition. The subsoil consists of a heavy silt loam of a brown or chocolate-brown color, which gradually becomes lighter in color with depth. At 24 to 30 inches the material becomes a yellowish-brown, slightly sticky, heavy silt loam. Below this depth it frequently becomes lighter in texture and at 40 inches there is usually an appreciable amount of fine and very fine sand. On the higher slopes and tops of knolls the soil is lighter in color than elsewhere, and in such locations the surface material has been eroded, leaving the subsoil exposed. On some of the lower knolls underlain by sandstone the soil is thin and there is more or less coarser material mixed with it, giving it a somewhat sandy texture.

The Bates silt loam is of small extent, the largest areas occurring directly north of Mondovi, occupying the sloping land bordering Big Bear Creek Valley, along the North Fork of Elk Creek, and the valleys of Big Waumandee and Kammuler Creeks. Other scattered areas of small extent occur in various parts of the survey.

The position which the type occupies is intermediate between the La Crosse silt loam of the terraces and the Boone silt loam of the

highest parts of the county. It occupies gentle slopes and even rather rolling upland areas, but these are always parallel with the alluvial valleys and immediately border them. The type grades into La Crosse silt loam on the one hand and Boone silt loam on the other, so that there is quite a range in the color of the material. On account of the sloping surface, the natural drainage is excellent, while the slopes are seldom steep enough to cause any considerable damage from erosion.

The silty material composing this type of soil is probably of residual origin from a shaly phase of the Potsdam formation. It differs from the Boone silt loam principally in its higher organic-matter content. The type as a whole is generally known as "oak openings," having been originally forested with scattered clumps of large oak trees, while the intervening spaces were in a semiprairie condition, supporting a more or less heavy growth of prairie grass.

The Bates silt loam is one of the desirable types of soil in the county. Because of its great natural fertility, it frequently has been ill used, too little attention being given to crop rotation and fertilization. All the general crops grown in the region do well on this type, and the average yields of some of the crops are considerably higher than on most of the other soils. The soil is especially well adapted to corn, of which the ordinary yield is 50 to 60 bushels an acre. This type and the La Crosse silt loam are the best two corn soils in the county. Barley produces 30 to 35 bushels and oats 30 to 40 bushels per acre. Wheat is still grown to some extent and yields of 25 to 30 bushels per acre are not at all uncommon. The quality of the small grains is not so good as of those grown on the Union or the Boone silt loam. Clover and timothy produce from 1½ to 2 tons per acre, and the pasturage is generally excellent. The rotation of crops most generally followed consists of corn, small grains, and hay. Of the small grains, oats is most commonly grown, though barley may also be grown in the rotation following the oats. A few small fields of alfalfa have been established on this soil. Where the acid condition is corrected and the soil inoculated this crop promises to do very well.

Dairying is the chief branch of farming followed, and hog raising is carried on quite extensively on many of the dairy farms. The buildings and other improvements on this soil are as a rule better than the average. Silos are in quite general use.

Farms located on land of this type have a selling price ranging from \$75 to \$100 an acre, depending upon improvements and nearness to markets.

Following are given the results of mechanical analyses of samples of the soil and subsoil of the Bates silt loam:

Mechanical analyses of Bates silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
311,416.....	Soil.....	0.0	0.4	0.4	1.4	13.2	68.5	15.9
311,417.....	Subsoil.....	.0	.2	.2	1.5	16.6	66.7	14.9

BATES FINE SANDY LOAM.

The surface soil of the Bates fine sandy loam to an average depth of 10 to 12 inches consists of a dark-brown to black fine sandy loam, which contains a large quantity of organic matter. When dry the material has a dark-grayish appearance. Litmus-paper tests usually indicate an acid condition. The subsoil consists of a chocolate-brown fine sandy loam or loam which becomes lighter in color with depth. At 22 to 24 inches it is frequently a heavy silty loam, and sometimes is quite claylike in appearance. At 38 or 40 inches the material is usually a yellow fine sandy loam.

The soil is subject to some variation and over small areas ranges from a fine sandy loam to a loam in texture, although the greater proportion of the material is a fine sandy loam.

The Bates fine sandy loam is one of the minor types of the county, occupying only 2.1 square miles. Nearly all of this type is found on the slopes bordering the south side of the Buffalo River Valley east of Mondovi. Here it occurs as a narrow strip from one-fourth to one-half mile wide, paralleling the valley in an east and west direction for nearly 4 miles.

This type occupies the lower portion of a long, gently rolling, residual fine sandy loam slope which leads down to the valley from the limestone ridges 3 miles south. The surface of the type is gently undulating and nearly level in places, but usually has a gentle slope toward the river. In a few places it is gently rolling. Because of the texture of the soil and the gently sloping surface, the natural drainage is good, but there is no serious danger from erosion.

While the field work was in progress some doubt was felt as to whether or not this type was in part an old alluvial terrace formation, but because of the undulating to gently rolling surface and the fact that sandstone was found outcropping at its lower edge along the river bottom, the soil was mapped as an upland type and placed in the Bates series.

No evidence of stratification in the subsoil was found, although the soil section has an average depth to the underlying sandstone of 15 to 20 feet.

The original growth of oak on this type was more evenly distributed than on the Bates silt loam, and it appears that no portion of the type was in the condition of prairie.

Practically all of the type is now under cultivation, and it is considered a valuable soil. Dairying and hog raising is the leading type of farming, and this is carried on in conjunction with general farming. Corn produces 50 to 55 bushels, oats 35 to 40 bushels, barley about 25 bushels, and clover $1\frac{1}{2}$ to 2 tons per acre. For a long period wheat was the most important crop grown on this soil and yields of 15 to 18 bushels per acre were obtained. The acreage of wheat at present is very small. This is a very good corn soil, ranking with the Bates and La Crosse silt loams in this respect. It is also well adapted to a number of truck crops, but trucking has not been developed to any extent. The soil is easy to cultivate. About the same methods are followed as on the silt loam.

Land of this type sells for \$65 to \$90 an acre, depending upon such factors as location and improvements.

LA CROSSE SERIES.

The soils of the La Crosse series are dark brown to black and overlie brown, light-brown, or grayish subsoils, which at depths of 3 feet and more are usually coarser in texture than the soils. They occur on stream terraces and very gently undulating upland valley basins and adjoining colluvial slopes. The series is derived from the weathering of stream-terrace and colluvial material and from areas of nearly flat topography formed by the disintegrating and leveling action of sheet-flood erosion on very soft rocks. The material is derived from the Potsdam sandstone, the lower Magnesian limestone, and a silty layer that has the physical characteristics of loess. The soils occur in coves and broad valley basins in the driftless region of the upper Mississippi Valley.

LA CROSSE SILT LOAM.

The surface soil of the La Crosse silt loam to a depth of 12 to 18 inches consists of a dark-brown or black silt loam containing a high percentage of organic matter. Its high percentage of silt and organic matter gives the soil an extremely smooth feel. Litmus-paper tests indicate an acid condition over a part of the type, though the degree of acidity is not uniform. The subsoil consists of a brown or buff-colored silt loam, which gradually becomes heavier in texture and lighter in color and at 24 to 30 inches consists of a yellowish-brown, compact, heavy silt loam or silty clay loam. In local areas where the drainage is deficient the subsoil shows a slight mottling of light gray or drab. This heavy subsoil extends to a considerable depth and the soil section will probably average 7 to 8 feet in thickness. Below this heavy mantle are to be found stratified beds of sand. Along the Mississippi and Buffalo Rivers and Farrington Creek some glacial gravel may also be found with the sand.

The largest areas of this soil occur in Little and Big Waumandee Valleys, where it is most typically developed. In the vicinity of Anchorage the black soil occupies most of each valley for a distance of 6 or 7 miles. The area varies in width from one-fourth to three-fourths of a mile. A comparatively extensive area is mapped also at the mouth of Schultz and Newton Valleys west of Mondovi and in Farmington Valley northwest of Mondovi. Strips of this type about one-fourth mile in width and from 1 mile to 3 miles in length are found in a great many of the smaller tributary valleys scattered over the county.

The surface of the La Crosse silt loam is level or has a very gentle slope toward the streams along which it occurs. In places it occupies a distinct terrace and lies about 6 to 10 feet above the present flood plain of the stream, while in other places it occupies an entire valley floor through which the stream has cut its channel, with the present water level from 3 to 10 feet below the surface of the type. Natural drainage over most of this type is fairly good. A few of the lower areas are subject to overflow during the heavy rains of spring, but by far the greater proportion is not subject to inundation. A considerable part of the type would be benefited by tile drains, though these have not been installed to any great extent. Because of the gentle slope or level character of the surface, there is no danger of erosion.

The material composing the La Crosse silt loam is of alluvial origin and occurs in the valleys of many streams throughout the county. The upper section, consisting largely of silt, was deposited in comparatively quiet waters, but the beds of sand forming the lower section were deposited by more rapidly moving currents. The dark color of the soil is due to the large content of organic matter resulting from the growth and decay of rank vegetation in the presence of moisture.

The native vegetation consists largely of grasses, with some timber, mainly oak, elm, and soft maple. The greater part of the merchantable timber has been removed.

Practically all of the La Crosse silt loam can be cultivated, and the greater proportion of it is now in farms and well improved. It is one of the most highly valued soils of the county, and with the soils of the Bates series comprises the best corn land. The yields of corn range from 60 to 80 bushels per acre during favorable years, and the ordinary yields are larger than those from the other types in the county. The small grains do well, but the quality is not so good as that of grains grown on the Union silt loam. Oats and barley each yield about 40 to 45 bushels per acre. An excessive quantity of straw is apt to be produced and these grains, especially oats, are likely to lodge. Clover and timothy do well and pasturage is always good.

Dairying and hog raising in connection with general farming is the prevailing type of agriculture. Numerous stock farms are located largely on this type, and draft horses and pure-bred cattle are raised quite extensively in the vicinity of Mondovi.

A rotation frequently followed consists of corn followed by small grain for 1 or 2 years and then hay for 2 years. Corn is often grown on the same field for 2 or 3 years in succession, and on the whole not enough consideration is given to the rotating of crops. Because of the natural fertility of this soil farmers have abused it. Cropping has been heavy and in many cases no element of fertility has been returned to the soil.

The La Crosse silt loam is not difficult to handle under proper moisture conditions, but it can not be worked under so wide a range of moisture conditions as the Bates silt loam, which has better drainage. Where the soil is well drained alfalfa can be successfully grown.

Land of this character brings from \$80 to \$150 an acre, depending upon location and improvement.

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

Mechanical analyses of La Crosse silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
311421.....	Soil.....	0.0	0.3	0.4	1.6	10.9	73.4	13.4
311422.....	Subsoil.....	.0	.1	.2	.6	11.4	72.3	15.4

LA CROSSE FINE SANDY LOAM.

The surface soil of the La Crosse fine sandy loam, to an average depth of about 14 inches, consists of a dark-brown fine sandy loam which contains a considerable proportion of very fine sand. The quantity of organic matter present is larger than is found in the soils of the Lintonia series, and this accounts for the darker color. Litmus-paper tests indicate that the soil is in an acid condition.

The subsoil consists of a light-brown fine sandy loam which grades at about 24 to 30 inches into a stratified yellow fine sand. Where the type occurs in the Mississippi River Valley, and in the Buffalo River Valley below Mondovi, gravel occurs in the deep subsoil.

The largest and most important area of this type is a long terrace lying between the bluffs and the Mississippi River in the vicinity of Cochrane. This belt varies in width from one-half to 1 mile, parallels the river for a distance of 6 or 7 miles, and has an elevation above the flood plain of 5 to 20 feet. The texture and organic-matter content of this area vary somewhat, it being more sandy and of a

lighter color on the side bordering the river than next to the bluffs. A few smaller tracts are found in various stream valleys throughout the county.

The La Crosse fine sandy loam is a terrace soil and the surface is usually level or slopes gently toward the streams along which it occurs. There are a few places, however, where the surface is undulating or even gently rolling, though such tracts are of small extent. On the whole the type has good drainage, but there are a few places where the surface is lower than usual and in these there is an excess of moisture during part of the year. On the other hand, some of the lighter textured, higher places are apt to suffer at times from drought.

This is largely an alluvial soil, the materials having been deposited by the streams when flowing at a much higher level than at present.

A forest, largely oak, with some elm and soft maple in the lower places, originally grew on this soil. The growth was rather open, with grass among the trees. Some portions of the type were originally in a semiprairie condition.

By far the greater proportion of the La Crosse fine sandy loam is under cultivation. It is considered a good farming soil. The chief crop grown is corn, which yields 45 to 50 bushels an acre. Oats yield 35 to 40 bushels an acre and barley about 30 bushels. A small acreage of wheat is grown and yields of 20 to 25 bushels an acre are obtained. The yields given above are for the average development of the type. On the more sandy tracts they are somewhat lower, and on the areas of heavier texture they are higher than indicated. This is especially true of corn. Timothy and clover are grown and alfalfa has been tried, but not extensively. Potatoes do well on this class of soil, and it would seem that this crop could well be grown more extensively.

Land of this type sells for \$35 to \$40 an acre, depending upon location, improvements, etc.

LA CROSSE FINE SAND.

The surface soil of the La Crosse fine sand to an average depth of about 10 inches consists of a dark-gray to dark-brown fine sand having a loose structure and a comparatively low content of organic matter. Litmus-paper tests indicate that the soil is acid. The subsoil consists of a fine to medium sand, which becomes lighter in color and grades into stratified sand in the lower subsoil. There is some variation in the texture and some of the material included with this type could be classed as a medium sand if the areas were of sufficient extent.

The type is of small extent and of minor importance. The largest areas are found in Spring Creek and Little Bear Valleys. The soil in Spring Creek Valley is somewhat coarser in texture than typical. In the vicinity of Waumandee there is also a small extent of this

soil, and here the type is better than the average, having a finer texture and containing enough silt and clay to make it slightly loamy.

Generally the surface of the type is level or slopes gently toward the streams. In a few places there is a billowy topography, and small undulations are common. These are doubtless due to the action of the wind. On account of the loose, open structure of the material, the natural drainage is excessive. There are some portions of the type where erosion has cut rather deep channels, especially on the gently sloping terraces in Little Bear Valley.

Areas of this type occur within valleys of streams which head within the driftless region, and there is no glacial material, even in the stratified subsoil. The sand was doubtless derived from Potsdam sandstone and later carried down the slopes by the action of water and deposited by stream action when the volume of water was much greater than it is at present, and when the streams were running at a much higher level.

The original growth on the La Crosse fine sand consisted chiefly of a few scattering scrub oak and some prairie grass.

A relatively large proportion of this soil is under cultivation, but it is doubtful if the average crop is profitable under present conditions of farming. Corn is grown to some extent, but the yields are low. Probably the average is not over 15 bushels per acre. In dry years the crops usually fail. Rye, which is grown more extensively than other small grains, usually yields about 8 to 12 bushels per acre. Buckwheat yields 10 to 12 bushels per acre. Clover and the grasses do not thrive and the pasturage is of little value except early in the season. Potatoes are of fairly good quality, but yields are small. This type is low in organic matter, and in order that farming operations may be profitable the most careful methods of soil and farm management are necessary.

Land of this type sells for \$10 to \$20 an acre. Farm buildings are usually inferior and fences and other improvements in poor condition.

LA CROSSE GRAVELLY SANDY LOAM.

The type mapped as La Crosse gravelly sandy loam is of very small extent and of minor importance in the present survey. It occurs in two separate tracts which have a somewhat different texture. That just northwest of Cochrane has a surface soil which consists of 12 to 16 inches of black or dark-brown loam. This contains a considerable quantity of coarse, rounded sand particles, and in a number of places the surface soil is a sandy loam. There is usually sufficient clay present to make the soil sticky when wet. The subsoil consists of a yellowish sandy loam to about 24 to 30 inches, where rounded, rather fine gravel is encountered. This

bed of stratified gravel and coarse sand is compact and difficult to penetrate with the soil auger.

The second area is found on the terrace near Nelson. The texture of the soil here is somewhat more silty than that of the first-mentioned area, though here also the soil varies to a coarse sandy loam, and in a few places a coarse loamy sand appears at the surface. This area is also underlain by stratified gravel. In a few localities this fine gravel outcrops, and there is considerable gravel scattered over the surface in such places. The surface soil is in an acid condition, as indicated by the litmus-paper test.

The surface of the type is level or very gently sloping. On account of the underlying sand and gravel beds the drainage is thorough, sometimes excessive, and, except where the covering over the gravel is deeper than usual, the type is inclined to be droughty during dry periods. The type is a terrace soil situated well above the present flood plain. Portions of it appear to lie in an abandoned stream channel, later filled by sediment and now having the same elevation as the remainder of the terrace. In such places the gravel is as much as 4 feet below the surface.

The La Crosse gravelly sandy loam is a prairie soil, the native growth consisting chiefly of grasses. At present the greater part of it is under cultivation, and in favorable years as much as 40 to 50 bushels of corn are grown per acre. Oats may yield 30 to 40 bushels and hay 1 ton to 1½ tons per acre. In dry seasons, however, the yields are considerably lower and crops frequently suffer greatly from lack of moisture.

LINTONIA SERIES.

The surface soils of the Lintonia series are light brown or yellowish brown and of silty texture. The subsoils are of slightly lighter color and somewhat more compact structure. The series occupies stream terraces and flat alluvial lands along streams, through which the channels are so deeply cut that overflows are of rare occurrence. In places narrow strips of colluvial material occur, usually adjoining terraces or bottom lands. The material is mainly alluvial and is derived from the Memphis, Richland, and Union soils. Drainage is well established.

LINTONIA SILT LOAM.

The surface soil of the Lintonia silt loam to an average depth of 10 inches consists of a brownish-gray, friable silt loam, which becomes lighter colored on drying and frequently has a whitish appearance. The quantity of organic matter present in the surface soil is comparatively small, and this accounts in part for the light color of the material. A slight acid condition has developed in places in the surface soil,

as indicated by the litmus-paper test. The subsoil consists of a yellowish-brown or buff-colored silt loam, which usually becomes somewhat heavier and more compact with depth, and at 24 to 30 inches may be a silty clay loam. Below this depth there is often a considerable quantity of fine and very fine sand, and this mixture extends to a depth of 3 feet or over and grades into stratified fine sand, with layers of gravel in the lower depths. The type is subject to some variation, and in Glencoe Township and the valley of Buffalo River the soil is somewhat darker than typical.

The soil quite closely resembles the Boone silt loam in texture and color, but differs from it in topography, origin, and the position which it occupies.

The most extensive areas of Lintonia silt loam are found in the Buffalo River Valley in the vicinity of Tell, where terraces of this soil have a width of from one-half to three-fourths of a mile, and these frequently extend back to tributary valleys for 1 mile to 3 miles. A number of areas also occur in Little Bear Creek Valley in the northwestern part of the county. Lower Big Waumandee Creek Valley and tributaries, and tributary valleys of the Trempealeau River in the southeastern part of the survey also contain quite extensive remnants of Lintonia silt loam terraces.

The surface of the Lintonia silt loam is usually level or nearly so, frequently having a gentle slope toward the stream channels along which it occurs. The type occurs as terraces, usually rather narrow, but extending along the streams for considerable distances. The part adjoining the upland rises slowly and frequently grades into the Boone silt loam so gradually that the boundary line must be arbitrarily placed. Near the Mississippi Valley the terraces of this soil have an elevation of 20 to 30 feet above the present flood plain, but as the distance back from the Mississippi River increases the elevation of the terraces above the flood plain becomes less, and the difference finally is not over 4 or 5 feet. As this type is found chiefly at the foot of considerably higher lying slopes, which are often very steep, large quantities of water must pass over the terraces during heavy rains, and as a result deep ravines are frequently formed. When the silt covering of the terraces is cut away the underlying fine sand is quickly washed out, and some of the terraces are so badly eroded in this way that cultivation is no longer practicable. Others have been nearly obliterated in this way. Such extreme erosion is most marked where the terraces are the highest. A typical example may be seen in sec. 32, T. 19 N., R. 10 W. in the valley which runs northeast from Marshall. Some of the gullies extend back slowly year after year, but others are eroded for considerable distances during a succession of hard storms in one season, especially where farmers have been careless in arranging their cultivated fields. Such gullies may

become a source of great expense and loss to individual farms. The natural drainage of this type is usually good, but there are a few places where the surface is nearly level, and in places over such tracts tile drains could be installed to advantage.

The material composing the Lintonia silt loam is largely of alluvial origin and was deposited during glacial periods when the melting ice sheets greatly increased the volume of water flowing down the Mississippi River and many of its tributaries. The high water in the Mississippi River itself caused a backwater or partly ponded condition in the tributary streams. In these more or less quiet waters the finer particles now forming the soil were deposited. The coarser particles in the deep subsoil were deposited earlier, before the ponded condition prevailed and when the current was swifter. It is probable that the surface material, especially close to the foot of the bluffs, is partly colluvial, having been washed down the steep slopes from the Boone and Union silt loam areas, which are always found at higher elevations.

The gravel in the Lintonia terraces is of glacial origin. In the valley of Buffalo River such gravel is found as far up as Mondovi, though none is found in this valley more than a mile east of Mondovi. Such gravel, however, is found in the valley of Farrington Creek to the west of Mondovi.

The original timber growth on the Lintonia silt loam consisted chiefly of oak, with some hickory and a few other species. Most of the timber has been removed. In the ravines there is now a second growth of sumac, hazel, and other brush.

Practically all the type, except the more eroded areas, is put to some agricultural use, and most of it is cultivated regularly. The land where erosion is most active is kept in pasture most of the time, or the grass may be cut for hay. The crops generally grown and the yields obtained are: Corn, 45 to 50 bushels; oats, 25 to 40 bushels; barley, 30 to 35 bushels; and hay, $1\frac{1}{2}$ to 2 tons per acre. Potatoes are grown on the type to a small extent for home use, but seldom on a commercial scale. The usual rotation consists of corn followed by a small grain, either oats or barley, or sometimes by one year of each of these crops, and then by clover and timothy mixed, seeded with the grain, the field being cut for hay one or two years, before returning to corn. The stable manure is usually applied to the sod to be plowed under for the corn crops. The methods of cultivation, fertilization, and treatment are practically the same as those practiced on the Boone and Union silt loams. The soil is not difficult to cultivate, and where the areas are of sufficient size to form fields or the larger part of a farm this terrace soil may be considered one of the most desirable types in the county.

Farms made up largely of soil of this type sell for \$50 to \$80 an acre, depending upon the location and improvements.

LINTONIA FINE SANDY LOAM.

The surface soil of the Lintonia fine sandy loam consists of 10 inches of light-brown or grayish-brown fine sandy loam which contains only a comparatively small quantity of organic matter and which is acid in some places. The subsoil is a yellowish-brown, compact fine sandy loam to a depth of 24 to 30 inches, where the texture and color usually become lighter. In a few instances a layer of compact clay loam was found at 24 inches. This lighter material, which would be classed as a loamy fine sand in most instances, extends to 36 or 40 inches or even deeper, where stratified fine sand is usually found. The terraces upon which this soil is found are often 25 to 30 feet high, and in such places this stratified material extends at least to this depth.

The soil is somewhat variable in texture and in some places, especially on the higher elevations, the surface material is a loamy fine sand. In its texture the type is quite similar to the Boone fine sandy loam, and it is subject to about the same variations. The Lintonia fine sandy loam is of limited extent and occupies only 6.1 square miles. The largest areas are those bordering the Buffalo River south of Mondovi and along the south side of Farrington Creek west of this place. There is also some of the type in Kammuler Valley north of Fountain City. Small tracts occur in various other places in the county.

The surface of this type is level or gently sloping toward the stream channel along which it occurs. The terrace which the type occupies has the same position and drainage conditions as the terraces of Lintonia silt loam, and this soil is subject to the same danger from erosion. The material composing the soil is also of the same origin, having been deposited when the waters were flowing at a much higher level than at present.

The original timber was chiefly scattered oak, but practically all of this has been removed, except where erosion has rendered the land unfit for cultivated crops.

The greater proportion of this type is under cultivation. It appears that the crop returns are somewhat better from the small areas of this soil in the small valleys than from the larger tracts found in the valley of the Buffalo River. Practically all of the crops common to the region are grown on this soil. Corn yields 30 to 50 bushels; oats, 25 to 40 bushels; barley, 25 to 30 bushels; and clover, 1 ton to 1½ tons an acre. While the soil was frequently found to be in an acid condition by the litmus-paper test, no difficulty was reported by the farmers in getting a stand of clover, except in dry years. Rye

is grown, but not so extensively as oats or barley. Fairly good yields are obtained. During ordinary seasons good crops of corn and fair crops of hay are always had. When the rainfall is scanty, however, the soil suffers from the lack of moisture and crop yields are reduced to a greater extent than on soils of heavier texture.

The rotation most commonly followed consists of corn, small grain, and hay. Potatoes might be added to this list. The type is also well suited to small fruits, strawberries, and a number of truck crops.

LINTONIA FINE SAND.

The surface soil of the Lintonia fine sand consists of a light-gray or yellowish loose fine sand extending to a depth of about 8 inches. This is underlain by a yellow loose fine sand which extends to a depth below the reach of the soil auger. In texture, structure, and color this type is quite similar to the Boone fine sand, but differs from that type in origin and topography. Like the Boone fine sand, it contains only a very small quantity of organic matter and is in an acid condition.

The Lintonia fine sand is of very small extent and minor importance in the present survey. It covers only 1 square mile, the largest area occurring in the northeastern part of the county along the south side of the Buffalo River. It occupies a terrace position between the present flood plain and areas of Boone fine sand.

The surface of this type is nearly level to gently undulating, with a gradual slope toward the Buffalo River. On account of the loose structure the natural drainage is excessive and the soil is droughty. While the type occupies a position above the present flood plain, the elevation is never so great as that of the other types of this series, which also occur as terrace soils. As indicated above, the type occupies a low terrace and the material composing it is of alluvial origin. Possibly a small quantity of material has also been washed down from the higher land adjoining, but the proportion of the type that is of colluvial origin is small.

The original timber was chiefly oak, but the growth was rather scattering. At present nearly all of the type is under cultivation, and most of the crops common to the region are grown. Yields are low, however, and the soil can be worked profitably only under the best methods of soil management.

PLAINFIELD SERIES.

The surface soils of the Plainfield series range in color from brown to grayish yellow, while the subsoils are usually pale yellow to yellowish brown. This series is developed in the deep drift-covered areas of Wisconsin, Michigan, and Minnesota, and comprises soils formed from sandy and gravelly glacial débris washed out from the fronts of

the glaciers. It is also developed as deep, filled-in valleys along major and minor streams like the Manistee and Au Sable Rivers in Michigan, and the Wisconsin River in Wisconsin. The first phase occurs as nearly level or gently sloping outwash aprons connected with terminal moraines, while the second is formed by the filling in of valleys, often several miles in width, during periods of former glaciation. Upon the flat floors of some of these valleys moraines of the later ice sheets have been deposited, leaving intermorainic exposures in the form of level plains. The greater part of the material of the series has been considerably assorted by voluminous glacial waters and consists mainly of sand and gravel. The deposits are deep and the soils leachy and droughty.

PLAINFIELD FINE SANDY LOAM.

The surface soil of the Plainfield fine sandy loam to an average depth of about 14 inches consists of a reddish-brown heavy fine sandy loam. At about 16 to 20 inches the color becomes a lighter reddish brown fine sandy loam, and this grades into stratified yellow fine sand at from 24 to 36 inches. While this is about the normal for the type, there are a number of variations, and the texture may range from a heavy fine sandy loam to a medium, and in a few places a rather coarse, loamy sand. None of the variations, however, were of sufficient extent to be indicated on the soil map. The chief difference between this type and the La Crosse fine sandy loam is that this soil has a reddish-brown color, while the La Crosse surface soil varies from dark brown to nearly black.

The Plainfield fine sandy loam is of small extent and is confined to the valley of the Buffalo River in the northeastern part of the county. It occurs here as a narrow belt and occupies a terrace bordering the Buffalo River.

The surface of the type varies from level to undulating, with a few small areas which approach gently rolling. The higher elevations are usually lighter and coarser in texture than the level tracts. As a whole the drainage is fair, but on the more sandy elevations a droughty condition frequently prevails, while over a few of the heaviest spots the natural drainage is somewhat deficient. The terrace upon which this soil occurs is somewhat lower in position than that occupied by the La Crosse fine sandy loam.

The material forming this type is of alluvial origin, and was deposited by the Buffalo River when that stream flowed at considerably higher levels than at the present time. The material has been derived in part from the unglaciated region and in part from the glaciated. It is noncalcareous, and the type is now slightly acid.

The original forest growth consisted chiefly of oak, elm, and soft maple. Most of the timber has been removed and the land placed under cultivation.

The type is devoted to general farming. Corn yields are somewhat larger than on the La Crosse fine sandy loam, but with other crops the yields are practically the same as on that type. The methods of cultivation, fertilization, etc., also are the same, and the same methods of improvement will apply to this type.

PLAINFIELD SAND.

The surface soil of the Plainfield sand to an average depth of about 12 to 14 inches consists of a fairly loose, brown to dark-brown loamy sand of medium texture. There is a considerable quantity of fine sand mixed with the medium sand in places, and in such places the soil might be classed as a fine sand if of sufficient extent. Litmus-paper tests indicate that the soil is acid. The subsoil consists of a lighter brown medium sand which gradually becomes a yellow sand at from 28 to 36 inches. The deep subsoil consists of stratified sand in which varying quantities of gravel may be found. As a rule the soil next to the bluffs is darker and slightly heavier than that close to the river.

The largest area of this type mapped in the present survey occurs as a narrow terrace along the Chippewa River Valley in the north-western part of the county. This terrace ranges in width from one-eighth to one-half mile, and has a length of over 10 miles and an elevation above the flood plain of the river of 20 to 50 feet or more. The rise from the flood plain is quite abrupt in most places. At the mouth of Big Waumandee Creek there is a terrace of the same soil about 4 miles long and in its widest place about three-fourths of a mile across. None of this type is found outside of the Mississippi and Chippewa Valleys.

The terrace occupied by this soil has the same position as that occupied by the La Crosse fine sandy loam, and the surface is usually level or gently sloping toward the streams. In places there is an undulating or billowy topography, where the wind apparently has altered the original surface features to a slight extent. On account of the loose, open structure of the material the type is excessively drained and subject to drought.

Being of a terrace formation, the type is alluvial in origin, the material having been deposited by the Mississippi River during the glacial period, when the volume of water carried by that stream was much greater than at the present time. A small quantity of gravel is mixed with the sand in the lower sections, and this gravel is doubtless of glacial origin, as is also a part of the sandy material.

The greater proportion of this type was originally in the condition of a prairie, with only a few scattered scrubby oaks. Prairie grass was the most common growth, though this was not heavy.

More than half the area of the Plainfield sand is under cultivation, although as a whole it must be considered of rather low agricultural value. During the most favorable years, when the rainfall is well distributed, fair crops are obtained, but usually, owing to the lack of moisture and of plant food, the ordinary yields are not satisfactory. That part of the type immediately along the bluffs has probably been influenced to some extent by the wash from the heavier upland soils, and for a short distance from the bluffs yields are usually better than along the outer margin of the type. Some areas are uncultivated practically all of the time, because of their extremely sandy nature and consequent low productiveness. On some fields a crop is grown every second year and the ground fallowed in alternate years.

On this type rye is an important crop and yields of 20 to 25 bushels per acre are common during the most favorable years. Corn yields 25 to 40 bushels per acre under the most favorable conditions, but the ordinary yields are far below these figures. Buckwheat is grown to some extent. Clover can be grown successfully only on the lower, darker portions of the type, and even here the yields are not large. Potatoes do fairly well, but only a few are grown for market.

The selling price of land of this type ranges from \$10 to \$40 an acre, depending upon location, improvements, etc.

WABASH SERIES.

The Wabash series includes soils of dark-brown to black color and high organic-matter content, with slightly lighter drab or gray subsoils. The members of this series are developed typically in the first bottoms of streams of the Central Prairie States, the material being derived principally from the loessial and associated soils of this region. They extend for many miles down the Mississippi River.

WABASH LOAM.

The Wabash loam where typically developed consists of a black loam surface soil extending to a depth of 12 to 16 inches, underlain by drab or grayish loam or silt loam which, in the lower subsoil, grades into sandy material. As found in this county, however, the type is quite variable and there is a considerable proportion which does not conform closely with this description. In a number of places the surface soil contains varying quantities of fine and very fine sand, and in such places the color is usually lighter than where the texture is a loam or silt loam. In a number of places the subsoil is darker than the present surface soil, owing to the fact that the

original black surface has been covered by wash of lighter colored material from the adjoining slopes. Frequently large quantities of sand and fragments of limestone have been washed out over the soil from the tributary valleys and ravines and the variations which result from such conditions could not be indicated. The material composing the type, however, is better adapted to agricultural development than most of the Meadow and was therefore separated from that type.

The Wabash loam is found most extensively along the Buffalo and Trempealeau Rivers and Big and Little Waumandee Creeks and some of their tributaries. It occupies narrow strips along these streams and is the lowest land in the bottoms. The surface usually has a gentle slope toward the streams and most of the type is subject to overflow. By straightening and deepening stream channels much of this type doubtless could be reclaimed. Tile drains could also be used in draining such tracts.

In origin this type is largely alluvial, though there are many narrow valleys and ravines having a small extent of this soil along the bottoms where the material is colluvial in origin. In such places there is a great rush of water during heavy rains, but this quickly runs off on account of the steep grade.

The growth on this soil consists of willow, hazel brush, poplar, cherry, elm, and soft maple. There is a rank growth of grass over much of the type, affording excellent pasturage, and frequently hay is cut where there is no brush to interfere. The cutting of hay and pasturing are the only agricultural uses to which the Wabash loam is put at present. If properly drained, as some of it could be, it would be adapted to corn, small grains, timothy hay, alsike clover, and a number of other crops.

MISCELLANEOUS MATERIAL.

ROUGH STONY LAND.

Rough stony land includes rock exposures, cliffs, and land which is too steep and rough to plow or cultivate profitably. It may be considered nonagricultural, as it is of value only for the small quantity of timber and pasture which it supplies.

This type occupies a large part of the steep walls bordering the valleys and forms a border between the valley bottoms and the high land of the ridges. The type is developed as narrow bands, many miles in extent, winding in and out of the valleys and coves, but 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 found. The bluffs and cliffs are highest along the western portion of the county, and frequently reach an elevation of 450 to 500

feet above the valley bottoms along the sides of which they occur. The ridge tops are also wider here than elsewhere, and range in width from one-half to 1 mile, while in the interior of the county and along the eastern portion the valleys ramify more extensively, the ridge tops are narrower, and the steep valley walls are not so high. The elevation of the ridge tops ranges from 150 to 250 feet above the valley floor throughout most of the interior of the county.

Rough stony land is quite uniformly distributed throughout the upland portion of the county and is intimately associated with Union silt loam and the steep phase of that type. Wherever there are a few inches of soil it is usually a silt loam, though there are exceptions to this in the region of sandstone rocks, where the soil is sandy. The greater proportion of the rock exposed consists of lower Magnesian limestone, though there is also considerable Potsdam sandstone exposed directly below the limestone.

The forest growth 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 serves to protect the slopes from washing.

The inclusion of Rough stony land in farms reduces the value of better land and it renders the fields and farms 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 this class of land.

MEADOW.

The material classed as Meadow is so variable that a division into separate types would be impossible on the scale of an inch to the mile. It lies entirely within the flood plain of the Mississippi, Chippewa, and Trempealeau Rivers and their tributaries, and is the fifth type in the county from the standpoint of acreage.

The largest tract of Meadow is found bordering the Chippewa River from the north county line south to its junction with the Mississippi River. The broad bottom extends to the southeast along the Mississippi River, gradually becoming narrower, until at Alma the river flows close to the bluffs on the Wisconsin side so that there is no bottom land at that point in this State. This stretch of Meadow has a maximum width of over 3 miles and comprises about 25 square miles. Below Alma, in the Mississippi Valley, the Meadow broadens out again, ranging from three-fourths of a mile to 1½ miles in width until the Trempealeau River is reached, where the bottom widens out into an extensive area. Tracts of Meadow are also found along Buffalo River and Big Waumandee Creek. The largest areas of Meadow are traversed lengthwise and crosswise by numerous sloughs and channels. Beef Slough, in the Chippewa Valley, is the largest of these. In the early days it was used for running logs, and numerous dams kept the water at a high level; at every rise all the bottoms

were covered by 6 to 9 feet of water. Since the dams have been removed overflows are less frequent, but much of the Meadow is still flooded during a part of nearly every year.

Sand and gravel strips border all of the sloughs, but some of the larger, more elevated areas between the sloughs are covered with a reddish-brown heavy loam to silt loam, which is underlain at 1 foot to 3 feet by fine brown sand or by sand and gravel. These silty tracts are largely "open" or partly covered by scattered clumps of trees. A good stand of grass is usually found in such open places, and this is usually cut for hay, stacked, and hauled out in the winter. Most of the tracts unsuitable for hay making lie parallel with the Chippewa River in the vicinity and to the north of Trevino. Large tracts of this land are held by development companies, and some attempt is being made to farm portions which are least subject to overflow.

The best drained open areas of the Meadow are grass-covered, but the thick brush and woods line most of the sloughs. Willow, elm, soft maple, some birch, and a little oak are to be found on the bottoms.

The material composing Meadow is of alluvial origin, having been deposited by the streams in times of overflow. The gravel and much of the finer material present have been carried from the glacial region to the north. Differences in texture are the result of variations in the swiftness of the current at different times. The coarsest particles are deposited by rapidly moving currents, and the finer particles of silt and clay by nearly quiet water.

Cultivation of Meadow has been attempted only in isolated spots. Two or three clearings have been started and abandoned along the Chicago, Milwaukee & St. Paul Railway parallel with the Chippewa River. A farm is located on Meadow in sec. 2, T. 23, R. 14. The farmer cuts hay, pastures his cattle on the bottoms, and cultivates a few acres of fine sandy loam soil. Excellent yields are reported from clearings in secs. 11 and 14, T. 23, R. 14, where as much as 50 bushels of corn an acre have been produced. Sixty to one hundred acres in secs. 27 and 34, east and north of Trevino, were being broken for corn and sugar beets at the time the survey was in progress. This is in the nature of an experiment by a large development company, and there is considerable interest in the outcome of the venture. In the southern part of the county much development is under way in the reclaiming of Meadow land. When once properly drained the Meadow will be expensive land, as in many cases levees will have to be constructed, and some drainage waters may have to be removed by pumping.

PEAT.

The material mapped as Peat consists of vegetable matter in various stages of decomposition and with which there has frequently been incorporated a very small quantity of mineral matter. The surface

is black or dark brown and is usually fairly well decomposed, while the underlying material is of a brownish color and fibrous in most cases. The Peat extends to a depth greater than 3 feet in all cases, and it is probable that it exceeds 10 feet over most of the areas, though the exact depth was not determined.

The Peat in this survey is of rather small extent. The largest area extends from about 3 miles west of Mondovi west and northwest to the county line and southward through several stream valleys. The area comprises the divide between Farrington Creek, flowing east into Buffalo River, and Big Bear Creek, flowing west into the Chippewa River. This divide, however, is not marked, and no differences in elevation in the marsh can be detected by the eye. Other areas of Peat are encountered in various stream valleys throughout the county, the largest occurring along the Trempealeau River in the southeastern part of the county. These consist of low, wet tracts bordering the river, and it would be difficult to reclaim them.

Some of the areas of Peat are covered with a dense growth of tamarack, while other portions are treeless and support a thick growth of coarse, wild grass. In Farrington Creek Valley both conditions are found. Over the open marshes the wild grass is frequently cut for hay, and this is the extent of the present agricultural use of this soil.

In a number of the Peat areas reclamation is practicable. When properly handled the Peat should yield good crops of corn, timothy, and alsike clover, and even small grains can be grown successfully.

SUMMARY.

Buffalo County is situated midway along the west State line of Wisconsin and comprises 687 square miles, or 439,680 acres. It may be divided broadly into two divisions, the valleys and the uplands. The topography of the valleys is level to undulating, becoming gently rolling in a few places, and at the upland ridgy. 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 county.

The first settlements in the territory embraced within the county were made between 1845 and 1850. All parts of the county are now well settled.

Three railroad systems enter the county, and these with the Mississippi River provide adequate transportation facilities, except for interior points. Alma, the county seat, is 353 miles from Chicago, over the Chicago, Burlington & Quincy Railroad, and 89 miles from Minneapolis.

The mean annual temperature of the county is about 45° F. and the mean annual precipitation about 30.5 inches. The length of the growing season is about 150 to 155 days.

Over practically all the county agriculture is well developed and prospering. The leading type of agriculture is general farming, with dairying as the main feature. The crops most extensively grown are oats, hay, corn, barley, rye, and wheat. The steep slopes afford excellent pasture and are usually kept in grass to prevent erosion.

Buffalo County lies within the unglaciated portion of the State and the soils have been derived largely from the disintegration products of the underlying limestones, shales, and sandstone, although possibly there has been influence in places by wind-blown material or loess, and from the material washed down from the slopes, transported by the streams, and deposited as terrace formations.

Including Rough stony land, Peat, and Meadow, 19 types of soil are recognized in the county.

The Union silt loam, with its steep phase, is an extensive type and is found throughout the upland portion of the county. It is a good general farming soil and upon it dairying is carried on quite extensively. It produces a better quality of grain than any of the other types.

The La Crosse series consists of dark-colored terrace soils, found along many of the streams throughout the county. This series includes some of the finest agricultural land in the county. The types mapped are the La Crosse silt loam, fine sandy loam, fine sand, and gravelly sandy loam.

The Boone series of soils is derived from the disintegration of the Potsdam sandstone. The fine sand and fine sandy loam members are not so productive as some of the other soils, but the silt loam is the most extensive and one of the most desirable soils in the county.

The Lintonia series forms the light-colored terraces throughout the county, but is not very extensively developed. The types mapped are the silt loam, fine sandy loam, and fine sand. The Lintonia silt loam is very similar to the Boone silt loam, except in topography and origin.

The Plainfield series of terrace soils includes the sand and fine sandy loam found along the Buffalo, Chippewa, and Mississippi Rivers. The fine sandy loam is used for general farming.

The Bates series is similar to the Boone, but the soils are black instead of light colored. The types mapped include some of the best soil in the county. The Bates silt loam and fine sandy loam are recognized and mapped as belonging to this series.

The first-bottom land, excepting Meadow, was classed with the Wabash series, and one type, the Wabash loam, was mapped.

Meadow consists of the low-lying land within the present flood plain of the Mississippi, Chippewa, and Trempealeau Rivers and a few tributary streams. It is subject to overflow, is poorly drained, undevel-

oped, and of such mixed textures that no separation into types is attempted.

Peat comprises areas of partially decomposed vegetable matter which occupy low, poorly drained positions, chiefly along streams. This soil is rather inextensive in Buffalo County.

Rough stony land includes rock exposures, cliffs, and land which is too steep and rough to cultivate profitably. It is only of value for the small amount of timber and pasture it supplies.



[PUBLIC RESOLUTION—No. 9.]

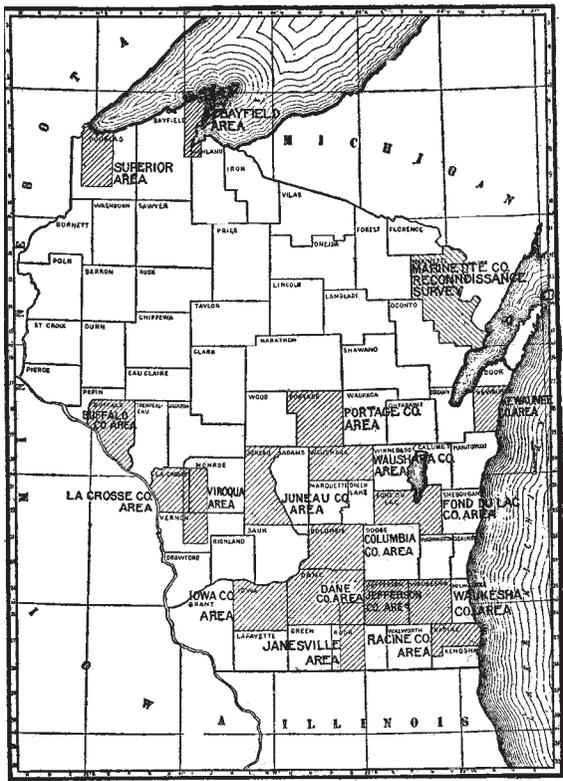
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved, March 14, 1904.

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



Areas surveyed in Wisconsin.

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