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BUREAU OF CHEMISTRY AND SOILS
In cooperation with the Wisconsin Geological and Natural History Survey and the University of Wisconsin College of Agriculture

SOIL SURVEY
OF
SHEBOYGAN COUNTY, WISCONSIN

BY

W. J. GEIB, in Charge, and A. C. ANDERSON
U. S. Department of Agriculture
and W. H. PIERRE, A. H. MEYER, G. D. SCARSETH
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Wisconsin Geological and Natural History Survey

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COUNTY SURVEYED

Sheboygan County is a little south of the east-central part of Wisconsin, bordering Lake Michigan. It has an area of 515 square miles, or 329,600 acres. The extreme length from north to south is 24 miles and the extreme width from east to west is about 23 miles. The city of Sheboygan is 52 miles from Milwaukee and 137 miles from Chicago.

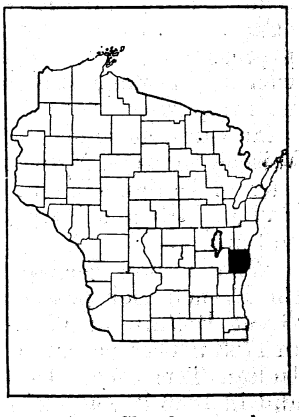

FIGURE 1.—Sketch map showing location of Sheboygan County, Wis.

The surface relief of Sheboygan County varies from level and rolling to hilly and irregular. The area consists of a gently rolling plain crossed by a range of hills known as the Kettle Range. This range crosses the county from northeast to southwest. It varies in width from 1½ to 3 or 4 miles. A second range of hills is south of the main range and nearly parallel to it. Within these ranges the surface is very irregular, kames, eskers, and potholes being numerous. The highest points are more than 200 feet above the surrounding country. Between the hills and Lake Michigan the land is level or gently rolling. It is generally more level near the lake and gradually becomes more rolling to the westward. West of the Kettle Range the surface is gently rolling. The general elevation of the county ranges from about 600 feet to about 972 feet. The most prominent relief is in the central and western parts, where the differences in elevation between valley bottoms and the adjacent ridges range from 200 to 300 feet. The highest points in the Kettle Range in the northern part of Mitchell Township and adjacent parts of Greenbush Township, are about 1,200 feet above sea level. The shore of Lake Michigan is steep and in most places is from 40 to 60 feet high.

The following table shows the elevation of cities, villages, and other places within the county and gives the authority for the data:

9445—28——1

Elevations of places and authority for the data

Place	Elevation	Authority
	Feet	
Adell	904	C., M. & St. P. Ry.
Cedar Grove	697	C. & N. W. Ry.
Greenbush	972	Do.
Hulls Crossing	940	Do.
Oostburg	701	Do.
Plymouth	845	Do.
Do	846	C., M. & St. P. Ry.
Random Lake	883	Do.
Sheboygan	589	C. & N. W. Ry.
Sheboygan Falls	668	Do.
Waldo	840	C., M. & St. P. Ry.
Lake Michigan	581	U. S. L. S. Ordinary water level.
Do	579	U. S. L. S. Low-water level.

The eastern, central, northern, and northwestern parts of the county are drained chiefly by Sheboygan River and its tributaries. Onion, Mullet, and Pigeon Rivers are the three largest tributaries within the county. Onion River drains much of the southeastern part of the county, Mullet River the central part, and Pigeon River the northeastern. The southwestern part is traversed by North Branch Milwaukee River. Numerous lakes and marshes are in various parts of the county. The largest, Sheboygan Marsh in the northwestern part of the county, covers about 15¾ square miles. This was once a lake and is bordered by beach bridges, wave-cut cliffs, and ice ramparts.

As early as 1824 the leading trading posts on Lake Michigan in Wisconsin were Milwaukee, Sheboygan, and Manitowoc. All were sites of Indian villages. At that date the whole region from Green Bay to Milwaukee was occupied by the Pottawattomie and Ottawa Indians.

What is now Sheboygan County was owned by the Indians until the French took possession in the seventeenth century. It passed to Great Britain in 1763. At the close of the American Revolution in 1783 it became part of the United States and in 1800 a part of the Indian Territory. In 1818 it was attached to Michigan Territory, and in 1836 it was included in Wisconsin Territory. Jacques Vieau, of the Northwestern Fur Co., the first white man to visit the present site of Sheboygan, arrived there in 1795. The first sawmill was built in 1834, and this was about the time of the first settlement. Sheboygan County was separated from Brown County in 1836.

In 1840, the population of the county was 133. The population increased rapidly during 1846 and 1847, owing to immigration of Dutch and German settlers. The Dutch settled first in the township of Holland. The township of Rhine was settled largely by Germans from the region of Rhine River. A body of Luxemburgers settled in the southern part of the county. Other early settlers included Norwegians and Irish.

In 1920, 80.7 per cent of the population of Sheboygan County were native-born whites, 19.2 per cent were foreign-born whites, and less than one-tenth of 1 per cent were colored. Of the total of 11,533 foreign-born inhabitants, 5,496 were Germans, 1,175 were from the Netherlands, and 2,009 were from Russia. Many of the foreign-born inhabitants, except the Dutch and Germans, live in the cities.

The first railroad was built in 1856. This encouraged the rapid development of the county. Sheboygan, the county seat and largest city in the county, had a population of 30,955 in 1920. It is an important manufacturing center and an important distributing point for farm machinery and supplies. Plymouth is the center of the American cheese industry and is reputed to be the largest cheese market in the world. Kohler and Sheboygan Falls are manufacturing centers of importance, and numerous smaller towns within the county are shipping centers for farm produce, as well as distributing centers for all kinds of farm supplies.

Two steam railway systems, the Chicago & North Western Railway, with a branch line, and the Chicago, Milwaukee & St. Paul Railway, and one electric line, the Milwaukee Electric Railway & Light Co., serve the county and provide good transportation facilities for freight and passenger traffic.

Considerable excellent road-building material is found in Sheboygan County in the form of gravel and limestone rock, and the highway system is highly developed. There are many miles of concrete roads and long stretches of gravel and crushed-rock highways. A patrol system keeps the roads in good repair, and poor highways are the exception rather than the rule. State and county trunk highways reach most parts of the county and provide excellent roadways for local as well as through travel.

The towns within the county afford markets and shipping points for the farm produce, much of which is shipped to Milwaukee and Chicago. Butter and cheese are shipped to all parts of the country.

CLIMATE

Sheboygan County is in the Michigan shore province, which is one of eight climatic provinces into which the State is divided.[1] The bulletin states:

> The Michigan shore possesses the most equable climate in Wisconsin. The winters are mild (22 degrees), and somewhat moister than elsewhere in the State, resembling those of the coast of Maine, or eastern Michigan; the springs (42 degrees) are retarded and cool, like those along the coasts of New England and British Columbia; the summers (67 degrees) are mild and pleasant, averaging over 2 degrees cooler than the Wisconsin or Rock River Valleys and 4 degrees cooler than the Mississippi Valley; while the autumns (50 degrees) are warmer than farther west, the temperature being about the same as that of eastern Massachusetts, the Hudson Valley, or the Lake Ontario shore of New York. During the winters an average of five days shows a temperature lower than 10 degrees below zero, while on seven days in the year the thermometer registers 90 degrees or more. The lake shore is not a distinctive corn region, but is splendid for pasture, peas, and hay, the growing season extending from about May 1 to October 10, thus resembling southern Ontario and northwestern New York. The average rainfall (30.3 inches) is slightly less than that of the State in general, and a larger proportion is precipitated in winter (5.2 inches), and less in summer (9.6 inches).

Two stations of the United States Weather Bureau are within the county, one at Sheboygan on the lake shore and one at Plymouth, about 12 miles inland. These two stations represent fairly well the conditions along the lake shore and also those in the inland part of the county. There is considerable difference at the two stations in

[1] WHITSON, A. R., and BAKER, O. E. THE CLIMATE OF WISCONSIN AND ITS RELATION TO AGRICULTURE. Wis. Agr. Expt. Sta. Bul. 223, 65 p., illus., July, 1912.

dates of killing frosts. At Sheboygan the frost-free season is shown to be about 180 days, extending from April 23 to October 20, whereas at Plymouth it is only 158 days, extending from May 7 to October 12. Frosts in the lowlands occur about two weeks earlier than on the adjoining highlands.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation at Plymouth and Sheboygan:

Normal monthly, seasonal, and annual temperature and precipitation

Month	Plymouth, elevation 843 feet		Sheboygan, elevation 589 feet	
	Mean temperature	Mean precipitation	Mean temperature	Mean precipitation
	°F.	Inches	°F.	Inches
December	23.3	1.24	25.2	1.71
January	16.4	1.46	19.6	1.97
February	17.9	1.50	19.3	1.69
Winter	19.2	4.20	21.4	5.37
March	31.2	1.68	32.5	2.14
April	43.6	2.22	42.8	2.35
May	53.8	3.80	52.7	3.76
Spring	42.9	7.70	42.7	8.25
June	64.1	3.27	63.2	3.10
July	70.4	2.26	69.9	2.96
August	67.7	3.27	68.9	3.16
Summer	67.4	8.80	67.3	9.22
September	60.3	3.94	61.8	3.59
October	50.2	3.23	50.8	2.74
November	35.5	2.37	37.8	2.05
Fall	48.7	9.54	50.1	8.38
Year	44.5	30.24	45.4	31.22

AGRICULTURE

The system of agriculture followed at present in Sheboygan County consists of general farming, with dairying as the most important branch. The importance of dairying will be appreciated when it is stated that there were in the county on January 1, 1920, more than 58,000 dairy cattle. In 1919 there were produced in the county more than 26,000,000 gallons of milk, about $1,125,000 worth of butter, and more than 17,000,000 pounds of cheese which had a value of more than $5,000,000.

The most important crops grown are those which are needed to support the dairy industry. From the viewpoint of acreage, the crops run in the following order: Oats, timothy and clover mixed, corn, alfalfa, barley, and canning peas. Rye, beans, clover seed, dry peas, wheat, potatoes, cabbage, buckwheat, and sugar beets are among the crops grown on a smaller acreage.

According to the report of the Wisconsin Department of Agriculture for 1923 oats in that year were grown on 57,946 acres and gave an average yield of 44 bushels to the acre. This crop is grown on practically all of the extensive upland soils but probably does best

on the loam, fine sandy loam, and silt loam soils of the Kewaunee and Bellefontaine series.

Mixed clover and timothy for hay were grown on 43,919 acres in 1923 and were the second most important crop from the viewpoint of acreage. Hay crops do well on the heavy soils of the county and are grown extensively on soils of the Superior series. The smallest acreages are on the sandy soils. Some wild hay is grown on the poorly drained land.

The total area devoted to corn in 1923 amounted to 36,837 acres, of which about 26,000 acres were grown for silage. The average yield of mature corn was 33 bushels to the acre, and the silage averaged 7.6 tons. Corn is grown on practically all the soils but probably does best on the well-drained, fairly heavy soils of the Miami, Kewaunee, and Bellefontaine series. Soils of a fine sandy loam or silt loam texture are well adapted to this crop. The level, heavy soils are apt to be cold, on account of deficient drainage. The low, poorly drained soils, such as Clyde silt loam and Maumee loam, are well suited to corn when they are well drained. On account of the influence of Lake Michigan on the climate, the acreage of corn is not so great immediately along the lake shore as it is back 10 or 15 miles.

Alfalfa is the crop fourth in acreage, and the acreage is rapidly increasing each year. There were 8,724 acres in alfalfa in 1923, and the average yield was 2.4 tons to the acre. This crop makes excellent feed and is of great value to dairy farmers, as it greatly reduces the quantity of ground feed needed. Alfalfa does best on the well-drained loam, gravelly loam, and silt loam soils which are well supplied with lime. In Sheboygan County these are the members of the Bellefontaine and Kewaunee series.

The acreage of barley is much smaller than that of oats, in 1923 being only 7,219 acres. The crop is used partly for feed, but some of it is sold.

Peas for canning were grown on 5,586 acres in 1923 and gave an average yield of 1,880 pounds to the acre. They are grown on a variety of well-drained soils ranging in texture from clay to fine sandy loam. The sandy soils are not favored for pea growing.

Rye was grown on about 2,000 acres and produced an average yield of 19 bushels to the acre in 1923. Rye does better on sandy soils than other small grains, but it is not grown exclusively on sandy soils. Spring wheat was grown on only 737 acres and gave an average yield of 15 bushels to the acre, and winter wheat was grown on 970 acres and gave an average yield of 17 bushels in 1923. Wheat is grown most extensively on the heavier, well-drained soils of the Superior, Kewaunee, and Miami series. Clover seed is an important product, and 4,000 acres of clover were harvested in 1923, giving an average yield of 2 bushels to the acre. Beans were grown on about 2,500 acres and peas for drying on 1,144 acres.

In 1923 potatoes were grown on 2,956 acres and gave an average yield of 107 bushels to the acre. Cabbage was grown on only 12 acres and yielded 8 tons to the acre. Buckwheat was grown on 337 acres, with an average yield of 15 bushels to the acre. Sugar beets were harvested from 75 acres, with an average yield of 7.8 tons to the acre.

Fruit growing is not as yet extensively practiced. The trucking industry is nowhere highly developed, but it could probably be extended with profit, so far as the soils are concerned.

The Holstein-Friesian is the predominating breed of dairy cattle, and there are many purebred herds and many grade cattle of good breeding. There are a few Guernseys and Brown Swiss in the county. Beef cattle are a minor factor in the livestock industry of the county. The dairy products are sold chiefly in the form of cheese and butter, but some whole milk is marketed. Sheboygan County is one of the leading cheese-producing counties in the State and in 1923 produced more than 19,000,000 pounds of American cheese. In 1924 there were in the county 119 cheese factories and 5 butter factories. A milk condensery was in operation in 1921 and 1922 but was not operating in 1924. There were in 1924 nine milk-receiving stations.

There were 33,637 hogs in the county in 1923. Where butter is produced hogs are fed the skimmed milk, and where cheese is made they get the whey. Nearly every farmer raises some poultry, and some keep a few stands of bees. Sheep are kept by only a few farmers.

The following table gives the acreage and production of the principal crops in 1919 and 1923:

Acreage and production of principal crops in 1919 and acreage and yield per acre in 1923

Crop	1919 [1]		1923 [2]	
	Acres	*Bushels*	*Acres*	*Bushels per acre*
Corn	10,626	457,919	31,837	33
Oats	46,924	1,614,000	57,946	44
Wheat	8,092	105,397	1,707	16
Barley	6,289	142,375	7,219	28
Rye	4,848	77,991	2,000	19
Buckwheat	292	3,665	337	15
Dry beans	283	3,489	254	11
Dry peas	1,099	16,660	1,144	15
Flaxseed	34	259		
Potatoes	2,944	202,709	2,956	107
		Tons		*Tons per acre*
Total hay and forage	85,913	284,129		
Tame hay	49,799	78,736		
Clover and timothy	31,384	50,207	43,919	1.1
Alfalfa	2,405	5,281	8,724	2.4
Wild hay	461	558	374	1.4
Silage crops	25,202	196,219		
Corn cut for forage	10,100	7,829		
Sugar beets	37	230	75	7.8
	Bearing trees	*Bushels*	*Bearing trees*	*Bushels*
Apples	83,130	45,089	52,497	37,794
Plums	[3] 3,668	625	944	71
Cherries	14,826	4,429	1,893	470
	Bearing vines	*Pounds*	*Bearing vines*	*Pounds*
Grapes	1,421	6,782	203	1,390

[1] United States census of 1920.
[2] Agricultural statistics of Sheboygan County.
[3] Includes plums and prunes.

Farm labor has been hard to obtain in Sheboygan County in the last few years. With the development of manufacturing in the cities in the eastern part of the State there has been a gradual drawing

away of labor from the farm. The pre-war farm wage was from $35 to $50 a month, with room and board furnished. A house was supplied to married men, and frequently a garden spot and wood for fuel were provided. Day labor commanded a higher wage. About the highest point in labor wages was reached in 1920, when as much as $100 a month was paid. In 1921 there was a marked decrease in farm wages.

In 1923 there were 3,609 farms in the county, according to the assessor's records. On January 1, 1920, according to the United States census, there were 3,664 farms. The average size of the farms was 86.8 acres.

In 1919, 87.9 per cent of the farms were operated by owners, about 59 farms by managers, and the remainder by tenants. Cash is the most common form of rental in Sheboygan County.

A wide range in the value and selling price of lands in Sheboygan County results from differences in soil, improvements, location, and surface features. The lowest prices prevail in the rough, broken, and hilly regions, where values range from less than $25 to $50 an acre. Highly improved farms on the best soils frequently have a selling value from $200 to $300 an acre. Some of the land in the marshes is of low value, as it must be improved by drainage before it can be farmed. Land near or adjoining lakes frequently has a high value, owing to its desirability for summer homes and resorts.

As given by the census of 1920, the value of all farm property in the county was $63,348,843, and the average value of all property to the farm was $17,290. The average value of land and buildings was $13,870, and the average value of land alone was $117.58 an acre.

Of all farms operated by the owner, 2,016 have a mortgage debt and 1,048 have no mortgage debt. The ratio of debt to the value of the farms on the average is 39.9 per cent, and the average rate of interest paid is 4.6 per cent.

On most of the farms in Sheboygan County the farm buildings are substantial and in good repair. The farm homes are neat and attractive. In 1923, 3,280 of the farms were equipped with silos. Farm machinery of the most approved type is in common use. Manure spreaders, hay loaders, side-delivery rakes, 2-horse cultivators, and 2-row cultivators are common. In 1923 there were 858 tractors in the county, and the number is gradually increasing.

A number of dairy farms are equipped with milking machines and electric-light plants. Free delivery of mail reaches practically every farm. Sheboygan County, as a whole, is a region of high agricultural development, and prosperous farms are the rule rather than the exception.

SOILS

Sheboygan County lies within the timbered region of the United States, where the surface relief, moisture, and temperature favored the growth of extensive forests. When the first settlers came to this region they found practically all of the land covered with a heavy growth of trees.

The soils of the county, therefore, with possibly one exception, show those characteristics which indicate that they were developed under a heavy forest cover. The most common characteristic of

these forested soils, where well drained, is their light color, indicating a low content of organic matter.

The soils of the county may be differentiated, on the basis of their most obvious characteristic, into light-colored and dark-colored soils. The areas of dark-colored soils, with one exception, are coextensive with the areas of poorly drained land. The exception is the Warsaw soils.

In the group of light-colored soils are the Bellefontaine, Miami, Conover, Coloma, Superior, Kewaunee, Rodman, Fox, Lucas, Plainfield, Bridgman, Genesee, and Ewen soil series. In the dark-colored group are the Warsaw, which are well drained, the Clyde, Poygan, Maumee, Wabash, and Saugatuck, which are poorly drained mineral soils, and the organic soils, Carlisle muck and Rifle peat.

As the parent soil materials of the county are comparatively recent glacial deposits, they have not been subjected to long periods of weathering. The parent materials, with very few exceptions, were very rich in lime, and lime is still abundant at a depth of 2 or 3 feet in the heavy and medium textured soils. The surface soils in the uplands show some acidity in places, but in many places alfalfa can be grown without liming.

The parent material of the soils of Sheboygan County, except muck and peat, consists of gacial drift or lake-laid material of varying degrees of fineness or grades of texture. The glacial drift is mostly ice laid and consists of a heterogeneous mixture of bowlders, gravel, sand, and clay. This rock débris consists of granite, gneiss, limestone, sandstone, and other rock material, with a high percentage of limestone material. In places, the glacial drift has been carried and redeposited by water, as stratified beds which may show assortment as to texture of material but which are still lithologically heterogeneous.

The soils of Sheboygan County have been grouped into soil series on the basis of common properties which could be determined by examination or by simple field tests. Among these properties are the arrangement and thickness of the natural soil layers, the texture of the material, except the surface soil, the color, consistence, structure, and certain readily recognizable chemical properties, such as content of lime and organic matter. The series are divided into soil types on the basis of the texture of the topsoil.

The members of the Bellefontaine series have topsoils which are grayish brown or brown. The subsoil is reddish brown or yellowish brown in the upper part and reddish brown below, and is heavier than the material above and rather plastic and tough. At a depth of 2 or 2½ feet it grades to lighter, more friable, slightly weathered stony and gravelly till containing a high percentage of limestone. In this series the surface layers are neutral or only slightly acid. The relief is undulating or strongly rolling, and drainage is well established. The silt loam, loam, fine sandy loam, and gravelly loam members of the series are mapped.

In the Miami soils the topsoils are brownish gray or grayish brown, and the subsoils are yellowish brown, commonly with some rust-brown iron streaks or specks in the lower part. The subsoil is heavy textured to a depth ranging from 30 to 48 inches and grades below to more friable material consisting of heavy glacial till, which is moder-

ately or strongly calcareous. The surface soil usually shows some acidity. The relief is undulating or gently rolling. Miami silty clay loam is mapped in Sheboygan County.

The Conover soils have gray or dark-gray surface soils and lighter gray, somewhat mottled subsurface soils. The subsoils are mottled gray, yellow, and brown heavy tough clay which grades, at a depth of 2 or 3 feet, to calcareous till similar to that underlying the Miami soils. The topsoil and upper part of the subsoil are acid. Conover silt loam was mapped.

The Coloma soils are characterized by grayish-brown topsoils and yellowish or yellowish-brown light, sandy subsoils. The unweathered parent material below a depth of 2½ or 3 feet usually is sand or fine sand containing little or no limestone material. The surface is undulating or rolling, and drainage is good or excessive. Coloma fine sand was mapped.

The members of the Rodman series occur in the hilly country. They are very irregular and broken, and on the rougher parts of the terraces only a very shallow layer of brown soil has formed over the loose gravel deposits. Drainage is excessive. Rodman gravelly loam was mapped.

The Superior soils consist of brown or reddish-brown surface soils underlain by heavy reddish clay and silty clay subsoils. Some gravel and stone and some lenses of sand are present in places, but as a rule the material is fine textured. The topsoil is commonly not acid, and the parent material is calcareous. Superior clay loam, Superior silt loam, Superior loam, and Superior fine sandy loam were mapped.

The Kewaunee soils are similar to the Superior, except that possibly they have a larger content of coarse material. The silty clay loam, silt loam, loam, and fine sandy loam of the series were mapped.

The Fox soils have grayish-brown or brown topsoils and yellowish-brown or reddish-brown subsoils, heavier than the topsoils and somewhat compact, which rest on stratified beds of sand or gravel at a depth ranging from 20 to 36 inches. The substratum contains a high percentage of limestone gravel, but the soil is in many places acid at the surface. The silt loam, loam, and fine sandy loam of the Fox series were mapped.

The soils of the Lucas series are similar to those of the Fox, but differ in having thicker layers of fine earth material over the beds of sand and gravel. Lucas silt loam is mapped.

The soils of the Plainfield series have grayish-brown sandy topsoils and yellow or yellow-brown sandy subsoils. Both the topsoil and the subsoil are commonly acid. Plainfield fine sand is mapped.

The Berrien soils differ from the Plainfield in having a calcareous clay substratum at a depth ranging from 3½ to 5 feet. Berrien fine sand is mapped.

The Saugatuck soils are sandy soils with dark-gray or nearly black topsoils underlain by light-gray sand. The subsoils are characteristically brown hardpan material, and the sandy substrata are water-logged or poorly drained and mottled. Saugatuck fine sand was mapped.

The Warsaw soils include dark-brown or black soils. The subsoils are commonly dark brown or yellowish brown and grade to beds of sand or gravel. Warsaw loam and Warsaw silt loam were mapped.

The Clyde series includes dark-brown or black poorly drained soils, commonly occupying depressions in the glacial-till region. The subsoils are gray, blue, or mottled and are heavy textured. They are underlain by calcareous glacial till. In very few places is the topsoil acid. Clyde silty clay loam and Clyde silt loam were mapped.

The Maumee soils are similar to the Clyde but differ in being underlain by sand and gravel and in consisting mostly of terrace material. The topsoil is dark colored, and the subsoil is gray, blue, or mottled. Maumee loam was mapped.

The Poygan soils typically are dark-brown or black soils having heavy red clay subsoils. Areas are low, level, or depressed, and natural drainage is poor. These soils are associated with those of the Kewaunee and Superior series. The silty clay loam, silt loam, and fine sandy loam of the Poygan series were mapped.

The Wabash series includes dark-colored first-bottom soils subject to overflow. The only member of the series mapped is the silt loam.

The Genesee series includes light-colored first-bottom soils subject to annual overflow. Genesee silt loam and Genesee fine sandy loam were mapped.

The soils of the Ewen series are similar to those of the Genesee but are reddish in color and are associated with the Kewaunee and Superior soils. They occupy first bottoms subject to flooding. Ewen silty clay loam and Ewen silt loam were mapped.

Dune sand occurs along lake shores where sand, previously thrown up by wave action, has been blown into dunes by the wind. It is of small extent and minor importance. Where the dunes have been quiescent, under forest cover for some time, a fine sand soil, Bridgman fine sand, has developed.

Muck consists of black, disintegrated organic matter mixed with a small quantity of mineral soil. Carlisle muck was mapped in this county.

Peat consists of brown organic matter, in various stages of decomposition, which has been mixed with small quantities of mineral matter. Rifle peat was mapped in Sheboygan County.

Rough broken land includes areas of rough land which is unfit for agricultural use, except possibly for grazing in some places.

In the following pages of this report the various soils are described in detail and their agricultural importance is discussed; their distribution is shown on the accompanying soil map; and their acreage and proportionate extent are given in the following table:

Acreage and proportionate extent of soils mapped in Sheboygan County, Wis.

Types of soil	Acres	Per cent	Types of soil	Acres	Per cent
Bellefontaine silt loam	77,184	25.1	Kewaunee fine sandy loam	1,792	0.5
Steep phase	5,632		Superior clay loam	6,592	2.0
Bellefontaine loam	2,560	.9	Superior silt loam	6,336	1.9
Steep phase	448		Superior loam	3,776	1.1
Bellefontaine gravelly loam	3,520	1.6	Superior fine sandy loam	3,200	1.0
Steep phase	1,664		Fox silt loam	9,216	3.6
Bellefontaine fine sandy loam	960	.3	Eroded phase	2,880	
Kewaunee silty clay loam	75,776	23.2	Fox loam	2,624	.9
Steep phase	768		Gravelly phase	384	
Kewaunee silt loam	16,256	4.9	Fox fine sandy loam	1,344	.4
Kewaunee loam	4,736	1.4	Lucas silt loam	3,136	1.0

Acreage and proportionate extent of soils mapped in Sheboygan County, Wis.—Continued

Types of soil	Acres	Per cent	Types of soil	Acres	Per cent
Warsaw silt loam	576	0.2	Clyde silty clay loam	3,264	1.0
Warsaw loam	256	.1	Maumee loam	1,280	.4
Miami silty clay loam	320	.2	Genesee silt loam	3,776	1.1
Berrien fine sand	1,728	.5	Genesee fine sandy loam	128	.1
Plainfield fine sand	576	0.2	Ewen silty clay loam	1,728	.5
Sangatuck fine sand	1,472	.4	Ewen silt loam	1,536	.5
Conover silt loam	1,984	.6	Wabash silt loam	3,200	1.0
Coloma fine sand	256	.4	Carlisle muck	20,352	6.9
Shallow phase	960		Shallow phase	2,304	
Rodman gravelly loam	12,800	3.9	Rifle peat	9,536	2.9
Bridgman fine sand	512	.2	Rough broken land	1,152	.3
Poygan silty clay loam	18,368	5.5	Dune sand	960	.3
Poygan silt loam	1,088	.3			
Poygan fine sandy loam	64	.1	Total	329,600	
Clyde silt loam	8,640	2.6			

BELLEFONTAINE SILT LOAM

The surface soil of typical Bellefontaine silt loam, in virgin areas, is rather dark brown silt loam containing considerable leaf mold to a depth of 1 or 2 inches. This grades to grayish-brown or brown, smooth, friable silt loam which, at a depth of 8 or 10 inches, is underlain by reddish-yellow, brownish-yellow, or reddish-brown silty clay loam or silty clay. Over considerable areas the upper part of this layer is yellow, reddish-yellow, or brownish-yellow silt loam. Below a depth ranging from 18 to 28 inches the material is commonly reddish-brown friable silty clay or rather gritty clay containing considerable angular gravel. The gravel is mostly derived from dolomitic limestone. This layer may become slightly heavier with depth. It appears somewhat heavy and hard where it is exposed in road cuts. Its thickness ranges from 2 to 36 or more inches, but commonly it continues to a depth of about 28 inches and grades directly to very gravelly friable clay or clay loam. This material varies considerably in color but is mostly reddish brown, varying to brownish yellow, grayish brown, or yellow. Gray calcareous mottles or soft concretions are common. The gravel is angular, some of it being granite incrusted with lime carbonate. This zone is typical glacial till which has been very slightly affected by weathering. It is the parent material from which the soil was derived.

In cultivated areas the thin, dark surface layer is not present, and the soil is brown or yellowish-brown silt loam to a depth of 8 or 10 inches. The surface material and the upper part of the subsoil are slightly acid or neutral. The lower part of the subsoil and the substratum are calcareous and effervesce slightly with hydrochloric acid. The topsoil is remarkably free from gravel, considering the large quantity of gravel in the subsoil. This was a stony soil before it was cleared, and uncleared areas are still stony. Some phases are almost carpeted with glacial bowlders. Nearly all the bowlders have been hauled off the cultivated areas, but a few are turned up to the surface by plowing every year. Stone fences are common over this soil. Areas in the morainic belt near areas of Rodman gravelly loam are the most rocky. The surface rock is largely granite, but some diorite and other igneous rocks and dolomitic limestone are

present. The percentage of dolomitic limestone increases with depth, and in the lower part of the gravel pits the bowlders are largely of this rock. The limestone in Bellefontaine silt loam is more largely dolomitic than in Kewaunee silty clay loam. That is probably one reason why the parent material of Bellefontaine silt loam effervesces less freely with hydrochloric acid.

Bellefontaine silt loam is remarkably uniform in this county, considering that it is such an extensive soil. The greatest variation is in the depth to the gravelly subtratum. The topsoil is shallower than the average in much of Rhine Township and in the belt near the area of Rodman gravelly loam in Mitchell Township and southeastern Greenbush Township. In areas of Bellefontaine silt loam in Russell and northern Greenbush Townships, the depth to the gravelly subsoil is greater than the average. In general, the depth to the gravelly subsoil increases westward. In some areas considerable gravel is on the surface, and the substratum is more gravelly than the average. Locally, the gravel is irregularly stratified. The soil is slightly more reddish than typical around Sheboygan Marsh in Russell and Greenbush Townships. Areas of this soil bordering areas of Rodman gravelly loam in Rhine Township and elsewhere have a more reddish, stiffer, heavier subsoil than the average.

Bellefontaine silt loam is the predominating soil in the western half of Sheboygan County and is the most extensive soil in the county. It occurs in association with other members of the Bellefontaine series, with Rodman gravelly loam, with the Fox and Genesee soils, and with muck and peat. Areas are mostly gently rolling or undulating. Some areas having a considerable slope were separated as a steep phase of the soil. Some very hilly areas of Rodman gravelly loam lie within the general region of this soil and make the region look hilly. A few areas have a level surface.

Drainage is mostly very good. A few small areas near the bottom of slopes receive considerable drainage water, but very little of the soil requires artificial drainage.

Bellefontaine silt loam is the most important farming soil in the county. A somewhat lower percentage of it is cultivated than of Kewaunee silty clay loam, but about 80 or 85 per cent is used for cultivated crops. The rest is in permanent pastures and wood lots. The timber is largely second growth, consisting of white oak, black ash, maple, hickory, basswood, elm, birch, butternut, and beech.

The percentage of the cultivated area devoted to different crops is about as follows: Oats, 22 per cent; corn, 17; clover and timothy hay, 17; clover and other tame-grass pasture, 20; alfalfa, 5; barley, 3; winter wheat, 6; spring wheat, 2; barley, 3; potatoes, green peas, rye, buckwheat, sugar beets, and other minor crops, 5. Most of the sugar beets raised in the county are grown on this soil, but very few green peas are grown on it. The average yields on this soil compare favorably with those on Kewaunee silty clay loam, but the yields of tame-grass crops are somewhat lower. Alfalfa yields are about the same on the two soils, but recently clover has not given good yields on either. The average acre-yields are about as follows: Oats, 45 bushels; corn, 8½ or 9 tons of silage or 45 or 50 bushels of shelled corn; barley, 30 bushels; winter wheat, 22 bushels; spring wheat, 19 bushels; clover and timothy hay, 1½ tons; alfalfa, 2¾ tons; sugar beets, about 9 tons; and other crops about the same relative yields.

Dairy farming is carried on almost exclusively on this soil. Most of the crops produced are fed on the farm, and the manure is returned to the soil. Most farmers buy some additional feed. The supply of nitrogen in the soil is probably being maintained, but there is a small annual loss of phosphorus. The soil contains a large natural supply of potassium. Most farmers practice regular rotation of crops, usually corn followed by oats or other grain, timothy and clover for hay, and timothy and clover for pasture. Alfalfa, which gives much better yields, is rapidly taking the place of clover and timothy for a hay crop, and sweet clover is beginning to take the place of timothy and clover for pasture.

Because of its friability, this is an easy soil to cultivate. Very little commercial fertilizer is used at the present time.

Improved Bellefontaine silt loam currently sells at prices ranging from about $125 to $150 an acre. Some areas sell at a considerably lower price, because less fertile soils are included.

Bellefontaine silt loam, steep phase.—The steep phase of Bellefontaine silt loam was separated from the typical soil entirely on the basis of surface relief. It includes areas having a slope sufficient to make them susceptible to erosion and to interfere with the use of ordinary farm machinery. The slopes vary from rolling to hilly; areas having a greater slope than 15° were mapped as rough broken land. The soil of the steep phase is the same as that of typical Bellefontaine silt loam, except that it is more stony.

This steep soil is most common on the steep slopes bordering streams, but some areas are found on morainic hillsides. Drainage is excessive. Probably 25 per cent of the land is cleared and cultivated; the rest is in woods and permanent pasture. The trees are hardwoods of the same species as those growing on the typical soil. Most of the larger trees have been cut, but many of the young trees are large enough to saw for timber.

Less corn and more hay and pasture crops are grown on this than on the typical soil. The average yields are about the same. Comparatively, more alfalfa is grown on this soil than on any other in the county. Alfalfa does particularly well because of the good drainage and calcareous subsoil, and it prevents the soil from washing. This steep soil is used with other soils for dairy farming.

Bellefontaine silt loam, steep phase, sells at prices varying from about $50 to $100 an acre, when it is sold alone.

BELLEFONTAINE LOAM

In cultivated areas the topsoil of Bellefontaine loam is grayish-brown or brown loam 6 or 8 inches thick. In most virgin areas there is a dark grayish-brown or dark-brown surface layer about 1 inch thick, which contains some leaf mold. The subsoil varies greatly. The upper part, to an average depth of about 16 inches, is commonly brownish-yellow or reddish-brown clay loam or gritty clay which grades to slightly more reddish gravelly clay or clay loam. Some faint-grayish calcareous mottles are present in most places. The material becomes more gravelly at a depth varying from 20 to 28 inches. It grades to yellow or grayish-brown gravelly loam which continues to a depth of 36 or more inches. The depth to the gravelly layer varies considerably and, where most of the

upper soil has been washed away, is slight. Thin layers of fine sandy loam occur in places in the subsoil. In other places a layer of red, stiff clay may be present in the subsoil at a depth of about 30 inches.

The topsoil is commonly very slightly acid, the upper part of the subsoil is slightly acid or neutral, and the substratum or parent material is calcareous. Some gravel is found in the soil, and areas which have not been cleared are fairly stony. The gravel is mostly dolomitic limestone, consisting entirely of glacial bowlders.

Bellefontaine loam occurs in scattered areas in the western part of the county. It is a common soil in the rather morainic region between Beechwood and Rhine. The surface is mostly gently rolling, but some areas are rather choppy and hummocky. Areas having steep slopes were separately mapped as the steep phase of the soil. This soil is nearly all well drained. It is fertile and very desirable for farming when it is cleared, but the large quantity of stone present makes it rather expensive to clear.

Probably 70 per cent of this soil is cultivated. The rest is in wood lots and permanent pasture. Corn, oats, timothy and clover, and alfalfa are the most important crops. Relatively the same acreage of different crops is grown as on Bellefontaine silt loam. The average yields are slightly lower, as this soil does not have quite the drought-resisting capacity of the silt loam.

Most of the crops grown on this soil are fed to dairy cows, and the manure is returned to the soil. Very little commercial fertilizer is used.

Improved Bellefontaine loam sells at prices varying from about $100 to $125 an acre.

Bellefontaine loam, steep phase.—The steep phase of Bellefontaine loam includes areas having a surface varying from rolling to hilly. The steep phase was separated from typical Bellefontaine loam entirely on the basis of relief. The soil is practically the same. The few small scattered areas of this soil are located on slopes near streams and on morainic hillsides.

About 25 per cent of the area of this soil is cultivated. The balance is used for wood lots and permanent pasture. The ordinary farm crops are grown, but a somewhat higher percentage of hay and pasture crops are grown to prevent the soil from washing. The steep slope makes areas susceptible to washing and interferes with the use of large farm machinery.

This soil sells at prices varying from about $50 to $100 an acre when it is sold alone but, sold with other soils, brings $125 or more an acre.

BELLEFONTAINE GRAVELLY LOAM

In virgin areas the 1-inch surface layer of Bellefontaine gravelly loam is commonly brown or dark-brown gravelly loam or gravelly silt loam containing considerable leaf mold. This grades to yellowish-brown or light-brown gravelly loam or gravelly silt loam, 6 or 8 inches thick. In cultivated areas, the dark surface layer is mixed with the underlying layer. The subsoil, to a depth of 24 inches, is commonly brownish-yellow or reddish-brown gravelly loam or gravelly clay loam which grades to yellow gravelly loam or gravel. The subsoil varies greatly. Red, gravelly, stiff clay is present in

places at a depth ranging from 20 to 30 inches, and layers of fine sandy loam may be found at any depth. The substratum or parent material is glacial drift, in places more or less irregularly stratified. Glacial bowlders, mostly of granite and hard dolomitic limestone, are thickly scattered over the surface in uncleared areas. The gravel is largely angular dolomitic limestone, with some granite incrusted with lime.

This soil occurs in numerous small scattered areas in the western part of the county. The surface is somewhat morainic or hummocky or gently rolling. The surface drainage is good and the underdrainage may be excessive.

About 40 or 45 per cent of this soil is cultivated. The rest is used for permanent pasture and wood lots. The crops common to the region are grown. The acreage in hay and pasture crops, which do not require cultivation, is greater than on the typical soil. The acre yields of crops are lower than the average for the county. The soil is rather difficult to cultivate, owing to the abundance of gravel. Most of the crops grown are fed to dairy cows on the farm.

Bellefontaine gravelly loam sells at prices varying from about $50 to $75 an acre, when it is sold alone.

Bellefontaine gravelly loam, steep phase.—The steep phase of Bellefontaine gravelly loam includes areas of the soil having an average slope of more than 7°. The soil is practically the same as that of the smoother areas.

Small areas, comprising 10 or 15 per cent of the total of this steep soil, are cultivated. The rest is in hardwood timber or permanent pasture. The surface is hummocky or hilly.

The current selling price of this soil is about $50 an acre when it is sold alone.

BELLEFONTAINE FINE SANDY LOAM

The surface soil of Bellefontaine fine sandy loam is commonly grayish-brown or light yellowish-brown fine sandy loam, 8 or 10 inches thick. In many places in virgin areas, there is a 1-inch rather dark brown surface layer containing considerable leaf mold and decayed grass roots. A trace of gravel and some glacial bowlders may be present in the soil. The subsoil varies considerably but is commonly brownish-yellow fine sandy loam containing a trace of gravel to a depth of about 16 inches, where it grades to reddish-brown friable clay or fine sandy clay containing more or less angular gravel. At an average depth of about 28 inches, it is in many places underlain by grayish-yellow, rather silty fine sandy loam or loamy fine sand. This sandy layer is near the surface in places. In other places the reddish-brown friable gravelly clay occurs at a depth between 24 and 36 or more inches. Layers of coarse and fine material are common in the lower part of the subsoil. The substratum is rather loose, coarse-textured glacial drift.

The topsoil is commonly slightly acid, and the subsoil varies from slightly acid to neutral.

Bellefontaine fine sandy loam occurs in scattered areas in the western half of the county, in many places on slopes bordering morainic hills. It is derived from coarse-textured glacial drift. The

surface is gently rolling, surface drainage is very good, and underdrainage is apt to be excessive. Crops suffer from drought more easily than on the heavier soils of the county.

This is a fairly productive soil. About 65 per cent of it is cultivated. Corn, oats, timothy and clover, alfalfa, and rye are among the important crops. The average acre yields are about as follows: Corn, 7 or 8 tons of silage; oats, 40 bushels; timothy and clover hay, 1⅓ tons; alfalfa 2¼ tons; and rye, 19 bushels. Corn, rye, potatoes, and garden and truck crops do especially well on this soil. Most of the forage crops grown are fed to dairy cows on the farm and much of the fertility removed by the crops is returned to the soil in the manure. This soil responds particularly well to the use of manure and other fertilizers. Practically no commercial fertilizer is used.

Improved Bellefontaine fine sandy loam sells at prices ranging from about $100 to $125 or more an acre.

KEWAUNEE SILTY CLAY LOAM

In virgin areas the surface soil of typical Kewaunee silty clay loam, to a depth of 1 or 2 inches, is friable brown clay loam or silty clay loam containing some leaf mold. This is underlain by brownish-yellow or light-brown clay loam or silty clay loam which continues to an average depth of 8 or 10 inches, where it grades to deep dull-red or brownish-red very stiff plastic clay containing a sprinkling of angular limestone gravel. This layer has a more or less columnar structure and dries out in roughly cubical fragments. Small, gray specks of calcareous concretionary material are present in most places in this layer. The material may become slightly heavier with depth. It is underlain, at a depth varying from 24 to 30 inches, by slightly more friable, pinkish, or dull-red plastic clay mottled faintly with gray, calcareous material and containing a trace of angular limestone gravel. The substratum or parent material from which the soil was derived is stiff, plastic, red clay containing some angular gravel and glacial bowlders and a few seams of sand. It appears to be typical glacial till. In the eastern part of the county the red clay continues to a depth varying from 30 to 100 or more feet, where it is underlain by the limestone bedrock. This layer becomes progressively thinner to the west, where it is underlain by very gravelly yellowish-brown glacial till similar to the parent material of the Bellefontaine soils.

Virgin areas of Kewaunee silty clay loam are very rare. In cultivated fields, the topsoil is commonly light-brown or grayish-brown rather heavy clay loam 8 or 10 inches thick and grades to the stiff red clay subsoil. Newly plowed fields have a distinctly reddish cast, especially on slopes where much of the surface soil has been washed away.

In many small, scattered areas of Kewaunee silty clay loam the surface soil has been entirely removed, leaving the stiff, red clay subsoil exposed. These clay spots, which include about 5 per cent of the total area of the soil, are too small to map as a separate soil type. They are most common in the western part of Holland Township, where the land is more rolling. Some limestone and granite bowlders were scattered over the surface of this soil, but most of them were removed before the soil was cultivated.

The lower part of the subsoil and the parent material are highly calcareous and effervesce freely with hydrochloric acid. The topsoil is commonly about neutral in reaction. Alfalfa can be grown successfully on nearly all areas without the addition of lime.

This soil is very uniform in texture and other soil characteristics, but averages slightly heavier in the southern part of the county. North of Sheboygan Falls and east of Sheboygan River, the soil is slightly coarser than typical, owing to a light covering of wind-blown silt from the river. Here the soil resembles silt loam in places.

Kewaunee silty clay loam is the predominating soil in the eastern part of the county. It is closely associated with coarser members of the Kewaunee series and with small patches of the Superior soils. Kewaunee silty clay loam is very sharply separated from Bellefontaine silt loam on the west and is bordered by a belt of the Superior soils or by Lake Michigan on the east.

Areas of this soil are mostly undulating or very gently rolling. Areas are somewhat more rolling in parts of Holland Township and where the soil borders areas of Bellefontaine silt loam. Most of the soil has enough slope to provide adequate drainage but not enough to cause excessive erosion. The slopes are nearly ideal for farming. Most of the areas which have poor natural drainage because of the nearly level surface have been tile drained.

Kewaunee silty clay loam ranks next to Bellefontaine silt loam in importance agriculturally. Probably 95 per cent of it is utilized for cultivated crops. All of it was formerly heavily timbered. Beech, maple, basswood, white oak, black oak, and hickory were the most common trees near Lake Michigan in the southern part of the county. An increasing number of white pine was found to the north of Wilson Township. Less beech and more white oak and black oak were found to the west on the western border of the soil.

Grain farming was most generally practiced when this soil was first cleared. As grain yields began to decline an intensive system of dairying developed, and that type of farming is now practiced on most of the soil. A regular system of crop rotation is in use on a majority of the farms. A common rotation has been: Corn, oats, clover and timothy for hay, and clover and timothy for pasture. Alfalfa is gradually taking the place of clover and timothy in the rotation. This year almost as much alfalfa as clover was seeded with oats and other nurse crops.

The percentage of this soil devoted to different crops is about as follows: Oats, 24 per cent; corn, 16; timothy and clover and other crops for hay, 22; alfalfa, 6; timothy, clover, and other crops for pasturage, 22; barley, rye, and wheat, 4; peas, 3.5; and potatoes, beans, and other minor crops, except peas, 2.5. Most farmers buy considerable livestock feed, and since the manure is conserved and applied to the land, the fertility of the soil is being fairly well maintained. Green peas are an important cash crop in the southern part of the county.

The average acre yield on this soil is about as follows: Oats, 46 bushels; barley, 30 bushels; green peas, 2,300 pounds; corn for silage, 9 tons; and alfalfa, about 2½ tons from two cuttings. Clover and timothy formerly averaged about 1¾ tons of hay to the acre, but the yield has been very poor in recent years. Crop yields, ex-

cepting that of corn, average somewhat higher than on other soils in the county.

Apples do particularly well on this soil and seem to thrive much better than on Superior clay loam. Sour cherries do fairly well. The soil is too heavy to be well adapted to garden or truck crops. Because of its heavy texture and sticky consistence, this is a very difficult soil to work. It can not be plowed when it is very wet, because it will puddle, nor when it is very dry, because it bakes too hard. Owing to its high lime content this soil has a good structure and is fairly friable for a soil that is so heavy. Three or four horses to the plow are needed on this soil, whereas only two are needed on the lighter soils in the western part of the county. Farming is somewhat more intensive than on the other soils, but otherwise this soil is managed in much the same way as are the others.

Very little commercial fertilizer is used on Kewaunee silty clay loam. On most farms the fertility removed by the crops is largely restored in the manure.

Improved Kewaunee silty clay loam currently sells at prices ranging from about $125 to $200 an acre. In the southeastern part of the county and near the city of Sheboygan it brings $200 or more an acre, and its value becomes progressively lower to the north and west. Areas affected by city real-estate values near Kohler have sold at $500 an acre. Kewaunee silty clay loam has the highest sale value of any soil in the county.

Kewaunee silty clay loam, steep phase.—The steep phase of Kewaunee silty clay loam was separated on the basis of surface relief. It includes areas having a slope of 7° or more, a slope sufficient to cause erosion or to interfere with the use of ordinary farm machinery.

The soil is the same as typical Kewaunee silty clay loam, except that the surface soil is thinner in the cultivated areas and that clay spots, where all the surface soil has been washed away, are more numerous.

This soil occurs in only a few small areas scattered through the typical soil. Probably 60 per cent of it is in wood lots and permanent pasture, and about 40 per cent of it is cultivated. Practically the same crops are grown as on Kewaunee silty clay loam, except that a large acreage is devoted to clover and timothy and alfalfa for hay and tame pasture.

This soil is sold with Kewaunee silty clay loam and other soils at a price varying from $125 to $175 or more an acre. If sold alone, its value would be less.

KEWAUNEE SILT LOAM

To an average depth of about 8 inches the topsoil of Kewaunee silt loam, in cultivated fields, is light-brown or grayish-brown heavy silt loam having a slightly reddish cast. In virgin areas it commonly consists of a 1-inch or 2-inch layer of brown silt loam containing considerable leaf mold underlain, to an average depth of about 8 inches, by brownish-yellow heavy silt loam. The topsoil is in most places underlain directly by dull-red, stiff, plastic clay, but in places it may be underlain by reddish-brown clay loam at a depth varying from 8 to 12 or more inches. At an average depth of about 28 inches the subsoil grades to slightly more friable dull-red, stiff, heavy clay.

Faint grayish calcareous mottles are common in this layer. The subsoil closely resembles that of Kewaunee silty clay loam. In places most of the surface soil has been washed away, and the heavy, red clay subsoil is near enough to the surface to be turned up when the soil is plowed. The substratum is commonly stiff red clay to a depth of 30 or more feet. It may contain seams of sand or gravel in places. It becomes progressively shallower to the west. Along the western border of the areas of this soil brownish-yellow friable clay may be present at a depth of about 24 inches. A few glacial bowlders are scattered on the surface, and a sprinkling of angular gravel, derived mostly from limestone, is found in the topsoil and subsoil. The topsoil is commonly sweet or only slightly acid, and the subsoil in most places is so rich in lime carbonate that it effervesces freely with hydrochloric acid.

Most of this soil, as mapped in Mosel Township, borders Kewaunee silty clay loam, and is somewhat heavier than typical. Some areas of silty clay loam or clay loam have been included in mapping. Along the western border of the areas of the Kewaunee soils in this county, some included soil is gradational between Bellefontaine silt loam and Kewaunee silty clay loam. These areas have a more rocky topsoil and a more friable and gravelly subsoil than typical.

The most extensive areas of this soil were mapped in Mosel and Sheboygan Townships. The surface is generally undulating or very gently rolling, with a few small, nearly level areas and some rolling and steep areas. Surface drainage is good, and underdrainage is adequate in spite of the heavy texture of the subsoil.

Nearly all of the Kewaunee silt loam is cultivated, but small areas are used for permanent pasture and wood lots. All of the soil was formerly heavily timbered. Beech, maple, basswood, and birch were the most common trees in the southern part of the county, and considerable white pine was found in the northeastern part. The relative acreage of the different crops and the yields are about the same as on Kewaunee silty clay loam, although the acreage of green peas is smaller. Nearly all the crops grown are fed on the farm, and most farmers buy additional feed. This is considered a hard soil to work, although it is not quite so heavy as Kewaunee silty clay loam.

Very little commercial fertilizer is used. Most farmers are restoring most of the fertility removed by the crops in the manure returned to the soil. Where considerable feed is purchased, the fertility is being maintained or even increased. Alfalfa does well without the use of lime.

The average sale price of improved Kewaunee silt loam is $150 or more an acre. Prices were considerably higher in 1920.

KEWAUNEE LOAM

The topsoil of Kewaunee loam in cultivated areas is grayish-brown or light reddish-brown loam 8 or 9 inches thick. In virgin areas it is commonly brown loam, containing more or less leaf mold, to a depth of 1 or 2 inches, underlain by light-brown or brownish-yellow loam which continues to a depth of 8 or 9 inches. The upper part of the subsoil is in most places reddish-brown loam or silty clay loam to a depth ranging from 16 to 24 inches, where it is under-

lain by dull-red stiff, plastic clay. At a depth of about 30 inches, it grades to slightly lighter colored or pinkish stiff clay containing gray, calcareous mottles. The substratum in most places is stiff red clay to a depth of 30 or more feet. A few glacial bowlders and a sprinkling of angular gravel, mostly limestone, are present in the topsoil and subsoil. The topsoil is commonly slightly acid or neutral, but the lower part of the subsoil and the substratum are calcareous.

This soil is rather variable. As mapped, it includes small areas of coarse clay loam and some heavy fine sandy loam. There is also considerable variation in the thickness of the topsoil and of the stiff, red clay subsoil. In a few small areas, mostly along Sheboygan River, south of Johnsonville, considerable gravel is present in the topsoil and subsoil, and in places the substratum is gravelly glacial till.

Kewaunee loam occurs in scattered areas in the eastern half of the county. Many of these areas are on the east side of streams where silt and fine sand have apparently blown from the stream bottoms, and covered the original clay loam with coarser material. Kewaunee loam is closely associated with Kewaunee silty clay loam. The surface is undulating or gently rolling, the slopes being ideal for farming. Surface drainage is good, and underdrainage is adequate. The moisture-holding capacity of the deep subsoil makes this a drought-resistant soil.

Probably 90 per cent of this soil is devoted to cultivated crops. It was formerly timbered with beech, maple, birch, white pine, basswood, and other hardwoods. The relative acreage and yields of the various crops are about the same as on Kewaunee silty clay loam, although yields of grass and hay crops are somewhat lower. Practically no green peas are grown.

This soil is much easier to manage than Kewaunee silty clay loam, but is harder to work than the average loam soil. Little, if any, commercial fertilizer is used. Most of the fertility removed by crops is returned to the soil in manure. No lime is required on most areas to grow alfalfa.

The current selling price of Kewaunee loam varies from about $125 to $150 an acre.

KEWAUNEE FINE SANDY LOAM

The topsoil of Kewaunee fine sandy loam is mostly light-brown fine sandy loam about 8 inches thick. It grades to brownish-yellow fine sandy loam. At an average depth of about 30 inches this fine sandy loam material is underlain by dull-red, stiff, plastic clay which continues downward to a considerable depth. A few glacial bowlders are present, and a sprinkling of gravel is found in the clay subsoil. The topsoil is usually slightly acid, but the deep subsoil is calcareous. The soil is rather variable in thickness and texture. In places it is fine sand to a depth of 24 or more inches and is underlain by red clay. Several acres of sandy loam were included in mapping.

Kewaunee fine sandy loam occurs only in small areas scattered throughout the eastern part of the county. In most places it is derived from deposits of fine sand which cover the typical reddish

clay of the Kewaunee soils to a depth of 2 or 3 feet. The surface is mostly gently rolling. The soil is well drained, and the heavy clay subsoil gives it a good water-holding capacity.

Probably 90 per cent of this soil is cultivated, and small areas are used for pastures and wood lots. Areas were formerly timbered with beech, maple, and other hardwoods and with some white pine and Norway pine in the northern part of the county. The average yields of different crops are about the same as on Kewaunee loam, although pasture and hay crops yield somewhat less. Very few green peas are grown.

Most of the fertility removed by the crops is replaced in the manure. Very little commercial fertilizer is used.

SUPERIOR CLAY LOAM

The topsoil of Superior clay loam is light-brown friable clay loam or silty clay loam, 6 or 8 inches thick. In virgin areas, which are rare, there may be a thin surface layer of dark-brown clay loam containing considerable root and leaf mold. Newly plowed fields have a distinctly reddish cast. On rather poorly drained areas the topsoil is somewhat darker than typical, approaching the color of the Poygan soils. At a depth of 6 or 8 inches the topsoil grades to dull-red or pinkish rather heavy but crumbly clay which may contain faint, calcareous mottles at a depth greater than 12 inches. This mottling becomes more pronounced downward, and below a depth of about 26 inches the material is somewhat lighter colored, more pinkish, dull-red clay with more or less gray, calcareous marbling. Seams of fine sand or waterworn gravel may be found in any part of the subsoil. Stratified layers of sand and clay are common below a depth of 3 feet, but the red clay may continue to a depth of 20 or more feet.

All of this soil was formerly heavily timbered with beech, maple, hickory, and other hardwoods, and some white pine grew in the northern part of the county. Probably 95 per cent of the soil in farms is devoted to cultivated crops. Intensive dairy farming is carried on, and most of the crops grown are fed on the farm.

Superior clay loam occurs mostly in scattered areas along the eastern border of the county, where it occupies level lake terraces, and in level, somewhat basinlike areas. It is closely associated with Kewaunee silty clay loam. The surface drainage is usually adequate, although the surface is very level. Much of the naturally poorly drained land has been tile drained. Most of the soil is sufficiently well drained to grow alfalfa successfully.

The system of farming on this soil is the same as on Kewaunee silty clay loam. The relative acreage of the different crops is about the same, and the average yields are only slightly lower.

Superior clay loam is a hard soil to cultivate and needs to be plowed under the most favorable moisture conditions. Very little commercial fertilizer is used, but most of the fertility removed by the crops is returned in the barnyard manure. Alfalfa can be grown successfully on most of the soil without using lime.

Improved areas of Superior clay loam sell at prices ranging from $150 to $175 or more an acre.

SUPERIOR SILT LOAM

The topsoil of Superior silt loam is light-brown or brown friable silt loam, about 10 inches thick. The subsoil is variable in texture, as it is made up of stratified layers of clay, silt, loam, and sandy material. The upper part of the subsoil ranges from yellowish-brown or yellow fine sandy loam to silty clay loam and is underlain by dull-red or pinkish, stiff, plastic clay at an average depth of about 20 inches. The red clay continues to a depth of 48 or more inches and is underlain by stratified layers of sand and clay. In places, the red clay is within 10 inches of the surface. Faint-grayish calcareous mottles are common in the red clay. The topsoil is slightly acid or neutral and is free from rock and gravel. Seams of waterworn gravel are present in places in the subsoil.

This soil occurs mostly in scattered areas on high, level terraces near Lake Michigan in the eastern part of the county. It is closely associated with other soils of the Superior and Kewaunee series. Drainage is fairly good, even though the surface is level. The subsoil was formerly water-logged in many areas, but tile drainage has largely overcome this condition.

Superior silt loam is considered a very good farming soil, and probably 90 per cent of it is now devoted to cultivated crops. It was formerly timbered with beech, maple, birch, hickory, and other hardwoods, and with pine. The same crops are grown, and generally in the same proportions, as on Kewaunee silty clay loam, but the average yields are slightly lower.

This is a much easier soil to manage than Superior clay loam. Very little commercial fertilizer is used, but most of the fertility removed by the crops is returned to the soil in manure.

Improved areas of Superior silt loam sell at an average price of $150 or more an acre.

SUPERIOR LOAM

The topsoil of Superior loam is commonly light brown to a depth of 8 or 10 inches. In virgin areas there is often a thin, dark grayish-brown surface layer. The subsoil is derived from stratified material and is variable in composition. The upper part varies from reddish-brown or yellow loam to reddish-brown silty clay loam. It continues to an average depth of about 20 inches, where the material usually becomes somewhat finer in texture. The deep subsoil or substratum, below a depth ranging from 20 to 36 inches, is generally dull-red stiff clay containing gray calcareous mottles or reddish-brown clay loam and underlain by red clay. Layers of gray fine sand or red clay may be found at any depth in the subsoil. The topsoil is slightly acid. Some waterworn gravel is present in the topsoil and subsoil in places, although the soil is typically free from rock.

This soil occurs in small, scattered areas on high, level, lake terraces along Lake Michigan, in the eastern part of the county. Most of it is sufficiently well drained to grow the ordinary crops of the region, but in places there is some seepage in the subsoil. This can be removed by tile drainage.

This soil was formerly timbered with beech, maple, and other hardwoods, and with white pine. Practically all of it is now cleared, and about 85 per cent of it is devoted to cultivated crops. About

20 per cent of the cultivated area is devoted to corn, and the same percentage to oats, to timothy and clover, and to hay and pasture. The remaining 20 per cent is used for alfalfa, barley, rye, potatoes, and other crops. Corn yields about 8 or 9 tons of silage or 40 bushels of husked corn to the acre. Other crops yield considerably lower than on Kewaunee silty clay loam.

Dairy farming is practiced on all areas of this soil. Most of the crops are fed on the farm, and the fertility removed by the crops is largely replaced in manure. Little commercial fertilizer is used, but some lime is applied for alfalfa. Alfalfa does fairly well where the drainage is adequate.

Improved Superior loam sells at prices ranging from $125 to $150 or more an acre.

SUPERIOR FINE SANDY LOAM

Superior fine sandy loam, to an average depth of 9 or 10 inches, is commonly light-brown fine sandy loam having a slightly reddish cast. The subsoil varies considerably in texture and color, as it is derived from stratified layers of brownish-yellow loamy fine sand and dull-red friable clay. The upper part of the subsoil is apt to be brownish-yellow loamy fine sand or fine sandy loam to a depth varying from 16 to 22 inches. Where dull-red friable clay occurs in the lower part of the subsoil, the substratum, below a depth of 36 inches, is largely dull-red or pinkish clay containing some gray calcareous mottles and some layers of sand. Seams of waterworn gravel are present in places in the subsoil. The topsoil and upper part of the subsoil are commonly slightly acid, and the deeper subsoil or substratum is calcareous.

This soil occurs in small scattered areas on high, level, well-drained lake terraces. It was formerly timbered with beech, maple, basswood, and other hardwoods, and some white pine in the northern part of the county. It is now practically all cleared, and about 85 per cent of it is devoted to cultivated crops. About the same relative acreage of various crops is grown as on Superior loam. Corn yields an average of about 40 or 45 bushels to the acre; oats, 35 bushels, and clover and timothy, 1½ tons. Crops, except corn, give materially lower yields than on Kewaunee silty clay loam, and farms do not appear so prosperous as on that soil.

Most of the crops are fed to dairy cows on the farm. Very little commercial fertilizer is used.

The current selling price of Superior fine sandy loam varies from about $100 to $125 an acre, when it is sold with other soils. Large areas of this soil exclusively would sell at a much lower figure.

FOX SILT LOAM

The topsoil of Fox silt loam, where cultivated, is light-brown, grayish-brown, or brown very friable silt loam about 9 inches thick. In many virgin areas there is a brown 1-inch or 1½-inch surface layer containing considerable leaf mold, underlain by grayish-brown silt loam. The subsoil varies considerably, as it is derived from stratified layers of fine and coarse material. The subsoil in the eastern part of the county, where this soil is surrounded by the Kewaunee

soils, is very different from that in areas surrounded by the Bellefontaine soils in the western part of the county.

In the eastern part of the county the subsoil is commonly reddish-brown clay loam to a depth of about 16 inches, underlain by reddish-brown or brownish-red friable clay to a depth ranging from 24 to 30 inches, where it is underlain by reddish-yellow fine sand or by grayish calcareous gravel with reddish-brown or grayish-yellow interstitial material.

In the western part of the county the subsoil is commonly brownish yellow to a depth ranging from 12 to 28 inches or to an average depth of about 20 inches. This is in many places underlain by yellowish-brown or reddish-brown silty clay loam or friable silty clay. At a depth ranging from 24 to 36 inches this is underlain by brownish-yellow or gray fine sand or gray calcareous gravel with grayish or brownish-yellow interstitial material. The depth to the gravel may be more than 36 inches in places. Extensive areas where the depth to gravel is more than 36 inches are mapped as Lucas silt loam.

Some rust-brown and grayish mottles and specks of limonite yellow may be found in the subsoil at a depth of 20 or 30 inches on the lowest terraces or very flat areas where the drainage is restricted. Seams of sand or waterworn gravel may be found in any part of the subsoil. The topsoil is free from stone. The reaction of the topsoil is neutral or slightly acid, and the substratum is generally calcareous.

This soil occurs in scattered areas all over the county, on high glacial-outwash terraces along Kettle Range and on the lower terraces along streams. The surface is very gently sloping or level. Areas which have been more or less eroded were separated as the eroded phase.

Surface drainage is generally good, and on most areas underdrainage is excessive, owing to the porosity of the substratum. Excessive drainage makes this a rather droughty soil. The water table is high in the subsoil on a few areas in the lower terraces.

Probably 90 per cent of this soil is cultivated. Practically the same crops are grown and the same system of farming used as on Bellefontaine silt loam. In moist years the crop yields are about the same on the two soils, but in dry years the yields are apt to be considerably lower on the Fox soils.

Most of the crops grown are fed on the farm, and the manure is returned to the soil. Manure is especially beneficial to this soil, as it assists in increasing the naturally low organic-matter content of the topsoil.

The current selling price of improved Fox silt loam varies from $125 to $150 or more an acre.

Fox silt loam, eroded phase.—The eroded phase of Fox silt loam comprises areas that have been somewhat dissected by erosion. It includes remnants of level terraces with gentle slopes leading down to small valleys of intermittent streams. The soil is more variable than the typical soil, as there are many included areas of sand and gravel that are too small to indicate on the map. The depth to the coarse sand and gravel substratum varies considerably.

The soil occurs on the high, old, glacial-outwash terraces. The substratum is distinctly stratified. Areas are all well drained, and the soil is not drought resistant.

The crop yields are the same as on typical Fox silt loam. The selling price varies from $125 to $150 or more an acre.

FOX LOAM

The topsoil of Fox loam is mostly light-brown rather gritty loam, 8 or 10 inches thick. On virgin areas there is a thin brown surface layer containing considerable leaf mold, underlain by yellowish-brown loam. The subsoil varies considerably in color and texture. The upper part is typically yellowish-brown or reddish-brown clay loam, which is underlain by stratified sand and gravel at a depth ranging from 20 to 30 inches. Layers of fine sand and gravel may be found at any depth in the subsoil. The topsoil is fairly free from rocks. The substratum may contain layers of red clay in the eastern part of the county, where the upland soils are mostly Kewaunee silty clay loam.

This soil occurs in small, scattered areas on low, level terraces, largely along the eastern border of the county. The total area mapped is only 2,624 acres. The soil is well drained.

Probably 80 per cent of the Fox loam is cultivated, and the rest is in permanent pasture and wood lots. Corn, oats, clover, timothy, and the other crops common to the region are grown. The yields probably average 20 per cent lower than on Bellefontaine silt loam, and crops suffer easily from drought.

Fox loam sells at about $100 an acre when sold alone and from $125 to $150 or more when sold with other soils.

Fox loam, gravelly phase.—The gravelly phase of Fox loam differs essentially from the typical soil in the higher content of gravel in the topsoil and subsoil.

Only a few small areas of this soil on rather high, somewhat eroded terraces were mapped.

The soil is rather droughty. Probably 70 per cent of its is cultivated. The rest is in permanent pasture and wood lots.

The gravelly texture of this soil makes it rather difficult to cultivate. The cultivated area is used largely for hay and pasture land, for crops like clover, timothy, and alfalfa, which do not require frequent plowing. Crop yields are probably about 25 per cent lower than on Bellefontaine silt loam.

Sold alone, Fox loam, gravelly phase, brings about $75 an acre.

FOX FINE SANDY LOAM

The topsoil of Fox fine sandy loam is light-brown fine sandy loam to a depth ranging from 8 to 12 inches, where it grades to brownish-yellow or reddish-yellow fine sandy loam. At a depth of about 15 inches this material, in places, grades to reddish-yellow loamy fine sand or fine sand. At a depth between 20 and 30 inches, there is often a layer of brownish-red clay loam or sandy clay which is underlain by sand and gravel. The subsoil varies greatly in color and texture. The soil is fairly free from rock. The topsoil is generally slightly acid.

Most of the Fox fine sandy loam is found in small areas on level terraces in the eastern part of the county. Only 1,344 acres were mapped in this county. Drainage is rather excessive.

Probably 75 per cent of this soil is cultivated to the crops common to the region. It is rather droughty, is lower in fertility than most soils, and the yields of grain and hay probably average 25 per cent lower than on Bellefontaine silt loam. The soil is well adapted to rye and truck crops.

Sold alone Fox fine sandy loam brings about $75 an acre. It is usually sold with other soils for $150 or more an acre.

LUCAS SILT LOAM

The surface soil of Lucas silt loam, in forested areas, is brown or dark-brown silt loam containing considerable leaf mold to a depth of about 1½ inches. This is underlain, to a depth ranging from 8 to 12 inches, by yellowish-brown or yellow silt loam. In cultivated areas the thin surface layer has been mixed with the layer below, giving it a somewhat darker color. The upper part of the subsoil is generally yellowish-brown or yellow silt loam or friable silty clay, to a depth of about 18 inches, where it grades to somewhat stiffer clay containing specks of lime and in places a trace of rust-brown and limonite-yellow mottling. Below a depth of about 30 inches the material commonly becomes somewhat coarser and grades to yellow or brownish more friable silty clay or silt loam. Most of the soil is underlain by stratified layers of calcareous gravel, fine sand, and loam below a depth of 36 inches. In places the coarse sand and gravel may be within 36 inches of the surface. Extensive areas having gravel within 36 inches of the surface were mapped as Fox silt loam. The deeper subsoil is derived from stratified material and may vary considerably. The soil is free from glacial bowlders, but scattered waterworn gravel may be present. The topsoil is neutral or slightly acid, and the lower subsoil or substratum is usually calcareous.

This soil occurs mostly on high, level, or gently sloping glacial outwash terraces on the east side of the Kettle Range. There are only a few areas, but these are of rather large extent. A few smaller ones were mapped on low terraces near streams. Drainage is good. The rust-brown and limonite-yellow mottles indicate that the underdrainage may be slightly deficient in places.

Probably 90 per cent of this soil is cultivated. The rest is in permanent pasture and wood lots. The crops grown, yields, and methods of farming practiced are about the same as on Bellefontaine silt loam.

Improved Lucas silt loam sells at prices varying from $125 to $150 or more an acre.

WARSAW SILT LOAM

The topsoil of Warsaw silt loam is dark-brown or black silt loam containing a large quantity of organic matter. The soil is black when moist. The subsoil is commonly yellowish-brown or brown silt loam, to a depth ranging from 14 to 24 inches, where it grades to yellowish-brown or gray silt loam or silty clay loam containing some faint-grayish and a trace of limonite-yellow mottling. In the eastern part of the county, where the upland soil is mostly Kewaunee silty clay loam, there is in places a layer of red silty clay at a depth

ranging from 20 to 30 inches. In most places a layer of gravelly loam occurs at a depth varying from about 24 to 30 inches and continues to a depth of 48 or more inches. Layers of fine sand may occur in any part of the subsoil. The substratum consists of stratified layers of sand and gravel, with occasional layers of clay. The topsoil is fairly free from rock and gravel.

This soil occurs mostly in small, scattered areas on flat, rather low terraces. Most areas are in the eastern part of the county. The surface drainage is adequate for the ordinary crops of the region. The water table, in places, is rather high in the substratum, and such areas are rather undesirable for growing alfalfa. About 85 per cent of the soil is cultivated, and the remainder is mostly in permanent pastures in which are a few scattered shade trees.

The crops common to the region are grown. The same system of farming is practiced and the crop yields are about the same as on Bellefontaine silt loam. Most of the crops are fed to dairy cows on the farm. Very little commercial fertilizer is used.

Improved Warsaw silt loam sells at $150 or more an acre.

WARSAW LOAM

The topsoil of Warsaw loam, to a depth of 10 or 12 inches, is dark-brown or black loam containing considerable organic matter and coarse, gritty material. The upper part of the subsoil is commonly yellowish-brown or grayish-yellow rather coarse loam, to an average depth ranging from 15 to 25 inches, underlain by brownish-gray fine sand or calcareous gravel. The subsoil and substratum are derived from stratified layers of sand, clay, and gravel. The soil is free from stone, although it may contain a sprinkling of waterworn gravel on the surface.

This soil occurs in small areas on level lake and stream terraces. Only a few small areas, mostly in the east-central part of the county, were mapped. Drainage is fairly good.

Probably 85 per cent or more of this soil is cultivated. The rest is used for permanent pasture. The crops common to the region are grown, but yields are not so good as on Warsaw silt loam. Most of the crops grown are fed to dairy cows on the farm. Considerable manure, but little commercial fertilizer, is used. This soil responds very well to fertilizers.

The current selling price of improved Warsaw loam is from $100 to $125 or more an acre.

MIAMI SILTY CLAY LOAM

The surface soil of cultivated Miami silty clay loam, to a depth of 6 or 8 inches, is light grayish-brown, smooth, friable silt loam. In virgin areas there may be a rather dark surface layer, from 1 to 1½ inches thick, containing considerable leaf mold. The upper part of the subsoil is commonly brownish-yellow or reddish-brown friable silty clay loam which becomes heavier with depth. At a depth of 12 or 14 inches, this layer grades to brownish-yellow or brown friable clay or silty clay underlain by light reddish-brown or yellowish-brown friable silty clay containing some grayish mottles and continuing to an average depth of about 28 inches. The substratum

below a depth of 36 inches is commonly reddish-brown gravelly clay or slightly weathered heavy glacial till. As mapped in Sheboygan County, Miami silty clay loam is associated with the Kewaunee soils and has a more reddish color in the subsoil and in the underlying parent material than is typical of the Miami series.

Only a few areas of this soil, along the southern boundary of the county, were mapped. Most of the areas are undulating, and the relief is ideal for farming. Drainage is good.

Probably 90 or 95 per cent of this soil is cultivated. The remainder is in small plots used for permanent pasture. The crops grown and the acre yields are about the same as on Bellefontaine silt loam.

BERRIEN FINE SAND

The topsoil of Berrien fine sand, in virgin areas, is medium-brown fine sand containing some leaf mold to a depth of 1 or 2 inches, underlain by yellowish-brown fine sand which continues to a depth of 6 or 8 inches. In cultivated areas it is commonly light-brown fine sand having a slightly reddish hue to a depth of 6 or 8 inches. The subsoil, to a depth of 24 inches, is yellowish-red porous fine sand which becomes somewhat lighter colored with depth. Between depths of 24 and 60 or more inches, the subsoil is commonly reddish-yellow porous fine sand. The sand is underlain, at an average depth of 5 or 6 feet, by dull-red, stiff, plastic clay. The clay in places may lie within 36 inches of the surface. Most of the soil is medium acid.

Areas of Berrien fine sand are found on high, well-drained, level lake terraces near Lake Michigan. Only a few areas were mapped. The underdrainage is rather excessive, but this is not so droughty a soil as the sandy surface might indicate, owing to the presence of the red clay substratum.

All of this soil was formerly timbered with a heavy stand of beech, maple, basswood, and other hardwoods, and white pine and aspen. About 30 per cent of the soil is still in wood lots. Probably 60 per cent is used for cultivated crops. Some has been cultivated but is now used for permanent pasture.

Considerable corn and buckwheat are grown on this soil, as these crops do better than others on the sandy soils. About 10 per cent of the cultivated area is devoted to rye, 20 or 25 per cent to corn, and the balance, in about equal parts, to oats, hay, and pasturage. This soil is naturally good for truck crops, and some strawberries, watermelons, and other truck crops are grown. The area devoted to these crops may be greatly increased in the future, when the adaptability of the fine sand to such crops becomes better known.

The average acre yields are about as follows: Rye, 18 bushels; corn, 40 bushels; oats, 30 bushels; buckwheat, 15 bushels; and potatoes, 100 bushels. The yields are considerably lower than the average for the county.

Most of the crops grown are fed on the farm, and the manure is returned to the soil. Considerable commercial fertilizer is used, especially on corn. The use of superphosphate (acid phosphate) or mixed fertilizers usually results in a substantial increase in crop yields. Alfalfa does fairly well, when the soil has been limed to overcome the acidity.

Improved Berrien fine sand sells at prices varying from $50 to $100 an acre. It is usually sold with other soils, and large areas of this soil would probably sell at a lower price. Areas near Sheboygan, affected by city real-estate values, command higher prices.

PLAINFIELD FINE SAND

The virgin surface layer of Plainfield fine sand, to a depth of 1 or 2 inches, is brown or dark-brown fine sand containing some leaf mold. This grades to brownish-yellow or yellowish-red fine sand which becomes lighter colored with depth and commonly grades to reddish-yellow, loose, porous fine sand at an average depth of about 20 inches. The substratum is generally reddish-yellow porous fine sand to a depth of 10 or more feet. Red clay may occur in the substratum below a depth of 4 feet. The upper soil is usually medium or slightly acid.

Nearly all the areas of this soil are on level lake terraces along Lake Michigan. The larger areas are in the southeastern part of Sheboygan Township and in the northeastern part of Wilson Township on the higher lake terrace, 30 or 40 feet above the lake.

Drainage is excessive, and crops suffer badly from drought, owing to the porosity of the subsoil and substratum.

About 40 per cent of this soil is used for cultivated crops; about 10 per cent has been cultivated, but is now used only for pasture land; possibly 35 per cent has been cleared for permanent pasture; and about 15 per cent is still wooded. Wooded areas support a fairly good growth of maple, beech, basswood, birch, and, in places, white pine. Practically the same crops are grown as on Berrien fine sand, but the yields average somewhat lower.

This soil is used mostly for dairy farming. The crops are fed on the farm, and the manure is returned to the soil. Considerable commercial fertilizer is also used. The soil is naturally low in fertility and does not produce good crops unless it is well fertilized.

This soil is particularly adapted to truck crops, such as strawberries, watermelons, and vegetables, and will probably be more largely used for such crops in the future.

Plainfield fine sand sells at an average price of about $50 an acre. It may bring considerably more if sold with areas of other soils. Areas on the high lake terraces are worth considerably more than areas on the low terraces.

SAUGATUCK FINE SAND

The surface soil of Saugatuck fine sand is commonly grayish-brown or brown fine sand 6 or 8 inches thick. A thin surface layer containing some leaf mold is present in many places in virgin areas. The subsoil varies from yellowish-red to yellowish-brown fine sand, which continues to an average depth of about 20 inches and which is underlain by brownish-yellow or reddish-yellow water-logged fine sand mottled somewhat with grayish and brownish material. A few small areas having a 5-inch or 6-inch surface layer of brown fine sandy loam and a few acres having a grayish-yellow subsoil were included with this soil in mapping.

Saugatuck fine sand occurs in a narrow strip on a low terrace just behind the beach and dune-sand areas along Lake Michigan. Most

of it is only a few feet above the water level of the lake. The surface is level or somewhat hummocky. All of the soil is poorly drained, and its position is so low that it can not be readily drained.

Most of this soil is still wooded. It is covered with a fairly good stand of white pine, beech, cedar, ash, birch, and other hardwoods. It is more valuable for the production of timber than for farming. Probably not more than 5 or 10 per cent is under cultivation, and an equal area, formerly cultivated, is now abandoned and used only for pasture land. The cultivated fields are mostly on the heavier areas which have a thin covering of fine sandy loam.

This soil is used to some extent for dairy farming, and rather largely for gardens by fishermen and others who live along the lake. Considerable manure and "fish gum" (local name for fish scrap) are applied.

Areas of Saugatuck fine sand sell at $25 or $30 an acre. Areas which support a good stand of timber may be worth considerably more.

CONOVER SILT LOAM

The topsoil of cultivated Conover silt loam is commonly grayish-brown friable silt loam about 10 inches thick but varying in thickness from about 6 to 12 inches. The upper part of the subsoil is yellowish-brown or brownish-yellow silt loam or silty clay loam to an average depth of about 16 inches, and it grades to reddish-brown or yellowish-brown silty clay containing conspicuous gray, rust-brown, and limonite-yellow mottles. The mottles become more conspicuous with depth, and below a depth of about 28 inches the material in places is somewhat coarser in texture. Brownish-yellow silt loam or silty clay loam containing some gray and limonite-yellow mottles occurs in many places at a depth ranging from 28 to 36 inches. The topsoil varies in color from grayish brown to rather dark brown and is darker than that of the Bellefontaine soils but not so dark as that of the Clyde. In places the material is silt loam to a depth of 36 or more inches. Some angular gravel may be present in the topsoil and subsoil, and seams of fine sand are not uncommon.

Glacial bowlders are scattered over the surface in uncleared areas. The upper soil is neutral or slightly acid, and the substratum is commonly calcareous. This soil occupies smooth, shallow depressions or swales in areas of Bellefontaine silt loam, in the western half of the county. In many places it surrounds an area of Clyde silt loam which occurs in a lower part of the depression. The soil is derived from glacial till which may have been partly assorted and shifted by wind action in places. The surface drainage is fair. Water does not stand permanently on the surface, but it runs off rather slowly after rains. The subsoil may be somewhat waterlogged in the spring and after heavy rains. Most of the soil can be well drained by ditching and tiling. Many of the cultivated areas are now well drained, and the former poor drainage is indicated only by the mottled condition of the subsoil.

Probably 65 or 70 per cent of this soil is cultivated, and the balance is in scattered woods and permanent pasture. The farm crops common to the region are grown, and the yields are about the same as

on Bellefontaine silt loam. Alfalfa does not thrive, because of the poor underdrainage. Most crops are fed to dairy cows on the farm. Very little fertilizer, except manure, is used.

Improved Conover silt loam sells at prices varying from about $100 to $125 or more an acre.

COLOMA FINE SAND

The undisturbed surface soil of Coloma fine sand, to a depth of 1 or 2 inches, is dark-brown fine sand containing considerable leaf mold. Between depths of 2 and 10 inches is light yellowish-brown or brownish-yellow fine sand. On cultivated areas the topsoil is light grayish-brown fine sand to a depth of about 10 inches. This grades to yellow or yellowish-red porous fine sand that becomes lighter in color with depth. The fine sand continues to a depth ranging from 3 to 10 feet, where it is generally underlain by stiff red clay. In most areas the red clay seems to occur at a depth of 4 or 5 feet, although the depth to the clay varies greatly in short distances.

This soil occurs only in a few very small areas surrounded by areas of the Kewaunee soils, mostly north of Sheboygan Falls. The surface is somewhat billowy or rolling, probably owing to wind action. There are a few blow-outs. Probably 55 per cent of the soil is cultivated.

Coloma fine sand is usually sold with other soils at $100 or $125 an acre. If sold alone, it would probably bring a much lower price.

Coloma fine sand, shallow phase.—The topsoil of cultivated Coloma fine sand, shallow phase, is mostly light grayish-brown fine sand 8 or 10 inches thick. In virgin areas the topsoil is often rather dark-brown fine sand containing some roots and leaf mold, to a depth of 1 or 2 inches, underlain by light yellowish-brown fine sand to a depth of 8 or 10 inches. The subsoil is yellowish-red or yellow fine sand which in many places becomes paler in color with depth and which, at a depth of about 36 inches, is underlain by dull-red stiff plastic clay. The red clay may occur at a depth ranging from 24 to 48 or more inches. The sandy topsoil and upper subsoil material are usually slightly acid. The deep clay subsoil is calcareous.

Most of the shallow phase of Coloma fine sand is found in a belt of scattered areas east of Sheboygan River. North and south of Sheboygan Falls the areas are rolling and commonly occur at the higher elevations. The surface is slightly billowy in places, owing to wind action.

This soil is excessively drained, owing to its porosity, but the clay in the lower part of the subsoil prevents it from being very droughty. It is usually considered a fairly good farming soil. Most of it was formerly timbered with beech and other hardwoods, white pine, and some Norway pine. Very little of the timber now remains. About 75 per cent of the soil is devoted to the crops common to the region. Considerable rye is grown. The crop yields are considerably below the average for the county. Some commercial fertilizers have been used and have produced substantially increased yields.

Coloma fine sand, shallow phase, is usually sold with better soils at $100 or $125 an acre, or more if buildings are included.

RODMAN GRAVELLY LOAM

The topsoil of Rodman gravelly loam is in most places medium-brown gravelly loam or gravelly silt loam containing considerable leaf mold to a depth of about 1 or 2 inches, where it grades to light-brown gravelly loam or gravelly silt loam which continues to a depth ranging from 4 to 10 inches. The subsoil is extremely variable. In many places it is brownish-yellow gravelly clay or brownish-red stiff gravelly clay at a depth varying from 10 to 20 inches. This is underlain by irregularly stratified sand, gravel, and bowlders, with gray interstitial material. In places the coarse sand and gravel crop out at the surface, and glacial bowlders are thickly strewn over the surface. The gravel is mostly dolomitic limestone but admixed with it is some granite which has been incrusted with lime. The bowlders in the substratum are mostly hard dolomitic limestone, and those on the surface are more largely granite. The gravel substratum appears to continue to a depth of 50 or more feet in most places.

Most of this soil was mapped on the Kettles, the range of hills extending from Crooked Lake toward the northeast of Crystal Lake and on to the north-central part of Rhine Township. The relief is extremely hilly, the series of irregularly rounded hills being set close together, with kettlelike depressions. The difference in elevation from the bottom of the kettles to the top of the bordering hills is from 75 feet to 100 feet, and most of the slopes range from about 10° to 35°. There is generally no surface drainage system on this soil. All the water sinks into the porous substratum and emerges as large springs on the borders of the areas.

Rodman gravelly loam differs from Bellefontaine gravelly loam in having a more shallow topsoil and a more gravelly subsoil. This is essentially a nonagricultural soil, and practically none of it is cultivated. A few small apple orchards have been set out on the borders of the areas, and probably 10 per cent of the soil has been cleared for permanent pasture. Much of the old, virgin timber still remains, although most of the larger trees have been cut. The timber is rather difficult to remove on account of the roughness of the country. Some of the most common trees are beech, white oak, black oak, maple, hickory, elm, ash, basswood, birch, and wild cherry. Nearly all of the timbered areas are fenced and are used more or less for permanent pasture.

This soil is valued for the commercial gravel found practically everywhere in the substratum, and numerous gravel pits have been opened. The gravel is largely derived from hard dolomitic limestone and is suitable for graveling roads. When washed, it is admirably adapted to all kinds of cement work.

The current selling price of Rodman gravelly loam ranges from about $25 to $50 or more an acre, when sold alone. It is often sold with areas of considerably more valuable soils. The price depends on the quantity of timber it supports, on its proximity to other farm lands, when it is more valuable for pasture, and, in places, on accessibility to roads and railroads.

BRIDGMAN FINE SAND

The topsoil of Bridgman fine sand consists of brownish sand, containing some leaf mold to a depth of about 1 inch, underlain by a layer of brownish-gray sand or fine sand 2 or 3 inches thick. This is underlain by loose, porous gray sand or fine sand. In depressions the brownish surface layer is somewhat deeper.

This soil occurs within areas of dune sand. The surface is hummocky or billowy and is from 2 to 8 feet above the level of Lake Michigan. The soil is covered with a heavy stand of white pine, with some cedar. Much timber has been cut. Where enough trees are left to hold the sand, timber grows rapidly. This soil is of no value for farming.

Bridgman fine sand sells at prices varying from $25 to $50 an acre, or more if the timber is good.

POYGAN SILTY CLAY LOAM

The surface soil of Poygan silty clay loam is generally dark-brown or black, rather heavy silty clay loam averaging about 10 inches in thickness, although it may continue downward to a depth of 24 or more inches. In places a mucky layer, 1 or 2 inches thick, covers the surface. The subsoil is generally slightly mottled drab-brown, brownish-gray, or gray silty clay loam or clay which may continue to a depth of 36 or more inches. The subsoil becomes more reddish in color with depth and, at an average depth of about 20 inches, grades to pinkish or brownish-red, stiff, plastic clay containing some gray or drab mottles and, in places, some specks of limonite yellow. The color varies considerably in the subsoil, owing to differences in drainage conditions; the more poorly drained the area the more gray and drab and the less pink or red color there is in the lower part of the subsoil. Seams of fine sand and layers of drab silty clay loam occur in places in the subsoil. A few glacial bowlders may be present on the surface, but the soil is free from gravel.

This soil is in no place sour. In most places both the topsoil and subsoil effervesce with hydrochloric acid. Areas surrounded by the Kewaunee soils have a somewhat heavier subsoil than those surrounded by the Superior soils. The soil is fairly well granulated and is of good structure for a poorly drained soil of such fine texture.

This soil occupies poorly drained depressions or basinlike areas, generally within areas of the Kewaunee and Superior soils. Areas are scattered over all the eastern part of the county.

Areas of this soil receive the run-off from the surrounding uplands, and many are under water in the spring and after heavy rains. Probably 75 per cent of the land has been ditched to remove the surface water, and possibly 20 per cent has been tile drained to some extent.

About 40 per cent of this soil is now cultivated, about 35 per cent is used for permanent pasture, and 25 per cent is still wooded. Elm, ash, beech, and oak are some of the most common trees.

Most of the crops common to the region are grown. The water table is too high for alfalfa, even when tile drains are installed.

Most of the soil can be ditched and tiled so as to give it good surface drainage. When tile drained it produces very good corn for silage, yields averaging about 8 tons to the acre. In very wet years much of the corn drowns out. The soil is rather cold and late for producing ear corn. Oats yield about 45 bushels to the acre and are the most important grain crop. All grains yield very well but are apt to lodge badly. Timothy and clover hay yield about 2 tons to the acre or about 15 per cent more than the average for the county. About 50 per cent of the cultivated area is in timothy and clover for hay and pasture. Permanent pastures are very good, and this is one reason why more of the soil is not cultivated.

Poygan silty clay loam is a very hard soil to cultivate, as it must be plowed when neither too wet nor too dry. No farms are made up exclusively of this soil. It is included with other soils on which dairy farming is practiced almost exclusively. The crops grown are fed on the farm, and the manure is returned to the soil. Manure helps to make the heavy soil more friable and more easily cultivated. Commercial fertilizers are not used.

Poygan silty clay loam sells at about $60 an acre for the undrained areas and $125 or more an acre for well-drained, tiled areas when sold alone.

POYGAN SILT LOAM

The surface soil of Poygan silt loam is generally very dark brown silt loam to an average depth of 10 inches. When wet, the surface soil is nearly black. The dark-colored surface layer is commonly underlain by brownish-gray or drab silt loam or silty clay loam containing some rust-brown and a trace of limonite-yellow mottling. This layer becomes more reddish with depth and, at a depth of about 24 inches, grades to pinkish or brownish-red clay which generally contains some grayish, rust-brown, and in places a trace of limonite-yellow mottling. In places the red clay lies within 14 inches of the surface. The subsoil varies considerably, as it is in places derived from more or less stratified layers of red clay and brownish-gray fine sandy loam. Areas bordering the Superior soils show the most stratification. The soil is free from stone and gravel. The topsoil and subsoil are neutral.

This soil occurs mostly in scattered small areas along the eastern border of the county. Most of the areas occupy poorly drained shallow depressions in areas of Superior silt loam and Kewaunee silt loam. Many areas have been drained by tiling and ditching, and nearly all of the soil can be fairly well drained.

About 40 per cent of the Poygan silt loam is used for cultivated crops, 30 per cent for permanent pasture, and 30 per cent for wood lots. The relative acreage of different crops and the yields are about the same as for Poygan silty clay loam.

Poygan silt loam is usually sold with adjacent upland soils at an average price of about $125 an acre. When sold alone, undrained areas are held at $50 or $75 an acre and drained, cultivated areas at $100 or $125 an acre.

POYGAN FINE SANDY LOAM

Poygan fine sandy loam is dark-brown fine sandy loam or very fine sandy loam to an average depth of about 10 inches. The sub-

soil varies considerably. The upper part is commonly rather coarse. It varies from yellow fine sand to red clay but is most commonly brownish-gray fine sandy loam with some rust-brown mottling. At an average depth of abut 28 inches it is underlain by pinkish or reddish-brown material of variable texture, ranging from clay to fine sand, which, in places, is stratified.

This soil resembles Poygan silt loam in its topographic position, drainage, and agricultural value. Only a few small areas were mapped. About 60 per cent of the soil is cultivated. It is sold with surrounding soil types at $125 or more an acre.

CLYDE SILT LOAM

The surface soil of Clyde silt loam, to an average depth of 8 or 10 inches but in places to a depth of 16 or more inches, is black or dark grayish-brown rather heavy silt loam containing a high percentage of organic material. The surface soil grades directly to a layer of gray, drab, or brownish-drab silt loam or silty clay loam containing pea-sized specks of limonite yellow. This layer, at a depth of about 20 inches, grades to mottled gray, bluish-drab, grayish-yellow, limonite-yellow, and greenish-gray heavy silty clay. Streaks of grayish calcareous material are common in the deep subsoil. Angular limestone gravel, similar to that found in the lower part of the subsoil of the Bellefontaine soils, is found in many places in the lower part of the subsoil of this soil. Both the topsoil and subsoil are sweet. The lower part of the subsoil effervesces freely with hydrochloric acid.

In places a mucky layer 3 or 4 inches thick is present on the surface. This has been mostly tramped out on pasture areas. Where an appreciable quantity of peat was found on the surface the area was mapped as a shallow phase of muck.

Most areas of this soil are very stony. Glacial bowlders are strewn thickly over the surface, but few are in the subsoil. Areas that are so stony that they would be difficult to clear were indicated by stone symbols on the map. A few small areas of Clyde loam were included with this soil in mapping.

The dark color of the surface soil of this soil is not very stable. After the areas are cultivated for a number of years the color may become medium brown instead of dark brown or black. Areas occupy low, poorly drained depressions in the western half of the county and are commonly surrounded by areas of Bellefontaine silt loam. Many areas of peat are found in the most poorly drained areas of Clyde silt loam.

The natural drainage of this soil is poor, and water stands over much of it in the spring and after heavy rains. Many areas are difficult to drain, as they occur in deep, kettlelike depressions where it is difficult to obtain an outlet.

Probably 75 per cent of this soil can be drained well enough to raise ordinary farm crops. The rest is good pasture land in the dry part of the summer. Most areas are nearly level, but a few occur on seeped places on slopes.

Clyde silt loam was formerly wooded with elm, ash, willow, beech, oak, alder, soft maple, and other trees. Probably 30 per cent of it is now cultivated. The rest is used for permanent pasture.

Most of the cultivated areas have been drained by shallow ditches, and many areas have been tile drained.

Clyde silt loam is particularly adapted to grass and root crops. Corn does very well on well-drained areas, especially in dry years. Small grains are apt to lodge. Barley seems to do the best of any small grain. The underdrainage is too poor for alfalfa. The crop yields are higher than the average for the county in dry years, but crops are often drowned out after heavy rains.

The average acre yields are about as follows: Corn for silage, 8 tons; clover and timothy hay, 1½ tons; barley, 30 bushels; and oats, 38 bushels. Most crops are fed to dairy cows on the farm. Not so much manure is returned to this soil as to the upland soils, as it is naturally very fertile. No commercial fertilizers are used.

The current selling price of Clyde silt loam varies from about $50 to $100 or more an acre when it is tile drained.

The greatest need of this soil is better drainage, which results in better aeration and a warmer soil, so that crops will start earlier in the spring. Many areas of this soil are locally spoken of as being sour when tests indicated that they are very sweet but are deficient in drainage.

CLYDE SILTY CLAY LOAM

Clyde silty clay loam is black, heavy silty clay loam to an average depth of 10 or 15 inches, where it grades sharply to mottled gray, drab, and brownish-drab silty clay loam or clay containing specks of limonite yellow. At a depth of about 24 inches this material commonly grades to drab or gray clay containing considerable limonite-yellow mottling. Seams or pockets of fine sand and some angular gravel are present in the lower part of the subsoil. The substratum is glacial drift. The soil is free from stone and gravel. The topsoil and subsoil are sweet, and the lower part of the subsoil effervesces freely with hydrochloric acid.

This soil is most common on the broader, more level depressions in the western half of the county. Natural drainage is poor. The surface soil appears to be derived in part from material washed in from adjacent slopes; the subsoil is derived from glacial drift.

Clyde silty clay loam was formerly covered with hardwoods. Probably 70 per cent of it is still wooded, and about 30 per cent is cultivated. The crop adaptation and crop yields are the same as on Clyde silt loam.

Well-drained Clyde silty clay loam sells at prices ranging from about $50 to $100 an acre. Sold with other soils it brings as much as $150 an acre.

MAUMEE LOAM

The topsoil of Maumee loam, to an average depth of 8 or 10 inches, but in places to a depth of as much as 16 or more inches, is black or dark-brown loam or silt loam. The upper part of the subsoil is commonly mottled brownish-gray or grayish-brown, gray, and limonite-yellow silt loam to a depth of 20 or more inches. The substratum consists of stratified layers of fine sand, friable clay, and gravel, generally grayish or mottled in color. The topsoil and subsoil are neutral or alkaline in reaction, and the substratum contains lime carbonate.

Most of this soil occupies low depressions in association with the Warsaw, Fox, and Superior soils. The natural drainage is poor. Probably 75 per cent or more of the total area can be drained sufficiently well to grow ordinary crops. The original vegetation on Maumee loam was a hardwood forest, and, in places, the original timber still remains.

Probably 35 per cent of this soil is under cultivation. The rest is used for pasture or is in timber. Most of the cultivated areas have been drained by shallow, open ditches or by tile drains.

Maumee loam has the same crop adaptation as Clyde silt loam, and the yields are about the same. On the tiled areas, the yields are fully as high or higher than on Bellefontaine silt loam. The soil is naturally very fertile.

This soil sells at prices ranging from about $50 to $100 an acre for the undrained areas and from $100 to $150 or more for areas that are tile drained.

GENESEE SILT LOAM

Genesee silt loam, to a depth ranging from 8 to 12 inches, is brown or light-brown silt loam varying greatly in texture. In areas near stream channels the surface soil is generally lighter textured, approaching fine sandy loam, whereas in depressions at some distance from the stream channels it may be silty clay loam. The upper part of the subsoil is commonly brown, yellowish-brown, or reddish-brown silty clay loam mottled with gray or drab and limonite yellow to a depth ranging from 18 to 36 or more inches. This is underlain by mottled yellow and gray loamy sand or gravelly loam containing rust-brown and limonite-yellow mottles. Layers of sand or clay may be found at any depth in the subsoil. The subsoil is more reddish in areas in the eastern part of the county where the uplands are largely Kewaunee silty clay loam. Areas having a distinctly brownish-red subsoil are separated as Ewen silt loam.

The surface soil is generally neutral or alkaline in reaction, and the subsoil effervesces freely with hydrocholoric acid. In more poorly drained places there is a peaty layer 2 or 3 inches thick on the surface. This layer has been mostly tramped out in the pastures.

Genesee silt loam is the predominating soil of the bottom lands in the county. It occurs along the first bottoms of both large and small streams in all parts. The surface is level but is cut up considerably by meandering stream channels. Most of the soil lies from 3 to 6 feet above the normal level of the stream. There is little standing water on the surface, but most of the land is flooded after heavy rains and in the spring of the year. Most areas which are flooded only after unusually heavy rains are cultivated. The water table in the subsoil is high.

This soil was formerly forested with elm, ash, beech, oak, birch, and other hardwoods, and with alder, soft maple, and willow. Most of the trees have been cut, except for a few left for shade trees in the pastures. Probably 20 or 25 per cent of the soil is cultivated, and the rest is used for permanent pastures.

This soil, like all bottom-land soils, produces a heavy growth of native and tame grasses and is especially valuable for pasture land. Hay and pasture crops, such as timothy and clover, are the most important crops. Oats and barley are grown for nurse crops.

but they are apt to lodge before ripening. Some corn is grown on the best drained areas. The soil is too poorly drained for alfalfa.

Genesee silt loam is naturally very fertile. In dry years crop yields on it are considerably above the average for the county, but in wet years they are lower, and crops are often drowned out after heavy rains. This soil would be very difficult to drain.

Genesee silt loam sells with other soils at $100 or $150 an acre.

GENESEE FINE SANDY LOAM

Genesee fine sandy loam is mostly brown or grayish-brown fine sandy loam to a depth of 8 or 10 inches. The subsoil consists of stratified layers of brownish-yellow or reddish-brown fine sand and sandy clay.

This soil is found in small, scattered, level areas along stream bottoms, where the stream gradient is rather high. It is subject to overflow after heavy rains. Probably 15 per cent of it is cultivated. The same crops are grown as on Genesee silt loam, but the yields are somewhat lower.

This land sells with other soils at $100 or $150 an acre.

EWEN SILTY CLAY LOAM

The surface soil of Ewen silty clay loam is brown, friable silty clay loam to a depth ranging from 8 to 12 inches. The subsoil is made up of stratified layers of brownish-red, reddish-brown, greenish-yellow, or black clay, and layers of brownish-red or gray fine sand. Considerable gray, rust-brown, and limonite-yellow mottling occurs in the subsoil. In many places the subsoil is brownish-red friable clay between depths of 10 and 18 inches, mottled greenish gray, yellow, and limonite yellow between depths of 18 and 28 inches, and red or gray fine sand between depths of 28 and 36 inches. Thin layers of waterworn gravel may be present. The surface soil is generally slightly acid or neutral, and the subsoil is calcareous.

This soil occurs in scattered areas in the first bottoms of streams in the eastern part of Sheboygan County. It is mostly derived from material washed down from areas of the Kewaunee soils. The most typical area is along Pigeon River, in the northeastern part of the county.

Areas of this soil are level but are cut up by meandering stream channels. Most of them lie from 3 to 5 feet above the normal level of the streams. There is usually no standing water on the surface, but much of the soil may be flooded after unusually heavy rains. The water table is always high, which makes underdrainage rather poor.

About 45 per cent of this soil is cultivated, an equal percentage is used for permanent pasture, and the rest is in wood lots. The most common trees are elm, ash, beech, and oak. The soil is better adapted to hay and pasture crops than to other crops. Clover, timothy, and other grasses do well. Alfalfa does not do well after the first year, because of the poor underdrainage.

Probably 60 per cent of the cultivated area of this soil is in timothy and clover for hay and pasturage, about 20 per cent is in oats, about 15 per cent is in corn, and the remainder is in minor

crops. The average yields are about as follows: Clover and timothy hay, 2 tons to the acre; oats, 40 bushels; and corn, 8 tons of silage.

Areas of Ewen silty clay loam are mostly included in dairy farms. The crops grown are fed on the farm. This soil is fertile, and the manure is more apt to be used on the adjoining upland soils. This is not usually a very hard soil to plow. Commercial fertilizers are not used.

Cultivated Ewen silty clay loam is held at $100 or $125 or more an acre. The most poorly drained areas sell at a considerably lower price. This soil is always sold with other soils, and its value is determined largely by the value of the surrounding land.

EWEN SILT LOAM

The surface soil of Ewen silt loam is brown silt loam to an average depth of about 10 inches. Usually the subsoil to a depth of about 28 inches is brownish-red or pinkish silty clay loam. It grades to more yellowish or brownish-red silt loam with, in places, grayish and rust-brown mottling. This is underlain by brownish, yellowish, red, or gray fine sandy loam or fine sand, at a depth ranging from 30 to 34 inches. The substratum is made up of stratified layers of red clay and reddish or grayish fine sand or gravel. The surface soil is generally slightly acid, and the lower part of the subsoil is calcareous.

Ewen silt loam occurs along the level first bottoms of streams in the eastern part of the county. The most typical areas are along Sheboygan River. The soil is largely derived from material washed down from areas of Kewaunee silty clay loam mixed with material from Bellefontaine silt loam and other soils.

The surface is smooth but is cut up considerably by meanders of stream channels. Most of the soil lies from 4 to 6 feet above the normal level of the streams, and much of it is flooded only after very heavy rains. There is seldom any standing water on the surface. The underdrainage is rather poor, owing to the high water table. This soil is somewhat better drained than Ewen silty clay loam. About 60 per cent of it is cultivated, and the rest is used for permanent pasture. About the same crops are grown as on Ewen silty clay loam, but the yields average somewhat higher, as there is less loss by flooding after heavy rains. Crop yields are very high in dry years. Somewhat more corn and oats are grown on this soil than on Ewen silty clay loam. Alfalfa does well the first year but is apt to die when the roots reach the water table.

This soil is fairly easy to cultivate. It is used for dairy farming, and most crops are fed on the farm. The manure is more apt to be returned to the upland soils, as this soil is very fertile. No commercial fertilizers are used.

The current selling price of Ewen silt loam ranges from $125 to $150 an acre.

WABASH SILT LOAM

Wabash silt loam is mostly black or dark-brown silt loam containing a high percentage of organic material to an average depth of 8 or 10 inches, although the layer may continue to a depth of 18 or more

inches. Areas bordering the stream channels have sandier surface soils, and areas at some distance from the stream channels are heavier in texture. A peaty surface layer, 2 or 3 inches thick, occurs in some places. The subsoil is generally gray or drab silt loam or silty clay containing rust-brown and limonite-yellow mottles to a depth ranging from 18 to 36 or more inches. In the eastern part of the county it may vary to reddish brown in places and in the western part it may be yellowish brown or yellow. At a depth of about 30 inches it becomes somewhat coarse and may pass into fine sand or gravelly loam. Layers of fine sand or peat may be found in any part of the subsoil. The substratum is distinctly stratified and may vary greatly in short distances. Both the topsoil and subsoil are neutral or alkaline in reaction.

A few small areas of loam were included with this soil in mapping.

Wabash silt loam occurs mostly in narrow strips on small stream bottoms in the eastern part of the county. The surface is flat but is cut up by stream channels. Areas lie from 2 to 5 feet above the normal level of the streams and may be flooded in the spring and after heavy rains, but there is no standing water. Areas above normal overflow are largely cultivated. The underdrainage is poor, owing to the high water table in the subsoil.

Areas of Wabash silt loam were formerly heavily wooded with hardwoods. Probably 25 per cent of the land is cultivated, and the rest is used for permanent pasture. Like other bottom-land soils, the cultivated areas are devoted largely to tame hay and pasture crops, to which they are especially adapted. The soil is too poorly drained to grow alfalfa successfully. It has practically the same adaptation as Genesee silt loam. Some oats and barley are grown for nurse crops, and some corn is grown. The yields are above the average in dry years but are below the average in wet years, and crops are often drowned out. No commercial fertilizers are used.

The greatest need of this soil is drainage. It would be very difficult to drain, because of the flood waters which come down the streams and cover the entire bottom. As the flood plains are very narrow, diking would not be practical because of the high acre cost.

CARLISLE MUCK

Carlisle muck consists of black or very dark brown disintegrated or mucky peat to a depth of 36 or more inches. In places it is brown, well-disintegrated peat below a depth ranging from 24 to 36 inches. There is usually a surface layer, 3 or 4 inches thick, consisting largely of grass, loose leaves, moss, and other undecayed organic matter. Carlisle muck is so well disintegrated below the immediate surface layer that the source of material is not easily discernible. Most of it contains less than 3 per cent extraneous mineral matter. In a few places along the stream channels it may contain from 5 to 10 per cent of mineral material washed in by the stream. In areas along Lake Michigan the material is more raw and fibrous than elsewhere.

The organic deposits from which Carlisle muck is derived average about 5 feet but range from 3 to 35 or more feet in thickness. Most areas are underlain by mottled drab or pinkish clay. Areas on the lower terraces bordering Lake Michigan are mostly underlain by

gray, yellowish, or red fine sand. Carlisle muck is not acid. Waters from the calcareous soils of the uplands which drain into the bogs contain much dissolved lime, which probably accounts for the neutral or alkaline reaction of the material. Fragments of shells are usually present.

Carlisle muck occurs in scattered areas throughout the county. It is more common in the western half within areas of soils of the Bellefontaine series. It commonly occupies well-defined depressions having rather distinct beachlike borders. The surface is flat. A few small areas were mapped on seepage places on slopes. The natural drainage is poor, and there is standing water on many of the areas in the spring and after rains. Many acres have been ditched to remove the surface water and to lower the water table.

Most areas of this soil were formerly covered with timber, consisting mostly of elm, ash, soft maple, heavy alder, aspen, willow, and beech. Small included areas were or are covered with tamarack, cedar, and spruce.

Probably 75 per cent of this soil is still wooded and used more or less for permanent pastures. About 20 per cent has been entirely cleared of timber and is used for pasture land. The greatest present value of the soil is for the production of timber and for permanent pastures.

Probably 5 per cent of this soil is now cultivated. Most of the cultivated areas are small patches bordering areas of the Kewaunee and Poygan soils. The cultivated areas have mostly been drained by ditching, but a few areas have been tile drained. This soil is often farmed with bordering upland soils, in order to preserve the regularity of the fields. The farmed areas are, in general, composed of the most highly disintegrated material.

The field crops common to the region are grown. Corn for silage has the greatest acreage, and it yields from 5 to 9 tons of silage to the acre. Some barley and oats are grown, but they are inclined to lodge just before ripening. Timothy and other grass crops produce fairly good hay and pasturage. When cleared and well drained this is an easy soil to cultivate.

Carlisle muck looks productive to one not familiar with organic soils. It is very poor in potash and phosphorus, but its nitrogen content is fairly high. It has to be well fertilized in order to produce good crops. It will often produce a good crop the year after it is broken, after which the yields become gradually lower unless the soil is fertilized.

Barnyard manure is the most common fertilizer used. It was formerly considered a poor policy to apply barnyard manure, since it supplies so much nitrogen. Actual experience, however, has shown that it gives the best results of any fertilizer, probably because it supplies bacteria that accentuate decomposition and help to make the organic matter available. The peat is usually spoken of as being cold, dead soil material. The use of commercial fertilizers containing phosphorus and potash have given profitable returns on this soil. The fertilizer should be spread with a fertilizer attachment which drops the fertilizer a short distance from the seed, so it can not come in direct contact with the seed. No truck crops or potatoes are grown

on this soil at present in Sheboygan County. When well drained, similar soil is used elsewhere for potatoes, onions, celery, lettuce, and cabbage.

Carlisle muck, shallow phase.—The shallow phase of Carlisle muck consists of black, well-disintegrated, soft, mucky plant remains 36 inches or less in thickness. This is underlain by mottled drab or pinkish friable clay or silt. The mineral substratum varies considerably.

The shallow phase of Carlisle muck occurs mostly in the more poorly drained depressions in association with Poygan silty clay loam. A few areas are on slopes. Most of the areas were formerly covered with hardwood timber. Probably from 15 to 25 per cent of this soil is now cultivated. Most of the cultivated areas are on the more shallow organic deposits, generally less than 18 inches thick. Practically the same crops are grown as on Poygan silty clay loam. Crop yields are somewhat lower than on that soil but are higher than on the organic soils derived from deeper deposits.

RIFLE PEAT

Rifle peat consists of brown or dark-brown, finely fibrous, more or less matted organic matter 18 or more inches thick. Layers of various colors, ranging from brown, golden brown, or yellowish brown, to black are found below a depth of 18 inches. Shells and remains of animals are scattered throughout the material. Rifle peat appears to be derived most largely from sedges and reeds, but it contains more or less woody peat. A thin layer derived from Hypnum moss was found in the northern part of Sheboygan Marsh.

Rifle peat averages about 6 feet but ranges from 3 to 15 or more feet in thickness. It is underlain by mucky clay or soft and slushy marl. According to local information it continues to a depth of 45 feet in places.

Most of the Rifle peat occurs in one large area in Sheboygan Marsh in the northwestern part of the county. This is a level area having well-defined beach marks around the border, indicating it has been a lake at a recent date. Sheboygan River channel meanders through the marsh, which was formerly a storage basin which helped to check the flood waters of the river. Government surveys indicate the marsh as a lake or intermittent lake in 1837. According to local information the river channel leaving the marsh was first deepened to lower the water in the marsh at about this date. In 1868 a canal was dug at the outlet to drain the marsh, and the lake, which still remained in the eastern part of the marsh, was largely drained away. The present canals, 5 or 6 feet deep, were dug a few years ago. There is now little standing water on the marsh, but most of it is water-logged to the surface. The water table can not easily be lowered any further, because of the dam across Sheboygan River several miles below the outlet of the marsh. Only some of the border of the marsh is sufficiently well drained to allow farming. The cost of drainage to date has been nearly a total loss, although the drainage of some of the lower areas of other soils bordering the marsh has been improved. The drainage of the marsh is said to have caused considerable damage to the bottom lands on Sheboygan River, because the water now flows out of the marsh in a flood after heavy rains

instead of slowly for a long period. There is considerable agitation to dam the outlet and again impound the water in the marsh in order to obtain a more uniform flow in the river to prevent destructive floods, to increase the growth of timber, and to increase the value as a fish and game preserve.

The outer border of the area is largely covered with ash, soft maple, elm, hoary alder, aspen, willow, mountain ash, and other trees. Away from the border of the marsh, tamarack and cedar predominate. The lowest, or central part of the marsh, is mostly covered with coarse sedges and grasses. None of this grass is cut for hay or pastured. In general, the areas covered with grass are composed of the rawest and most fibrous material, the areas covered with brush, tamarack, and cedar are composed of materials intermediate in disintegration, and the areas covered with hardwoods are composed of the more highly disintegrated material.

Practically none of the raw, fibrous peat is cultivated. Much valuable timber has been cut from areas of this soil. The cedar is especially valuable for posts and poles. In the present status of agriculture, this peat seems to be more valuable for the production of timber than for farming.

The raw peat is naturally an infertile soil, owing in part to its low content of potash and phosphorus. A liberal supply of commercial fertilizer containing these constituents and of stable manure would be required to produce farm crops. The water table would have to be lowered considerably by the installation of numerous ditches and tile drains.

Crops freeze very easily on peat, owing to the poor air drainage and to the looseness of the material, which does not absorb or radiate heat as do mineral soils.

In the past most farming projects attempted on raw peat have proved unprofitable, except with special crops such as celery, cabbage, onions, potatoes, and cranberries. Cranberries probably would not thrive in this county, as they prefer an acid peat and tests indicate that Rifle peat in Sheboygan County is neutral or alkaline in reaction.

The underlying marl and marly clay may prove to be of considerable value at some time for industrial purposes or as a source of agricultural lime. Since most of the surrounding uplands are not acid, little agricultural lime is required in this locality at the present time.

ROUGH BROKEN LAND

Rough broken land includes the areas not mapped as Rodman gravelly loam that are too rough and stony to cultivate. Most areas have a slope of more than 15°. The soil is largely light-brown rather gravelly stony clay loam underlain by red clay in the eastern half of the county, and light-brown gravelly stony silt loam underlain by reddish-brown friable clay in the western half. Rough broken land does not have the stratified gravel substratum of Bellefontaine gravelly loam.

Rough broken land occurs in narrow areas on steep slopes bordering streams and on the low bluffs bordering Lake Michigan. It is mostly covered with a scattered growth of trees and brush and is

used for permanent pasture land. Its value varies from about $10 to $25 an acre for pasture.

DUNE SAND

Dune sand is gray, loose, porous, wind-blown sand or fine sand to a depth of 36 or more inches. It was mapped mainly in a narrow strip, ranging in width from a few rods to nearly half a mile, on the shore of Lake Michigan in the southern part of the county. The surface is hummocky or billowy. The soil is generally barren but in some places is covered with a sparse growth of sand grass. Some of it was at one time covered with white pine. This sand is too sterile to be of any value for farming but might be used for the production of timber. None of it is cultivated.

Dune sand is valued as a site for fishing establishments and summer homes along the lake front.

SUMMARY

Sheboygan County is near the east-central part of Wisconsin, bordering Lake Michigan. It comprises an area of 515 square miles.

The relief varies from level to rolling and hilly. The most conspicuous physiographic feature of the county is the Kettle Range of hills, which crosses the county from northeast to southwest. Elevations range from the level of Lake Michigan, which is about 600 feet above sea level, to about 1,200 feet above sea level in the high parts of the Kettle Range.

Drainage is into Lake Michigan, chiefly through Sheboygan River and its tributaries.

The first white man visited Sheboygan in 1795. The first sawmill was built in 1834, and settlement followed soon after this date. The first railroad was built in 1856. All parts of the county are now settled and highly improved.

The average frost-free season is about 180 days along the lake shore and about 158 in the central part of the county.

General farming prevails in all parts of the county, and dairying is the most important branch of agriculture. Corn is grown least extensively along the lake shore, where nights are cool. Small grains, clover, alfalfa, and sweet clover are important crops. Oats is the most extensively grown small grain, and barley, rye, and wheat are of less importance. Cheese is the most important dairy product.

In 1920 there were 3,664 farms in the county, and 93.4 per cent of the land was in farms. The average size of the farms was 85 acres.

In the mapping of the soils of Sheboygan County, 20 mineral soil series, 2 organic soils, and 2 miscellaneous classes of material, dune sand and rough broken land, were recognized.

The Bellefontaine series includes light-colored, well-drained soils derived from highly calcareous glacial drift.

The Kewaunee soils are similar to the Superior, but the parent material is typically heavy glacial till and the relief is rolling.

The Superior series includes light-colored soils having heavy reddish clay subsoils.

The Fox series includes light-colored soils on terraces or outwash plains.

The Lucas soils are similar to the Conover but are underlain by stratified deposits.

The Warsaw series includes dark-colored, well-drained soils on terraces and outwash plains. The parent material consists of stratified calcareous sand and gravel.

The Miami soils are similar to the Bellefontaine but are more free from coarse material, are smoother in relief, and are deeper to unassorted till.

The Berrien soils are sand soils, similar to the Plainfield, except that the deep substrata consist of heavy clay.

The Plainfield series includes light-colored very sandy soils on terraces and outwash plains.

The Saugatuck series includes poorly drained sand soils.

The Conover soils are similar to the Miami but are more nearly level, are deficient in drainage, and have mottled subsoils.

The Coloma and Bridgman series include sand soils of light color.

The Rodman soils are mapped in rough, broken, morainic areas where there is a very thin cover of soil over glacial gravel.

The Poygan soils have similar parent material to the Superior but occupy low, more poorly drained areas, and the surface soils are dark colored.

The Cldye series include very dark colored soils in low, poorly drained depressions in the glacial till.

The Maumee soils are similar to the Clyde but are derived from water-deposited material with sand or gravel strata in the deep subsoil.

The Genesee soils are light-colored first-bottom soils subject to annual overflow.

The Ewen soils are similar to the Genesee but have a reddish cast and are associated with the Kewaunee and Superior soils. They occupy first bottoms.

The Wabash series includes dark-colored poorly drained first-bottom lands subject to overflow.

Carlisle muck and Rifle peat are composed of organic matter. The muck is dark colored and more thoroughly disintegrated than the peat. Both are low lying and poorly drained.

Dune sand includes areas of wind-blown sand or dunes near Lake Michigan.

Rough broken land includes steep, rough, broken and rocky areas which have no agricultural value, except as pasture land.

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U. S. DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
HENRY G. KNIGHT, CHIEF
A. G. McCALL, CHIEF, SOIL INVESTIGATIONS
CURTIS F. MARBUT, IN CHARGE SOIL SURVEY

SOIL MAP
SHEBOYGAN COUNTY
WISCONSIN

WISCONSIN GEOLOGICAL AND NATURAL HISTORY SURVEY
ERNEST F. BEAN, DIRECTOR
UNIVERSITY OF WISCONSIN COLLEGE OF AGRICULTURE
H. L. RUSSELL, DEAN
A. R. WHITSON, IN CHARGE SOIL SURVEY

CONVENTIONAL SIGNS

CULTURE
(Printed in black)

City or Village, Roads, Buildings, Wharves, Jetties, Breakwater, Levee, Lighthouse, Fort.
Secondary roads and Trails
Railroads Steam and Electric
Bridges, Ferry
R.R. crossings, Tunnel
Ford, Dam
School or Church Cemeteries
Mine or Quarry Mine dumps Made land
Bluff, Escarpment Rock outcrop and Triangulation station
Stony and Gravelly areas
Soil boundaries
Boundary lines
Boundary lines
Boundary lines
U.S. township and section lines

RELIEF
(Printed in brown or black)

Contours Depression contours
Prominent Hills Mountain Peaks
Sand, Wash, and Sand dunes
Shore and Low-water line, Sandbar

DRAINAGE
(Printed in blue)

Streams
Lakes, Ponds, Intermittent lakes
Intermittent streams
Springs, Canals and Ditches, Flumes
Swamp Salt marshes
Submerged marsh Tidal flats

The above signs are in current use on the soil maps. Variations from this usage appear in some maps of earlier dates.

LEGEND

- Bellefontaine gravelly loam — Bg
- Steep phase — Bg
- Kewaunee fine sandy loam — Kf
- Kewaunee loam — Km
- Bellefontaine fine sandy loam — Bf
- Kewaunee silt loam — Kl
- Bellefontaine loam — B
- Steep phase — B
- Kewaunee silty clay loam — Ks
- Steep phase — Ks
- Bellefontaine silt loam — Bs
- Steep phase — Bs
- Lucas silt loam — Ls
- Maumee loam — Ml
- Berrien fine sand — Bd
- Miami silty clay loam — Ms
- Bridgman fine sand — Br
- Plainfield fine sand — Ps
- Clyde silt loam — Cs
- Poygan fine sandy loam — Pf
- Clyde silty clay loam — Cc
- Poygan silt loam — Pm
- Coloma fine sand — C
- Shallow phase — C
- Poygan silty clay loam — Pc
- Rodman gravelly loam — Rl
- Conover silt loam — Co
- Saugatuck fine sand — Sf
- Ewen silt loam — Es
- Ewen silty clay loam — Ec
- Superior fine sandy loam — S
- Superior loam — Sl
- Fox fine sandy loam — Fl
- Superior silt loam — Ss
- Fox loam — Fm
- Gravelly phase — Fm
- Superior clay loam — Sc
- Wabash silt loam — Wm
- Fox silt loam — F
- Eroded phase — F
- Warsaw loam — Wl
- Warsaw silt loam — Ws
- Genesee fine sandy loam — Gf
- Genesee silt loam — Gs
- Carlisle muck — Cm
- Shallow phase — Cm
- Dunesand — D
- Rifle peat — Rp
- Rough broken land — Rb

Mark Baldwin, Inspector, District 1.
Soils surveyed by W. J. Geib, in charge, and A. C. Anderson, U. S. Department of Agriculture, and W. H. Pierre, A. H. Meyer, G. D. Scarseth, and Robert Bartholomew, Wisconsin Geological and Natural History Survey.

Scale 1 inch=1 mile

LITHO EASTERN OFFSET INC., BALTO.

Field Operations
Bureau of Soils
1924

[PUBLIC RESOLUTION—No. 9]

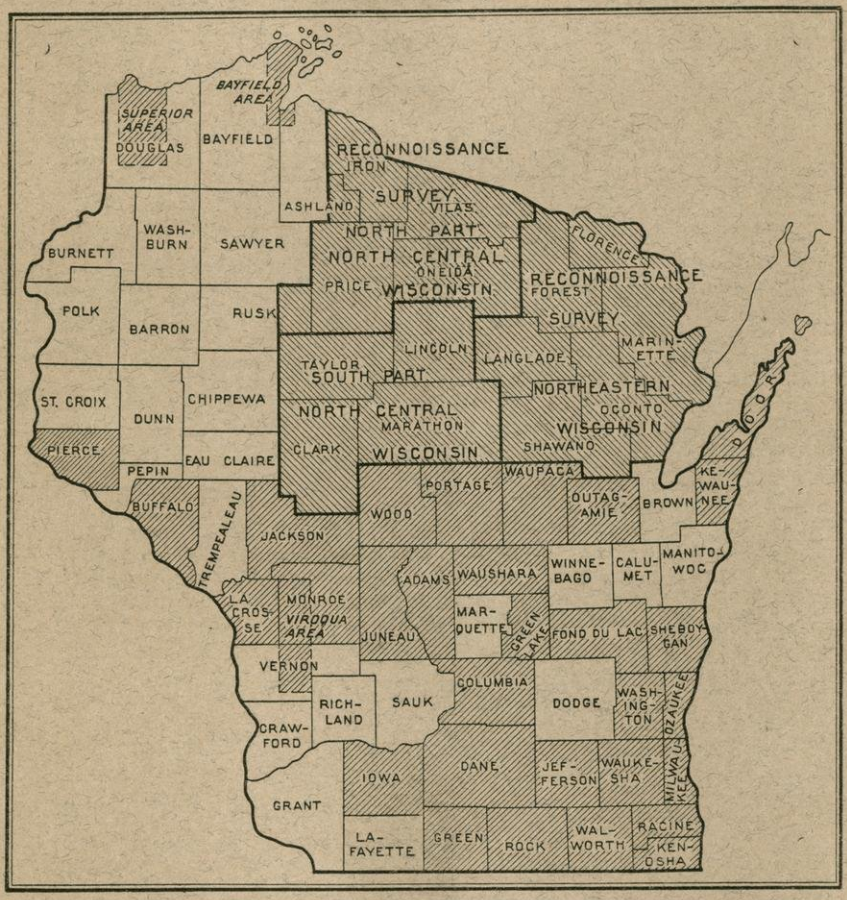
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]



Areas surveyed in Wisconsin, shown by shading