SOIL SURVEY OF KENOSHA AND RACINE COUNTIES, WISCONSIN.

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DESCRIPTION OF THE AREA.

Kenosha and Racine Counties lie in the southeastern corner of the State of Wisconsin, Lake Michigan forming the eastern boundary. The area of these two counties is 606 square miles, or 387,840 acres.

There are within this area six topographic divisions, viz, smooth plains, mainly in the western part of the area, underlain by glacial outwash gravel and sand; the undulating plains of the Early Wisconsin drift; the rolling and hilly belt comprising the Valparaiso Moraine; the parallel belts of low, rolling ridges known as the Lake Border Moraine, a system of the Late Wisconsin drift; the undulating plains near Lake Michigan; and the terraces along Lake Michigan.

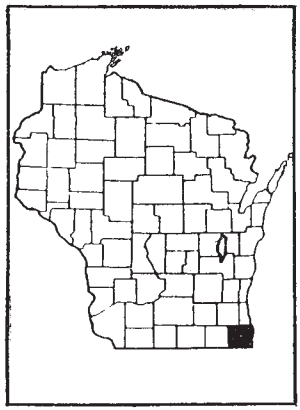

FIG. 29.—Sketch map showing location of the Kenosha and Racine Counties area, Wisconsin.

The smooth plains underlain by glacial outwash occur in the western part of the area and consist of flat surfaces. One of these comprises 6 square miles and lies between the Walworth County line and Powers Lake on the west and Twin Lakes on the east. Smaller outwash plains, varying in extent from 1 to 2 square miles, occur south of Caldwell, southwest of Wind Lake, west of Rochester, and about halfway between Twin Lakes and Wilmot.

The undulating plain of the Early Wisconsin drift region, which covers an area of about 6 miles and occurs immediately west of Twin Lakes, has a rather deep covering of drift material. Overlying this is a blanket of loess, ranging from 2 to 6 feet thick. The surface is smooth and varies in topography from undulating to gently rolling. All parts are reached by drainage ways.

The rolling to hilly Valparaiso Moraine occupies most of the western fourth of the area, entering it from Lake County, Ill., in a belt about 8 miles wide, and extending along the State line from a point 1½ miles southwest of Wilmot east to a point due south of George Lake. This belt extends in a northerly direction and includes Salem, Wheatland, Burlington, and about all of Rochester and Waterford Townships, together with the western part of Bristol, the western part of Brighton and Norway, the northwestern corner of Dover, and part of Randall Townships.

The smooth lands along Lake Michigan comprise the Lake Michigan Ground Moraine, which borders the Valparaiso Moraine on the east and consists of a zone varying from 4 to 6 miles wide between the Waukesha County line and Brighton, and narrowing to about 1 mile between Brighton and Bristol. South of Bristol it widens again until where it enters Illinois it has a width of 3½ miles. The surface ranges from undulating to gently rolling.

West of the Fox River the surface is marked by discontinuous groups of kames forming bulky ridges, whose surfaces are pitted with kettle holes. These alternate with low marshy areas and nearly flat areas, underlain by sand and gravel. East of the Fox River the topography is marked by broader undulations and depressions, with abrupt ice-contact slopes, which are occupied by lakelets and marshes.

The Lake Border Moraine adjoins the Lake Michigan Moraine on the east and covers all of the east half of the area surveyed, except a strip along Lake Michigan, known as the Lake Michigan Terrace. The Lake Border Moraine is distinctively a ground moraine composed of a series of broad, gently sloping ridges of drift which nearly parallels the shore of Lake Michigan. Here and there groups of kettle holes pit the surface, but for the most part the surface is marked only by broad gentle undulations. The notable feature of the tract is the disposition of the drift in the broad ridges parallel to the lake shore, so that, though the general elevation increases toward the east, the drainage reaches the lake only where the streams have cut transversely across the trend of the ridges, as in the case of Root and Pike Rivers. The Desplaines River which traverses the area from north to south does not enter the Lake, but flows southward to the Illinois River.

The Lake Michigan Terrace consists of a level belt from 1¼ to 2 miles wide bordering Lake Michigan and extending from Illinois to the Milwaukee County line.

The area surveyed has two drainage systems. The first includes that part of Kenosha County, except a small area along the Illinois line, lying east of the Chicago, Milwaukee & St. Paul Railway, and almost all of Racine County lying east of Dover and Norway Towns,[1]

[1] "Town" as used in this area is synonymous with township.

with the exception of a small area near Sylvania. It is drained into Lake Michigan by the Root and Pike Rivers and their tributaries, and also by a number of short intermittent streams, which have their heads along the eastern slope of the most easterly ridges of the Lake Border Moraine.

The second system is drained by the Desplaines River and the Fox River into the Illinois River. The Desplaines and Fox are separated by a divide extending from east of Cross Lake north through Salem and Klondike to the north-central part of Brighton Town. The large number of lakes, swamps, and marshes in this region indicate a very young topography, so young that practically all of the lowland has very poor drainage or no drainage at all. The streams have not had time to develop valleys sufficiently deep to ramify all sections with their tributaries to provide drainage for those low areas.

The first settlement in the area was made in 1834 at the mouth of Root River, and the next in 1835 when the town of Port Gilbert was established at the same place. This was the first white settlement in southeastern Wisconsin. A settlement was made at the junction of the Fox and White Rivers in 1835. The first settlement in Kenosha County was made in 1836, at the present site of Salem.

Racine County was formed in 1836, and Kenosha County was set off from it in 1850. The early settlers were of Anglo-Saxon descent, and came largely from New York and New England. Later there was a great influx of Germans, Norwegians, Irish, Scotch, and English. All parts of the area are now thickly settled and well developed. The population of the two counties is given in the 1920 census as 130,245, of which 27,554 is classed as rural, averaging 45 persons to the square mile.

The city of Kenosha on Lake Michigan in the east-central part of Kenosha County is the county seat of Kenosha County. According to the census of 1920 it has a population of 40,472. Kenosha is a manufacturing center of considerable importance and is provided with both steam and electric railroad and water transportation facilities to Chicago and Milwaukee. Other towns and shipping points in Kenosha County are Somers, Truesdell, Bristol, Salem, Silver Lake, Wheatland, Trevor, Bassett, and Twin Lakes.

Racine is the county seat of Racine County. It is one of the leading manufacturing cities of the State, and has splendid steam, electric, and water transportation facilities. Its population at the last census was 58,593. Burlington, with a population of 3,626, is located in the extreme western part of the county. A condensery, canning factory, sauerkraut factory, blanket factory, and basket factory are located here. It is on two steam railroads, and one electric road running to Milwaukee. Union Grove has sauerkraut and hemp factories; Franksville has a sauerkraut factory. At Rochester is located

the county agricultural school. Other towns in Racine County include Waterford, Wind Lake, Corliss, Sylvania, Kansasville, Dover, and Honey Creek.

The area as a whole is very well provided with transportation facilities. Two double-track lines of the Chicago & North Western Railway Co. cross the eastern part of the area from north to south. A branch of this road traverses Kenosha County east and west through Salem and Twin Lakes. The Chicago, Milwaukee & St. Paul Railway Co. has a double-track line crossing the area north and south, passing through Corliss, and another line crossing Racine County from Racine through Union Grove to Burlington and on to Beloit. The Soo Line touches the western part of the area, passing through Trevor, Silver Lake, Wheatland, Burlington, and Honey Creek. Two interurban railways connecting Chicago and Milwaukee cross the eastern part of the area, passing through Kenosha and Racine, and another runs from Rochester to Milwaukee, passing through Waterford and Wind Lake. Steamboat lines connect Racine and Kenosha with all of the Great Lake ports.

The area is provided with a very good road system. A number of concrete roads extend out from Racine and Kenosha, and all of the more important roads are kept in good condition. Under the present road-making system all of the public roads receive some attention. For a time during the spring and fall many of the cross and secondary roads are not in good condition. Practically all parts of the area are reached by rural mail delivery routes and by telephone lines.

Racine and Kenosha are the principal home markets, and Milwaukee and Chicago are the leading markets outside of the area.

CLIMATE.[2]

Among the factors which influence the agriculture of a State none is more important than the climate. The class of crops which can be grown is largely determined by the length of the growing season and the amount and distribution of the rainfall; so that the climate may determine the type of agriculture which can be practiced to best advantage.

The distribution of rainfall over Wisconsin is remarkably uniform, the average yearly precipitation ranging from 28 to 34 inches, while the mean for the State as a whole is 31 inches. This is a slightly heavier rainfall than is received by eastern England, northern France, most of Germany and Sweden, and the Danube Valley. As compared with other sections of the country, Wisconsin has a total rainfall equal to that of central Oklahoma and Kansas, northern

[2] Bul. No. 223, Wis. Agr. Expt. Sta., The Climate of Wisconsin and Its Relations to Agriculture, has been drawn on freely in writing this chapter.

Iowa, Michigan, northwestern New York, or the Puget Sound Basin of Washington. Owing to its northern location, however, the lessened evaporation probably makes the precipitation as effective as that of Arkansas, Illinois, or Virginia.

The local distribution of rainfall varies, however, from year to year, the variation being caused by variation in the movement of cyclonic storms. In the driest year since authentic records have been kept the average rainfall for the State was 21.4 inches, and in the wettest year 37 inches. For Kenosha County the total precipitation for the driest year of record is 20 inches, and of the wettest year 36.06 inches. For Racine County the averages are practically the same. The mean annual precipitation is 29.65 inches.

Of equal importance in agriculture to the total amount of rainfall is its seasonal distribution, and in this respect Wisconsin is favorably situated, as about half of the total rainfall occurs in May, June, July, and August, and nearly 70 per cent from April to September, inclusive. The precipitation for the winter months for Kenosha County is 4.26 inches, for the spring 8.26 inches, for the summer 9.14 inches, and for the fall 7.99 inches. Most of the rainfall occurs just preceding and during the period of plant growth; thus the growing season, April to September, inclusive, has an average of 19.04 inches. Owing to the small winter precipitation there is practically no leaching of fertility from the soil during this season of the year.

Another phase of rainfall distribution of great importance is its variation within a period of a few weeks. Frequently periods of drought and periods of unusually heavy rainfall occur, continuing for from one to four weeks and occasionally longer. Observations over a period of 30 years seem to indicate that there are usually several 10-day periods during each season when the amount of rainfall is so slight that crops on a moderately heavy soil, such as the Miami silt loam, actually suffer from lack of moisture.

This area lies in the section of Wisconsin that has the longest growing season in the State, averaging about 170 days, which is as long as that of central Illinois, longer than that of central Indiana or Ohio, and about equal to that of the Valley of Virginia and that of central Maryland. The mean annual temperature is 47.4° F.

The temperature of summer is similar to that of northern Illinois, Indiana, Ohio, and southwestern Pennsylvania, while in winter it is comparable to that of southern Vermont, northern Iowa, and southern Montana. On seven summer days on the average each year the thermometer may reach 90° F., and during five winter mornings on an average it falls to —10° F. or lower. The highest temperature recorded in the county is 107° F., and the lowest —24° F., but such extremes are of rare occurrence and of short duration.

The average date of the last killing frost in the spring is May 2; the latest date of killing frost recorded is May 31. The average date of the first killing frost in the fall is October 14. while the earliest date recorded is September 16.

AGRICULTURE.

The history of the agriculture in Kenosha and Racine Counties, Wis., begins with the earliest settlement, which, as already stated, was made at the mouth of the Root River in 1835. Rumors of the fertility of the soil of Wisconsin spread rapidly through the older States and started a tide of immigration to the Northwest, and within one year from the time that the first cabin was built there were more than 100 settlers within the territory now included in these counties.

The early farming consisted largely of the growing of wheat as a cash crop, and of corn, oats, hay, potatoes, and vegetables for subsistence. As more settlers entered the county the growing of wheat was extended into various sections of the area and particularly into the large, open prairies and oak openings. About 1845, in the period of more general settlement and farm development, it was reported that the land yielded an average of 30 bushels of wheat per acre. In succeeding years considerable difficulty was experienced in raising wheat on account of blight, and in 1862 a reduction of acreage was caused by the chinch bug. Corn and oats proved to be profitable and the raising and feeding of stock gradually developed into an important industry.

The growing of hops was a very important industry in this area during the sixties and seventies. In 1857 the price of hops was 40 to 50 cents a pound, and in many cases a single crop paid for the land and all improvements. So many went into hop growing, however, that overproduction resulted, and in 1869 the price was only 10 to 15 cents a pound, hops of poor quality bringing only 3 cents a pound. The low prices and the hop louse finally caused the complete abandonment of the industry.

Flax was an important crop in the seventies, reaching its maximum production in 1879. It continued to be grown extensively until 1887, when the acreage began gradually to decline.

According to the 1880 census, there were 30,386 acres in corn in 1879, producing 1,180,525 bushels. The oats acreage was 62,670 acres with an output of over one and one-fourth million bushels. There were slightly over 19,000 acres in wheat with a production of 289,000 bushels. The barley acreage was 3,321 acres and the yield 84,533 bushels. There were then 2,375 acres in rye with a production of 47,110 bushels. The acreage in hay was 81,230 acres, producing 97,930 tons.

In addition to these crops, 139,438 bushels of flaxseed and 259,180 bushels of potatoes were produced. There was also some production of buckwheat, peas, sorghum, and maple sirup, and $89,647 worth of orchard products.

The principal form of agriculture in the area at present consists of general farming combined with dairying. The chief crops are corn, oats, barley, and hay. Potatoes, wheat, rye, and buckwheat are grown to a small extent. Special crops are sugar beets, cabbage, and onions.

Corn is the most important crop in the area. In 1909 there were in this crop 50,515 acres, producing 1,923,477 bushels. In 1919 only 23,744 acres, with a total production of 913,374 bushels, is returned by the census, but there is also reported 27,083 acres in silage crops, a distinction not made in the census of 1910, which may be assumed to be almost entirely corn, so that the total acreage in this crop has changed but little, if any, during the last decade. The Wisconsin No. 8 and the Golden Glow, or Wisconsin No. 12, are the most popular varieties. The corn is usually cut with a harvester and that not used for ensilage is husked from the shock, the stover being stacked in the field or shed or stored in the barn for coarse winter feed. About 75 per cent of the farms of this area have silos and a large part of the corn is used for silage.

Hay ranks next to corn in importance, the acreage in tame grasses cut for hay being somewhat larger than for corn; the hay is used almost entirely on the farm for feeding stock.

In 1909 there were 59,179 acres of tame or cultivated grasses yielding 92,368 tons of hay and 11,314 acres of marsh grasses, which yielded 13,304 tons. There was a slight increase in the acreage of tame hay during the last decade and a corresponding decrease in the area from which marsh hay was cut.

Of the hay crops a mixture of timothy and clover is the most common. These are usually sown with some small grain as a nurse crop. Medium red clover is the most popular clover.

Alfalfa is becoming an important crop, especially in the region where the soils are somewhat gravelly in the western part of the area. The 1919 acreage was 5,576 acres and the production 12,043 tons. Three cuttings are usually obtained annually, with an average yield of about 3 tons per acre per season. Alfalfa does well on many of the different types of soil when proper care has been devoted to the preparation of the seed bed, inoculation, fertilization, and the correction of acidity.

Considerable difficulty has been experienced in obtaining a good stand of clover, owing apparently partly to winter killing during the late winter when the snow is melting and the ground freezes and

thaws alternately, and partly to the dry weather during the late summer.

With the exception of the Clyde and part of the Bellefontaine soils a more or less acid condition exists which is detrimental to the best results with clover. Some alsike clover is grown on the more poorly drained types of soil. Mammoth clover does well on the lighter soils, but on the heavier types it is coarse and not as satisfactory as the medium red. Over the low marshy tracts many tons of marsh hay are cut each year, but this is of inferior quality.

Oats, which follow hay in importance, are used mainly for feed on the farm. In 1919 there were 42,981 acres in oats with a production of 1,309,818 bushels. In 1919 wheat was grown on 12,935 acres, producing 213,454 bushels. This acreage is over ten times as great as in 1909. This marked increase is the result of the high prices of the war period. Barley is grown on all heavy soils; with a number of farmers it is the chief cash crop. According to the 1920 census, there were 9,370 acres in barley in 1919, with a production of 254,986 bushels, and 1,282 acres in rye, from which 26,194 bushels were harvested.

In addition to these cereals, a little buckwheat is grown. It is confined largely to sandy soil.

Dairying is the leading agricultural industry and is carried on throughout the area except in the extreme eastern part of the Lake Michigan Terrace, where the trucking industry has developed. The dairy farmers usually have from 6 to 30 cows, but the number of larger herds is considerable. The income derived from the sale of dairy products in 1909 amounted to $1,825,369 and in 1919 to $2,986,632. The milk is shipped mainly to Chicago and other cities. There are bottling plants at Woodworth, Bristol, Wheatland, and Bassett, a condensery at Burlington, and a malted-milk factory at Racine. There are some purebred herds in the area. The Holstein breed predominates, with Guernsey probably second. There are also some Jersey and Brown Swiss cattle. The great majority of the dairy cattle is made up of grades, with Holstein and Shorthorn blood predominating. Many of the herds now are headed by purebred sires.

Some steers are shipped into the area from Chicago and from the West for finishing. On a number of farms from 10 to 50 of these animals are fed for several months and then sold for beef. Most of the male calves of grade stock from the dairy farms are vealed. The majority of the home-grown cattle sold for beef are milk cows that are no longer profitable producers or animals that do not give promise of becoming profitable producers. In 1909 there were 24,661 calves sold or slaughtered. The 1919 census does not give comparable data.

Hog raising is carried on in all parts of the area. The Poland-China, Chester White, and Duroc-Jersey are the predominating breeds. There are also some Berkshires and a few Hampshires.

A large percentage of farmers raise horses for their own use, and there are a few horse breeders who ship out of the area. Clydesdale and Percheron are the leading breeds.

Sheep raising is carried on by a small proportion of the farmers in the western half of the area, where the land is somewhat rolling. The Shropshire is the leading breed. Many sheep are shipped in from the West, fed at Burlington and Trevor, and later sold in Chicago.

Of the special crops grown, cabbage and sugar beets are the most important. Cabbage growing is carried on in the eastern half of the area and also in the vicinity of Kansasville, Bristol, and Salem. The crop is shipped mainly to Chicago and Milwaukee. Sugar beets are grown more or less throughout the eastern part of the area and most extensively on the Lake Michigan Terrace. They are also grown in the vicinity of Salem, Bristol, and Kansasville. The beets are shipped to sugar factories at Janesville, Menomonee Falls, and Madison, Wis., and at Riverdale, Ill.

According to the 1910 census, the acreage of sugar beets in the two counties in 1909 was 1,390 acres, which produced 18,421 tons. In 1919 the acreage was 3,879 and the tonnage was 49,516. It is customary for the farmer to put in the crop and tend to the implement cultivation, while the factory furnishes labor to do the hand work, such as thinning, weeding, and topping.

Potatoes are grown on a commercial scale on the Lake Michigan Terrace. In other parts of the area practically all the farmers produce their own supply and many have some for the local markets. The best potatoes are produced in the sandy sections. In 1909 there were 5,339 acres in potatoes, which yielded 561,604 bushels, and in 1919, 5,091 acres, yielding 217,787 bushels. The Early Rose, Early Ohio, Rural New Yorker, and Peerless are among the varieties most commonly grown.

Onions are grown extensively on the Lake Michigan Terrace between Kenosha and Racine. About 95 per cent of the crop consists of a variety known as the Red Globe. The product is shipped to all parts of the United States east of the Rocky Mountains.

Commercial gardening also is important on the Lake Michigan Terrace, most of the produce being shipped to Chicago and to Milwaukee, or sold in the markets of Kenosha and Racine.

Apples are grown in small orchards on many of the farms, but there are no commercial orchards within the area. Very few farmers prune or spray their trees. Strawberries, blackberries, raspberries,

currants, plums, and grapes are grown to a small extent, chiefly to supply the home.

Most of the farmers in this region are beginning to recognize the difference in the adaptation of soils to certain crops and varieties of crops, and very many are guided in their general farming operations by such knowledge, but only a few carefully select the crops to which their soils are best adapted. Farmers in general realize that the soils of the Bellefontaine series and the Rodman soils, where not too rough, are best suited to alfalfa. Corn is known to do best on the well-drained and rather heavy types of the Clyde, Maumee, and Newton series. It also does well on the heavier dark-colored soils of the Carrington, Waukesha, and Wabash series. The Wisconsin No. 8 corn is more suitable for the heavier, poorly drained, silty clay loam soils that cover most of the eastern half of the area, while the Wisconsin No. 12 is most popular in the western part of the area, where the soils are better drained and have lighter texture. The Wisconsin No. 8 requires from 8 to 14 days less to mature than does the No. 12.

On the dark soils having a large percentage of organic matter small grains are likely to lodge. The quality of the grain is not as good on these soils as on the light-colored heavy soils of the area. Potatoes of the best quality are grown on the sandy soils. The sugar content of beets grown on the heavier Maumee, Newton, Carrington, Clyde, and Waukesha soils is lower than of those produced on the Miami and Fox soils, but the yield is enough higher on the dark soils to give slightly better net returns.

On the Lake Michigan Terrace the light-textured soils of the Fox, Plainfield, Waukesha, Newton, and Maumee series are the earliest of the truck soils, but the largest yields are obtained from the heavier members of these series. Cabbage gives the best yields on the Maumee and Newton clay loams, silty clay loams, and loams and on the Carrington soils. Onions do best on the fine sandy loam of the Waukesha and Fox series.

The tendency throughout the area is toward better methods of cultivation, the use of fertilizers, and seed selection, and as a result of this advance crop yields are gradually increasing.

Where the land is droughty and not subject to wash, fall plowing has been found helpful in the conservation of moisture. Even the heavy soils in sod are plowed in the fall. It is customary to apply stable manure on land intended for corn. If the land is plowed in the fall, the manure is often hauled out during the winter and scattered over the plowed surface. If not plowed in the fall, the manure is plowed under in the spring. Where stubble land is plowed in the latter part of the summer, manure is frequently applied before plow-

ing. Throughout the area most of the farmers plan to seed their land to grass at least once every four or five years.

The farm buildings, including dwellings, are generally large and substantial. The barns are large and usually have a concrete or stone foundation. The silo forms a part of the equipment of most of the dairy farms. The fences are usually good, many of them being of woven wire. The work stock consists of draft horses of medium to heavy weight. The farm machinery in general use includes two-horse to four-horse turning plows, smoothing harrows, disk harrows, large riding cultivators, mowing machines, tedders, loaders, and binders.

Many farmers have gasoline tractors; about 10 per cent of the plowing in the county is done with tractors. Machines for thrashing grain travel about the county, serving the farmers soon after harvest. Many farmers have their own silage cutters, but it is common for a number to cooperate in owning such equipment.

Different systems of crop rotation are practiced in this area. One in common use on the light-colored, heavy-textured soils consists of corn, followed by oats, and then by barley or wheat, seeded with timothy and clover. Hay is usually cut for two years before the field is again plowed for corn. On the prairie soils wheat is often grown for two years in succession. In those sections where erosion is an important factor but little corn is grown, and the rotation is often small grain for two years, followed by clover and timothy for two or more years. Where cabbage or sugar beets are grown the rotation consists of one or the other special crop succeeded by a small grain, with which clover and timothy are seeded.

Practically all farmers use barnyard manure for corn. In a few cases ground limestone has been applied to correct acidity and ground rock phosphate or acid phosphate have been used. A complete commercial fertilizer analyzing 1–8–2 is sometimes used at the rate of 150 pounds per acre for sugar beets, from 500 to 700 pounds per acre for cabbage, and 1,000 pounds per acre for onions. The same grade of fertilizer is sometimes used in growing corn.

The supply of labor is limited, and the members of the farmer's family do most of the work. Farm laborers are paid from $25 to $75 a month. During haying and harvest day laborers are paid $2.50 to $3.50 a day. Where sugar beets are grown labor is supplied by the factories at a cost to the farmer of $25 per acre.

In 1919 the number of farms in the area was 3,598, comprising 90.4 per cent of the total land area. The average size of farms is 100.6 acres, of which 73.6 acres, or about 74 per cent, is improved. The percentage of farms operated by owners is 69.8, by tenants 27.8, and by managers slightly over 2 per cent. Where renting on shares is

practiced the landowner supplies the work stock, tools, etc., and receives two-thirds of the crop. Where the tenant supplies these in addition to his labor, the landowner receives one-half of the crop. Cash rents range from $4 to $15 an acre, depending upon the location with respect to Racine and Kenosha, transportation facilities, the character of the soil, and improvements.

The selling price of the better grades of farm land in the area ranges from $125 to $400 per acre, the valuation depending upon the quality of the soil, the topography, improvements, distance from markets, railroad transportation, and the condition of the public highways. The highest priced land, excluding locations near cities and towns, consists of the heavy types, and especially the silt loams, silty clay loams, and clay loams, where the surface ranges from level to gently rolling and where the underdrainage is good. The most rolling land, the sandy loam areas, and poorly drained areas range in value from $50 to $125 an acre, and the deeper sand types, some peat beds, and soils subject to overflow are valued at from $30 to $50 an acre.

The question of commercial fertilizers in this area is one that is assuming increased importance. Commercial fertilizers are used most extensively on the special truck crops, such as sugar beets, potatoes, onions, and cabbage, and their use is proving profitable. On the general farm crops of the county fertilizers have not been used to any great extent. Some of the farmers, experimenting in a small way with fertilizers, are gradually realizing that with proper selection and the adaptation of these fertilizers to the crops and soils considerable increases in crop yields can be obtained with profit.

Most of the fertilizers which have been used in this area are of a much lower grade than would seem advisable. It is believed that there should not be less than 14 per cent total plant food and at least 2 per cent ammonia and 2 per cent potash in a complete fertilizer and larger amounts where conditions require them.

The following table gives some of the general farm and special crops and the different fertilizers which should be used for these crops under different soil conditions as regards texture. The amounts of each fertilizer which should be used will depend upon the condition of the soil and upon the type of farming which has been followed. Where the fertility is comparatively high, smaller quantities will be needed than where the soil is in a run-down condition. For general farm crops an application of 150 to 400 pounds should be made; on special crops the application will range from 300 to 400 pounds to as high as 1,000 pounds or more per acre.

Fertilizer suggestions for general farm and special crops grown on soils of different textures.

Crop.	Sand.	Loam.	Clay.
Corn	3-10-4	3-10-2	3-12-0
Clover, alfalfa, field peas, oats, barley, wheat	2-10-4	2-12-2	2-12-0
Potatoes, sugar beets, cabbage	3-10-4	3-10-2	3-12-0
Onions	2- 8-8	2- 8-8	2- 8-8

The numbers in the table refer to the analysis of the fertilizer in terms of ammonia, available phosphorus, and potash. A 2-12-2, therefore, contains 2 per cent ammonia, 12 per cent available phosphoric acid, and 2 per cent potash. High-analysis fertilizers are the most economical and therefore the most profitable to the farmer. The question of what treatment to use for the soil must be governed by what is profitable. Growing corn on poor land, for example, is a costly proposition. It pays to handle the soil so that big crops may be grown on every acre planted.

SOILS.[3]

Kenosha and Racine Counties lie almost wholly within the area covered by the late Wisconsin stage of glaciation, and the period for soil development has been much shorter than in the older glacial regions and in other regions beyond the limits of glaciation. The comparative youth of the soils is evidenced in many ways. Weathering has not extended to any great depth, leaching has not been excessive, and there has not developed any marked compaction of the subsoil. While the soil layer has been leached of excess carbonates and usually shows a moderate acid reaction, the subsoil is neutral to only slightly acid, and the partially weathered parent material, forming the substratum at depths ranging from 2 to 4 feet is highly calcareous, carrying accumulations of amorphous calcium carbonate as well as an abundance of limestone gravel and fragments.

The soils of the two counties have developed under uniform climatic conditions—that is, there are no important local differences in temperature or precipitation which have had any appreciable modifying influence on soil development.

[3] Racine County adjoins the Waukesha County area, surveyed in 1910, and the Milwaukee County area, surveyed in 1916. In some cases the soils do not join properly along the boundary line. This is due in part to the greater detail shown in the present survey and in part to changes in the classification since the earlier surveys were made. For instance, material mapped as of the Miami series in Waukesha and Milwaukee Counties is separated into the Miami and Bellefontaine series, and areas shown as the Clyde series into the Clyde and Maumee and Newton series. The Miami clay loam in Milwaukee County becomes the Miami silty clay loam in Racine and Kenosha Counties. Where any differences occur along the boundary the mapping in Racine County should be taken as correct and extended to similar soils across the line.

On the basis of color characteristics the soils group themselves into two main divisions: First, the light-colored soils; second, dark-colored soils. The first division is coextensive with the timbered areas of the uplands or the areas that were timbered before agricultural development by white man began. The second division includes all of the prairie lands as well as the marshy and swampy areas. The dark soils are by far the more extensive. They include most of the Lake Michigan Terrace and the great central prairie section, as well as numerous areas through the morainic belt across the western ends of the two counties. The light-colored soils occur on the morainic ridges, some of the higher terraces, the more pronounced slopes and ridges through the main prairie belt, and in the Lake Michigan Terrace where the soil material is of light texture.

The light-colored soils have developed under fairly good to rather excessive drainage conditions. Where the drainage is only fair the surface soils are brownish gray, moderately compact, and in an acid condition, or if still under timber cover the surface 2 to 4 inches may be gray to dark gray with a light-yellow or yellowish and gray mottled layer immediately beneath. The subsoil in the upper part is yellowish brown with some gray mottlings, somewhat granular or friable in structure but heavier and more compact than the soils. The lower subsoil is yellowish brown with a slight development of gray mottlings, heavy in texture, and of a tough compact structure. Partly weathered parent material begins at depths of 2 to 4 feet. In the upland this is a friable mass of calcareous till, while in the terraces it varies from stratified beds of gravel and sand to silt and heavy clays. In the areas with good to excessive drainage the surface soils are brown to slightly reddish brown, or, if in the virgin state, dark gray for a few inches with a pronounced yellowish-brown to reddish-brown layer beneath, finely granular or friable in structure, and neutral to only slightly acid in reaction. The subsoil is yellowish brown to reddish brown, as heavy as or heavier than the soil in texture, friable to quite tough, and somewhat plastic in structure, and neutral to slightly acid or containing some calcareous material in the form of limestone gravel. Parent material in a partially weathered condition occurs at depths of 18 to 30 inches, being calcareous gravelly till in the uplands and stratified beds of silt, sand, and gravel in the terraces.

The best drained of the prairie lands are characterized by dark-brown to nearly black soils, mellow in structure, and moderately acid in reaction; brown subsurface layers, friable but slightly more compact than the soils; a yellow-brown compact subsoil, heavier than the soils in texture; and calcareous substrata, ranging from a

highly calcareous till in the uplands to calcareous beds of silt, sand, and gravel in the terraces.

In areas less well drained but not marshy or badly water-logged the soils have reached a stage of development intermediate between those of the best drained prairies and the marshes. Here the soils are black, rather deep, and neutral to slightly acid, and the subsoil is gray or drab, mottled with yellow and brown, compact, and tough to moderately plastic in structure, neutral to moderately calcareous (alkaline) in reaction. Calcareous till and stratified beds of silt, sand, and gravel form the substrata at depths of 2 to 3 feet.

A still lower stage of soil development occurs in the areas where a marshy or swampy condition has prevailed. The surface layer varies from a black mineral soil with a high content of organic matter, through a true Muck soil with only a small percentage of mineral matter to a black to brown Peat composed almost altogether of partly decomposed vegetable remains. Some of the Peat beds are of a brown fibrous nature and have great depth, others have a black peaty or mucky surface soil, underlain to considerable depths by black to brown peaty material. Usually the subsoil and substratum are gray mottled or drab in color, heavy in texture, and calcareous. In some areas marly deposits occur at the point of contact between the organic layer and the substratum. In some of the deeper areas of Peat and Muck the surface layer may show an acid reaction.

Another grouping of the soils can be made on the basis of the origin of the soil-forming material and processes by which it has been accumulated. Those of the terminal and ground moraine areas, where the material has been accumulated by the action of ice, form one group. These may be designated as the uplands. Another group is formed by the Lake Michigan Terrace with the accompanying old beach lines, and by outwash plains, stream terraces, and plainlike areas in different sections of the area. The material in this group has been laid down by water. A third group includes the recent alluvium along streams. The processes by which the alluvial deposits have accumulated are not essentially different from those of the terraces, but the time difference has been great enough to allow important soil differences to develop. In the alluvial soils no important changes through the agencies of weathering have taken place since the material reached its present position. In fact the process of accumulation is still going on.

In each of the three groups outlined above are subgroups, or what in the classification of soils are designated as series. A series includes soils with common characteristics as of color of surface soil, color, structure, and heaviness of subsoil, absence or presence of lime carbonate in the soil and subsoil, and depth to and character of the

substratum. In other words, a soil series includes all those soils having uniform profiles developed from similar parent materials. The soil type is the individual member of the soil series, and the unit of separation in the mapping of soils. The type separation in any one series is based wholly on textural differences. Differences with some agricultural significance but not important enough to designate as types are recognized as phases of the types to which they are most closely related.

The soils of the glacial uplands are classed in the Bellefontaine, Miami, Carrington, and Clyde series, also in the Rodman series, where the material is of a decidedly gravelly nature and the topography is rough and kamey. The terrace group, derived from old stratified deposits, give the Fox, Rodman, Belmore, Superior, Plainfield, Waukesha, Newton, and Maumee series. The recent alluvium where the processes of accumulation are still active is classed in the Genesee series. The older alluvial deposits along stream courses have the characteristics of the Maumee soils and are classed with them. Muck, Peat, and Dunesand are miscellaneous types.

The Bellefontaine series is characterized by light-brown to brown surface soils, and a yellowish-brown to slightly reddish brown heavier subsoil, resting at depths of 18 to 36 inches upon a porous mass of stony and gravelly till, only slightly weathered and carrying a high percentage of limestone material. In this series the soil usually is not in acid condition and probably does not require applications of lime for maximum crop development. The areas are rolling to very irregular, ridgy, and knolly in topography and have good to excessive natural drainage. Soils of this series have developed under forest cover. They form the dominant soils of the irregular morainic uplands in the western end of the area. Three types are mapped, the silt loam, fine sandy loam, and loam.

The soils in the Miami series are brownish gray to light brown with a grayish tinge. The subsoil is heavier than the soils in texture, compact and rather tough in structure, yellowish brown in the lighter textured areas where drainage is best to dull yellowish brown mottled slightly with gray and brown in the areas of heavy texture. A moderately friable to heavy compact, calcareous till, only slightly weathered, forms the substratum at depths of 2 to 3 feet, or in some places at a depth slightly greater than 3 feet. The surface soils frequently are acid and respond favorably to applications of lime. The Miami soils have developed under conditions of fair to good drainage in forested areas, usually of ground moraine, where the till does not carry excessive quantities of gravel and stone. The silt loam and silty clay loam members are mapped.

The Carrington series includes types with very dark brown soils and a heavier textured, compact, yellowish-brown subsoil that rests

upon partly weathered calcareous till at depths of 2½ to 3 feet. In the areas of heavier texture there may be a slight mottling with gray in the upper subsoil and at the point of contact between the subsoil and substratum. The surface soils are moderately acid. These soils have formed under typical prairie conditions where the topography is gently rolling to rolling and the natural drainage is fair to good. As with the Miami soils the parent glacial material is not excessively stony or gravelly. The silt loam and silty clay loam members of the series are mapped. There are a few scattering areas of the loam and fine sandy loam of mapable size, but these are included with the silt loam on account of their small total extent.

The soils of the types in the Clyde series are black and the subsoil is gray, mottled with yellow and brown, heavier than the soils in texture, and compact to tough and somewhat plastic. Below depths of 2 to 3 feet the subsoil becomes calcareous and gives way gradually to calcareous till, having the same general character as that underlying the Carrington and Miami soils. In most cases the surface soils are not in an acid condition. The Clyde soils are derived from glacial till. They occupy flat and depressed areas, the natural drainage of which has been very poor, and have developed under marshy to swampy conditions. The series is represented by the silt loam and silty clay loam members and small areas of the fine sandy loam which are shown as a phase of the silt loam.

The types included in the Rodman series are characterized by brown soils, overlying at shallow depths porous beds of stratified gravel and sand carrying a high percentage of limestone material. In many places the surface soils are quite gravelly and give way to beds of gravel without any intervening subsoil layer. The topography is very broken, consisting of kames, eskers, and terrace escarpments, and the drainage is excessive. The gravelly loam is the only type mapped.

In the Fox series the surface soils are brown and the subsoil is yellowish brown to slightly reddish brown, heavier than the soil, and compact to rather tough in character. The subsoil gives way at depths of 2 to 3 feet, or in some places at greater depth, to stratified beds of gravel and sand in which there is a high percentage of limestone material. The surface soil is neutral to only slightly acid, except in some of the areas of the heavy subsoil phase of the silt loam, where, the stage of soil development corresponding closely to that of the Miami series of the uplands, the acid condition of the soil is more pronounced. The topography is flat to slightly undulating and the natural drainage is good. The series is represented by the loam and silt loam.

The types of the Plainfield series have light-brown soils and a brownish-yellow subsoil, as light as the soil in texture. The sub-

stratum is similar in texture to the subsoil or may be light in the upper layers and heavier at greater depths. The surface is level to undulating and the natural drainage is good. The series has been formed from material of a noncalcareous character laid down by water and probably modified subsequently to some extent by wind action. The fine sand and a loamy phase of the fine sand occur in small areas on the Lake Michigan Terrace.

The Belmore series is characterized by surface soils of a rich brown color, usually carrying large quantities of fine gravel, and by a subsoil of a brown to yellowish-brown color, quite friable and more or less gravelly, resting upon beds of fine gravel at depths of 20 to 36 inches. Except in the sandier areas approaching the Plainfield material, the soil is not acid, or only slightly acid, and in all areas the underlying gravel and sand carry an abundance of limestone material. The topography is level to gently sloping. The natural drainage is good. In the present survey the Belmore soils are confined to old beach lines in the Lake Michigan Terrace. The series is represented by the gravelly fine sandy loam with some included areas of gravelly fine sand.

The Superior series consists of types with brown to yellowish-brown surface soils, underlain by a mottled yellow and gray upper subsoil and pinkish-red heavy clay lower subsoil. The heavy underlying clays are moderately calcareous, but the surface soils are in an acid condition. This series occurs in lake terraces occupying flat areas with poor drainage. The types mapped are the fine sandy loam and silty clay loam, with small areas of the loam included as a heavy phase of the fine sandy loam.

The surface soils of the types included in the Waukesha series are very dark brown, and the subsoil is yellowish brown, somewhat heavier and more compact than the soil, and underlain at depths of 2 to 3 feet, or in the deep subsoil phases of the types at greater depths, by stratified beds of gravel and sand carrying a high percentage of limestone material. The surface soils have been leached of excess lime and usually give an acid reaction. The areas are level to slightly undulating in topography and have good natural drainage. Like the Carrington soils, the Waukesha soils have developed under prairie conditions. Four types are represented—the loam, silt loam, with a deep phase, fine sandy loam, and fine sand.

The types in the Newton series have very dark brown or nearly black soils and a yellow and gray mottled subsoil with yellow as the dominant color. The subsoil is somewhat heavier than the soils in texture, compact, and in the heavier areas quite tough, but only slightly plastic in structure. Material not much different in texture from that of the subsoil forms the substratum to a considerable

depth, and this is moderately calcareous. The surface soils are slightly acid. Probably leaching has not been as thorough as in the Waukesha soils, though a little more complete than in the Maumee soils. The Newton areas are level and in their natural condition poorly drained. These soils have developed under prairie conditions in the Lake Michigan Terrace. The loam, loamy fine sand, silt loam, and clay loam are shown on the map. On account of their not being important enough to show separately, small areas of the Maumee clay loam were included with Newton clay loam and of the Maumee fine sand with the Newton loamy fine sand. The so-called Newton loamy fine sand, mucky phase, is in reality nothing more than beach sand overlying beds of Peat.

The surface soils of the types in Maumee series are black and overlie a gray or drab mottled subsoil, heavier than the soil in texture, rather compact, and in the heavier types tough and plastic. The surface soils are not in an acid condition. The substratum, varying with the types from sandy to quite heavy and claylike, is slightly to strongly calcareous. The Maumee soils have developed on the Lake Michigan Terrace and other plainlike areas of water deposited material under very poor drainage conditions. The series is represented in the present survey by the silty clay loam, silt loam, and fine sandy loam. A marshy phase of the silt loam is mapped and small areas of the loam also are included with that type.

The Genesee soils are not typically developed in Kenosha and Racine Counties. As mapped the surface soils are brownish gray to brown and the subsoil is yellow and gray mottled to light brown. There is no important textural change from the surface downward. These soils are developed in the flood plains of the Root River and other larger streams of the area where considerable deposition of material still takes place during overflows. The silt loam is mapped and small areas of the fine sandy loam, too small in extent to show as a separate type, are treated as a sandy phase of the silt loam.

From the foregoing it can be seen that there are some striking resemblances between the soils of the uplands and those of the terraces and plains, the greatest noticeable difference being in their topographic features. The Rodman series is common to both groups. The Bellefontaine soils have their counterpart in the Fox soils of the terraces. No series is mapped in the terraces to correspond to the Miami of the uplands, but essentially the Miami condition is developed in the heavy-subsoil phase of the Fox silt loam. The Carrington series has its counterpart in the Waukesha series and the Clyde in the Maumee series. The Newton soils correspond to the more poorly drained areas included with the Carrington soils, which, if occurring on a larger scale, would have been mapped in a sepa-

rate series. The Plainfield, Superior, and Belmore soils do not have their counterparts in the uplands.

The names of the different soils with their actual and relative extent are given in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Carrington silty clay loam	112,320	29.0	Newton clay loam (Clyde)	3,648	0.9
Miami silty clay loam	56,384	14.5	Waukesha fine sandy loam	3,264	.8
Miami silt loam	31,808	8.2	Bellefontaine fine sandy loam (Miami)	3,200	.8
Maumee silt loam (Clyde)	26,496	6.9	Maumee fine sandy loam (Clyde)	2,304	.6
Marsh phase	192		Newton loam (Clyde)	2,112	.5
Peat	23,552	6.5	Waukesha fine sand	1,984	.5
Shallow phase	1,664		Plainfield fine sand	576	.5
Clyde silty clay loam	18,048	5.0	Loamy phase	1,408	
Marsh phase	1,152		Waukesha loam	1,536	.4
Maumee silty clay loam (Clyde)	17,280	4.4	Newton loamy fine sand (Clyde)	960	.3
Fox silt loam	9,856	4.0	Mucky phase	64	
Gray sandy phase	3,136		Superior fine sandy loam	704	.3
Heavy-subsoil phase	2,624		Heavy phase	256	
Bellefontaine silt loam (Miami)	15,488	4.0	Muck	832	.2
Carrington silt loam	9,920	2.5	Belmore gravelly fine sandy loam	832	.2
Rodman gravelly loam	8,512	2.2	Dunesand	384	.1
Bellefontaine loam (Miami)	6,272	1.7	Genesee silt loam	192	.1
Gravelly phase	320		Sandy phase	128	
Waukesha silt loam	3,840	1.4	Superior silty clay loam	320	.1
Deep phase	1,600		Total	387,840	
Fox loam	4,608	1.2			
Newton silt loam (Clyde)	4,224	1.1			
Clyde silt loam	3,712	1.1			
Sandy phase	64				
Marsh phase	64				

NOTE.—The names in parentheses are those used in the report published by the State.

BELLEFONTAINE FINE SANDY LOAM (MIAMI).

The surface soil of the Bellefontaine fine sandy loam consists of an average of 8 or 10 inches of a light-brown fine sandy loam, containing only a small proportion of organic matter and being in many places in a slightly acid condition. This is underlain by a yellow fine sandy loam that gradually becomes heavier with increasing depth, until a sandy clay loam is reached at from 15 to 24 inches. This continues to a depth of 3 feet or more. There is often some gravel in both the soil and subsoil.

The type as mapped is not uniform. In small areas, particularly along the crests of ridges and on steep slopes where wash has carried away the surface soil, the fine sandy loam extends to a depth of only a few inches and rests on a yellowish sandy clay, and at the bases of these slopes where the wash materials have been deposited there is a surface soil of much greater depth.

The Bellefontaine fine sandy loam is of small extent in Kenosha and Racine Counties, being confined almost entirely to small areas scattered through the western half of the area. The topography is gently rolling to ridgy and very broken, and the drainage, because of the surface features and the sandy nature of the soil and subsoil, is usually well established, and in the more sandy places, excessive.

Probably 60 per cent of this type is cultivated; the remainder is used for pasture. The forest growth consists of several varieties of oak, hickory, maple, and some walnut and basswood. The crops grown and methods of farming followed are practically the same as on the Bellefontaine silt loam. The crops mature somewhat earlier. The methods of improvement suggested for the loam and silt loam of the series will also apply to this type.

BELLEFONTAINE LOAM (MIAMI).

The surface soil of the Bellefontaine loam consists of 8 or 10 inches of a light-brown loam containing relatively large proportions of silt and fine sand. The subsoil is a yellowish-brown loam which grades into a silty clay loam at about 14 inches. This may continue to a depth of 3 feet or more, or it may change at any depth within the 3-foot section below 16 inches into a yellowish fine sandy loam. Gravel is common below 30 inches. In some places the subsoil is composed entirely of clayey fine sandy loam. Included areas of Bellefontaine silt loam and fine sandy loam too small to map are very common.

The Bellefontaine loam is of rather small extent. It occurs in the extreme western part of the area, principally in Wheatland and Burlington Towns and in that part of the area which borders Walworth County. It also occurs in the western parts of Salem, Brighton, Dover, and Norway Towns. The surface varies from gently rolling to rolling and the natural drainage is good. The structure of both soil and subsoil is usually favorable for the retention of moisture. However, there are places on narrow ridges and kames where the gravel is near the surface and the soil droughty. On some of the areas erosion is severe and deep gullies and ravines have developed.

General farming in conjunction with dairying is the principal form of agriculture. Probably 75 per cent of the type is cultivated. The remainder is used as permanent pasture or is in forest, consisting of several varieties of oak, maple, hickory, basswood, elm, and walnut. All of the common farm crops of the region do well on this soil. Corn, hay, oats, and barley are the principal crops. Alfalfa is well adapted to this soil and is grown on many farms. Wheat and buckwheat are produced in a small way. The method of handling this soil and the yields obtained are essentially the same as in the case of the Bellefontaine silt loam.

The selling price of this land ranges from $60 to $125 an acre, depending largely upon the proportion of cleared land, the topography, erosion, location, and improvements. Great care should be exercised in cultivated fields to avoid erosion on the slopes. A good practice is to plow the land in strips following the contour of the hill leaving strips of sod between the plowed areas. The steeper slopes should remain in pasture.

The supply of organic matter is low. This may be increased by supplementing the stable manure with green manuring crops, preferably legumes. Where the soil is acid, which is often the case at the surface, finely ground limestone should be applied. The soil responds to applications of either rock phosphate or acid phosphate. The method of applying these phosphate fertilizers is discussed under various other types.

Bellefontaine loam, gravelly phase.—The surface soil of the Bellefontaine loam, gravelly phase, consists of 6 to 8 inches of a light-brown loam or fine sandy loam, carrying varying quantities of rounded limestone, quartz, chert, and crystalline rock gravel. The upper subsoil is a yellowish-brown loam, also with some gravel. At about 14 to 16 inches this passes into a gravelly sandy clay loam, and in many places at 30 inches into a gravelly loam or beds of gravelly sand.

This phase is of very small extent. It is found chiefly in small areas south of Rochester and north of Bonner Lake. The surface ranges from rolling to broken. Except in kettle holes and other basins the drainage is good to excessive. The material forming this type has been derived from glaciated limestone débris which has been deposited as moraines. Inasmuch as there is a large amount of lime present, the soil is not acid and the subsoil is strongly calcareous. Probably 20 per cent of this type is under cultivation. The rest is covered with a growth of oak and hickory. Corn, oats, rye, alfalfa, clover, and timothy are the principal crops. The yields obtained, methods of handling the soil, and fertilization are about the same as employed on the Bellefontaine silt loam. Only the least rolling parts of the gravelly loam should be cultivated; the remainder should be seeded to grass or alfalfa, which does especially well on this soil. The maintenance of the supply of organic matter requires special attention.

BELLEFONTAINE SILT LOAM (MIAMI).

The Bellefontaine silt loam, to an average depth of 10 inches, consists of a light-brown friable silt loam with a relatively large proportion of fine sand and an appreciable admixture of gravel. The content of organic matter is low. Where the silt content is highest the

soil is usually fairly free from gravel and sand, and approaches closest the characteristics of the Miami silt loam. Truog's test and the litmus test both show that the soil is slightly acid at the surface. The upper subsoil is a yellowish-brown sandy silt loam which passes at about 16 inches into a reddish or yellowish-brown sandy or gravelly clay loam. At about 24 inches yellowish and reddish gravelly sandy clay is found, and this is uniformly calcareous. In a number of areas the lower subsoil consists of a gravelly fine sandy loam. In the SW. ¼, NE. ¼, Sec. 32, T. 4 N., R. 19 E., the subsoil below 24 inches consists of a gravelly fine sand or gravelly sand. As mapped the type has many inclusions of Bellefontaine loam and Miami silt loam.

With the exception of a few small areas in the western part of Norway, Dover, Salem, and Brighton Towns this soil is confined to Waterford, Rochester, Burlington, Wheatland, and Randall Towns. It occurs principally in the terminal and recessional moraine areas and has, for the most part, a rolling surface. In places it is decidedly hummocky and ridgy. Both the surface drainage and underdrainage are good. In some of the small areas occurring on narrow ridges or kames, or where beds of sand or gravel are present in the lower subsoil, the type is droughty.

The Bellefontaine silt loam is of small extent and of little importance in this area. About 75 per cent of it is under cultivation, the remainder being forested. The principal trees are white, red, and black oak, maple, hickory, and basswood, and there is some walnut and cherry.

Corn, oats, alfalfa, clover, timothy, and barley are the leading crops. Wheat and buckwheat are grown by a few farmers. Sweet corn for the Milwaukee market is an important crop in Waterford Town.

Stable manure is the only fertilizer used. The rotation followed by a number of farmers is corn planted on sod land, followed by a small grain for 1 year, and then, after manuring, corn for another year. This is succeeded by a small grain, and this by hay for 2 years.

This type has a value of $60 to $200 an acre, depending upon the location, extent of improvements, and topography.

Examinations made by the Wisconsin soils laboratory show that this soil is ordinarily low in phosphorus but is only slightly acid. However, in spots where characteristics of the Miami soil developed there is considerable acidity. To increase the supply of organic matter, which is very much needed, the growing of clover in the rotations and plowing under of as much sod and second growth of clover as is practicable will be very helpful. Where the soil is acid, pulverized limestone at the rate of 2 tons per acre will greatly assist in the growing of clover. The increasing of the phosphorus content can be effected by the addition of rock phosphate mixed with manure

or plowed under with a green manuring crop. It is excellent practice to sprinkle the rock phosphate in the gutters of the stable at the rate of about 1½ quarts to the cow per day. This brings about a thorough mixture with the manure and renders the phosphorus more available to crops. For grain, acid phosphate may be used alone at the rate of 250 to 350 pounds per acre. This can be applied to the soil before seeding or worked in at the time of seeding.

The steeper slopes could be very profitably seeded to alfalfa, as this type is especially adapted to the growing of the crop. The slopes should be kept in sod as much of the time as possible in order to prevent erosion.

RODMAN GRAVELLY LOAM.

The surface soil of the Rodman gravelly loam consists of 6 inches of a brown, or grayish-brown, gravelly sandy loam of fine to medium texture. In places there is present a relatively large proportion of silt. With increasing depth the color of the material becomes lighter, and at about 12 inches gravelly sandy clay is encountered. At about 15 inches this grades into a bed of stratified gravel and sand. The surface inch of the soil is in many places quite dark, owing to the accumulation of organic matter. The layer of soil material over the gravel is commonly shallow but varies considerably. Along the lower slopes the layer is thickest and may reach 2 feet or more. In such places it is the steep topography rather than the character of the soil itself that determines the grouping of the material with this type. The gravel consists of about 95 per cent limestone, 1 per cent chert, 2 per cent granite-gneiss, and 2 per cent other crystalline rocks.

Included with the Rodman gravelly loam are numerous areas which if of sufficient extent would have been mapped as the Bellefontaine loam, silt loam, and fine sandy loam.

The Rodman gravelly loam is confined largely to the western tier of towns. The topography is rough and broken and is usually so steep that modern farm machinery can not be used.

This soil is derived from glacial débris deposited by the ice sheet in the form of kames, eskers, and very rough moraines.

The native vegetation consists chiefly of oaks, with some hickory and a few other hardwoods. Only small patches here and there are cultivated. The crops common to the region are grown usually with indifferent success. Alfalfa does fairly well and is probably the best crop for this type of land. Only the less broken parts of the type should be cultivated on account of the danger of erosion. This rough land is best suited to grazing and should be kept in permanent pasture. It is a question if much of it could not well be devoted to forestry.

MIAMI SILT LOAM.

To a depth of 10 inches the Miami silt loam consists of a light-brown or grayish-brown friable silt loam, containing a comparatively small quantity of organic matter. In places it carries an appreciable amount of fine sand, but typically it has a smooth velvety feel. Where the silt content is high the material is usually free from stones and fine gravel. The lower part of the surface soil becomes yellowish, and at 12 or 13 inches the material passes into a pale-yellowish silt loam, and this at 16 inches into a yellowish silty clay loam, carrying some fine gravel and sand. At a depth of 24 inches a clay loam is encountered, and this continues to a depth of more than 3 feet. The subsoil below 30 inches may be moderately calcareous.

A notable variation is found in the Early Wisconsin drift east of Twin Lakes, where the surface soil consists of a light-brown, friable silt, 12 to 14 inches deep. When dry the surface presents an ashen appearance, and the proportion of gravel, bowlders, and fine sand is noticeably less than in the typical soil. The subsoil here consists of a yellowish silt loam which becomes heavier with increasing depth, grading at 24 inches into a silty clay loam, which at about 36 inches shows in many places a slight mottling of gray. In this variation no lime reaction can be had in the material within 40 inches of the surface.

Where this type is associated with the Miami silty clay loam or Carrington silty clay loam the subsoil at depths ranging from 15 to 20 inches is a rather heavy, compact, yellow clay which continues to a depth of 3 feet or more, and the lower subsoil shows more or less mottling. In depressions, lower slopes, and over level tracts the soil is deeper than typical, while on steep slopes, ridges, and knolls more or less of the soil has been washed away and the sandy clay may be exposed. In the western part of the area small bodies of the Bellefontaine silt loam are included which have a reddish-brown soil and a reddish-yellow subsoil.

The Miami silt loam is confined to the morainic parts of the area. The most extensive developments are in the western tier of towns. Other areas occur in Norway, Dover, Brighton, Salem, Bristol, Mount Pleasant, and Somers Towns.

The surface features of this type range from undulating to gently rolling, and the natural drainage is good. The internal drainage is much better than in the Miami silty clay loam areas. Along some of the lower slopes and in depressions between hills and ridges there is some land that would be benefited by tile drains, but the type as a whole is not in need of artificial drainage.

This soil is derived from glaciated limestone material. Because of lime rock entering into its composition the deep subsoil is not acid,

but the surface and upper subsoil having been subjected to long periods of leaching in many places show a slight acid reaction.

The native forest growth consists of several varieties of oak, maple, hickory, basswood, walnut, and cherry. Practically all of the merchantable timber has been cut, and probably 75 per cent of the land is under cultivation. General farming in conjunction with dairying is the prevailing type of agriculture. Corn, hay, oats, barley, and wheat are the leading crops, ranking in importance in about the order named. Irish potatoes, rye, alfalfa, and buckwheat are grown in a small way. There are some apple orchards, but none of commercial size. The fruit is usually of an inferior quality, owing largely to failure to prune or spray the trees properly.

The yields of the general farm crops are as a rule satisfactory and range a little higher than on the silty clay loam. The rotation most commonly followed consists of corn, followed by a small grain crop for two years, and then by timothy and clover. Hay may be cut for two years before the land is plowed again for corn. Sometimes the field is pastured a year following the taking off of the hay crops.

The value of land of this character ranges from $75 to $200 or more per acre, depending upon the location, improvements, and condition of the soil.

From reports of the Wisconsin soils laboratory it is found that this type is deficient in nitrogen, organic matter, and phosphorus. The nitrogen deficiency can best be overcome by plowing under green-manure crops, of which legumes are best. In order to get the legume crop started it may be desirable to use commercial fertilizers for a time. The phosphorus can best be supplied by the application of acid phosphate. If the raw rock is used at any time, it should be mixed with manure. On land where small grains are to be grown and the organic matter is low a mixed commercial fertilizer containing nitrogen and phosphorus can be used to advantage. On a majority of the farms deeper plowing and more thorough cultivation will improve the productiveness of the land. Contour plowing should be practiced on the steeper slopes to prevent erosion. Many of the steep slopes now are kept in permanent pasture.

MIAMI SILTY CLAY LOAM.[4]

The surface soil of the Miami silty clay loam consists of a light-brown heavy silt loam, which gradually becomes yellowish in color and somewhat heavier in texture with increasing depth. At 12 inches it is underlain by a rather plastic and compact yellow silty clay loam slightly mottled with gray, and at 15 to 24 inches by a very compact calcareous clay with yellow, brown, and gray mottlings. This may

[4] State name is Miami silt loam, deep phase.

continue to a depth of more than 3 feet, but in many places a rather friable, silty, calcareous clay occurs below 24 inches. This type differs from the Miami silt loam in that the subsoil is heavier, is freer from coarse material, and uniformly somewhat mottled.

This is the second soil in point of extent and one of the more important types in the area. It is widely distributed throughout the two counties, except in the western morainic region and immediately along the lake shore on the lake terraces. The surface ranges from undulating to gently rolling. Because of the heavy character of the subsoil the internal drainage is somewhat deficient. The surface drainage is prevailingly adequate, although in places artificial drainage is essential to the best results, and the use of tile drains would prove profitable over a considerable proportion of the type.

The Miami silty clay loam has been derived from glaciated limestone débris deposited chiefly as ground moraine. The percentage of clay in this deposit is much higher than in most of the glacial material in this part of the State. The deep subsoil is normally well supplied with lime carbonate and in places the subsoil at 24 inches shows an appreciable amount present, but in many places the surface soil has been leached to such an extent that it now gives a slight acid reaction.

The original forest growth consisted of several varieties of oak, hickory, basswood, maple, some walnut, and cherry. Practically all of the merchantable timber has been removed, and approximately 80 per cent of the land is now under cultivation. General farming combined with dairying is the leading type of agriculture. The chief crops and the usual yields obtained are as follows: Corn, 25 to 70 bushels; oats, 32 to 75 bushels; hay, from three-fourths to 2 tons; sugar beets, from 6 to 16 tons, with an average of 8 tons; and cabbage, from 6 to 17 tons, with an average of 8 or 9 tons per acre.

Comparatively few farmers employ a carefully worked-out rotation, although in many cases corn is followed by small grain, in which clover and timothy are seeded. The clover sod is well manured before being plowed for corn. This results in a marked improvement in the yields of following crops. The special crops often take the place of corn in the rotation.

Farms on this soil range in value from $75 to $200 an acre, depending upon the location, improvements, and condition of the soil.

Reports of the Wisconsin soils laboratory show the Miami silty clay loam to be only slightly acid, but in need of nitrogen and phosphorus. The nitrogen can be supplied by plowing under green manuring crops, preferably legumes. The phosphorus deficiency can best be supplied either by the use of ground rock phosphate or acid phosphate. When rock phosphate is used it should either be mixed with manure or applied on a green crop at the time of plow-

ing under. The decay of organic material makes the phosphorus more available. In the acid phosphate the phosphorus is immediately available and the crops get the full benefit the first season. Where difficulty is experienced in getting clover started it is probable that lime is needed to correct an acid condition of the soil. Frequently a mixed fertilizer also can be used to good advantage in seeding clover. When the soil has been put in a condition to grow clover well, this is one of the best crops for keeping up the supply of organic matter.

One of the needs of the Miami silty clay loam is drainage. The necessity for drainage is not so apparent as on the Clyde soils or Maumee soils, for example, and many crops can be grown with fair success without drainage, yet it has been clearly demonstrated that with the installation of tile drains the physical condition of the soil is improved, the land warms up earlier in the season, the growing season is lengthened, and the yields materially increased. The subsoil being very heavy, the movement of the water through the soil is slow. Drainage with tile will correct this. The physical condition of the soil can in most cases be improved to some extent by fall plowing and a more thorough pulverizing and working of the land before planting. This alone will increase the yield of the immediate crops and leave the land in better condition for subsequent crops.

FOX LOAM.

The Fox loam, to an average depth of 10 inches, consists of a light to medium brown loam. Below this depth the material takes on a yellowish color and becomes a friable sandy clay loam, which normally carries some gravel. At 20 inches a gravelly sandy clay is encountered, and this grades into beds of gravel or sand at from 26 to 30 inches. In some places the underlying coarse material lies within 18 inches of the surface; in others it is not found within the 3-foot section. The underlying gravel and sandy layers carry a high percentage of limestone material. There are some included areas of fine sandy loam and silt loam that are too small to map.

The Fox loam is distributed in small areas in the western, southern, and eastern parts of the survey. Most of these occur in the glacial outwash plains between Camp Lake and Powers Lake, on the terraces of the Fox and Desplaines Rivers, and on the Lake Michigan Terrace.

The surface of this type is level to gently undulating and the drainage is good. The soil is open and porous and readily absorbs the normal rainfall.

The Fox loam is of alluvial origin, having been deposited by water issuing from beneath the ice sheet or as terraces along swollen

streams. The material comes from the glaciated limestone débris, which forms the adjoining uplands.

Though nearly all of the Fox loam is under cultivation, it is very inextensive, and therefore of little importance. It is a good soil, and is devoted to the production of most of the general farm crops common to the region. The methods of farming followed and the fertilization and rotation used are practically the same as on the Miami and Bellefontaine soils of similar texture.

The Fox loam is easy to cultivate and a mellow seed bed is readily formed. In the improvement of the type it is advisable first to correct the acidity, wherever this condition exists. About 2 tons of ground limestone per acre will accomplish this. When the acidity has been corrected and the soil inoculated, alfalfa can be grown with success. The type is deficient in organic matter, and this can be supplied when the quantity of stable manure is insufficient, by plowing under clover or some other legume. The supply of phosphorus, which is also small, can be supplemented by the use of raw rock phosphate or acid phosphate in the manner described for other soils of this area.

FOX SILT LOAM.

The surface soil of the Fox silt loam consists of 10 inches of light-brown or grayish-brown friable silt loam. This is underlain by a yellow silt loam which grades at about 15 inches into a silty clay loam. At about 24 to 30 inches a brown gravelly or sandy clay loam is often present, and at from 32 to 36 inches this is underlain by beds of sand or gravel, which carry a high percentage of limestone material. In many cases a fine sandy loam is found at 2 to 3 feet below the surface, and in other cases the yellow clay loam changes to a silty clay loam at about 22 inches, and extends to a depth of about 30 inches.

The Fox silt loam, where it is associated with the Carrington silty clay loam and Miami silty clay loam, is heavier than typical, and the subsoil is often a yellow clay loam passing into a rather compact sandy clay that shows some brown and yellow mottling in the lower depths.

The largest areas of this type occur in the glaciated outwash plains west of Wilmot, in the vicinity of Powers Lake, west of Waterford and north of Burlington. There are many other areas, ranging from a few acres to several hundred acres, scattered throughout Kenosha County and in the western half of Racine County. These areas also occupy glacial outwash plains or streams or lake terraces.

The surface of this type is flat to very gently undulating, and the natural drainage is good. In places where the subsoil is heavier

than typical the water drainage is sometimes slightly deficient, in which case tile drains could be used to advantage.

The original forest growth on this soil consisted of several varieties of oak, hickory, basswood, elm, ash, and some maple. Most of the merchantable timber has been removed.

Although of comparatively small extent, the Fox silt loam is an important type. Practically 95 per cent of it is under cultivation. General farming in conjunction with dairying is the type of agriculture. Some trucking is done on this soil on the Lake Michigan Terrace near Berryville.

The leading crops are hay, corn, oats, barley, and wheat. Some special crops, chiefly cabbage and onions, are grown on the lake terrace areas. The yields of most of the farm crops are as a rule satisfactory and compare favorably with those on the types of the same texture in the Miami and the Carrington series. The methods of cultivation, the crop rotations, and the use of fertilizer are essentially the same as on the Miami silt loam.

As in the case with other light-colored upland soils, this soil is deficient in organic matter. This, in the absence of a sufficient supply of barnyard manure, can best be increased by plowing under a green-manuring crop. The type responds well to applications of phosphoric fertilizer. Acid phosphate will, of course, give the quickest results, but rock phosphate, especially if mixed with manure, will be found beneficial. The suggestions which have been given for the improvement of other light-colored soils are equally applicable to this type.

Fox silt loam, heavy-subsoil phase.—The surface soil of the Fox silt loam, heavy-subsoil phase, consists of 10 to 12 inches of light-brown friable silt loam, low in organic matter. Below this the material passes into a yellow silt loam, which at about 16 inches grades into a yellowish silty clay loam. This becomes heavier with depth, grading at 26 to 30 inches into a silty clay. At about 3 feet or a little less heavy yellow compact clay is encountered. This may be slightly mottled. Stratified beds of sand and gravel occur at varying depths below 4 feet.

This phase is not extensively developed. It has its chief occurrence on the glacial terrace between Powers Lake and Twin Lakes. A few small areas occur southeast of Paris, north of Burlington, south of Caldwell, and southwest of Pleasant Prairie.

The surface is level to very gently undulating and natural drainage is good, although in some places tile drains would be beneficial.

The materials giving this soil are all waterlaid, having been deposited as glacial outwash plains, or as terraces along streams.

The original forest included several varieties of oaks, maple, elm, hickory, and cherry. Practically all of the merchantable timber has

been removed and a large proportion of the land placed in cultivation. Under normal conditions this phase gives slightly higher average yields than the typical soil. The methods of cultivation followed, the rotations, and fertilizer practices are the same as on the Miami silt loam. As with other light colored soils of the region, this phase of the Fox silt loam is deficient in organic matter, and, according to tests of the State soils laboratory, in phosphorus and nitrogen. These deficiencies may be met as suggested in earlier pages of this report.

Fox silt loam, gray sandy phase.—The areas mapped as the gray sandy phase of the Fox silt loam are in reality the Fox fine sandy loam but were given a phase designation on account of their small extent.

The surface of this soil to a depth of 8 inches consists of a light-brown or grayish fine sandy loam. This is underlain by a pale-yellowish fine sandy loam that extends to about 14 inches, gradually becoming heavier with depth. The subsoil ranges from a heavy pale-yellow fine sandy loam to a sandy clay loam. In places this material extends to a depth of 3 feet or more, but commonly a bed of sand and gravel is found at depths between 2 and 3 feet. In the southeastern part of sec. 1 and the north-central part of sec. 13, T. 2 N., R. 22 E. there are included with this type some small ridges that might have been mapped as gravelly sandy loam, had they been of sufficient extent.

The Fox silt loam, gray sandy phase, is of very small extent. It is developed mainly on the terraces of Root and Fox Rivers, although small areas lie on the Lake Michigan Terrace and other terraces, as well as in the outwash plains in many parts of Kenosha County and the northern part of Racine County. The surface of the areas is flat to very gently undulating. The drainage is good, except in a few small areas where the water table lies near the surface.

The soil is of alluvial origin, having been deposited by water issuing from beneath the ice or as terraces along streams. While most of the material has come from glacial limestone débris, the surface layer is in many places slightly acid, owing to the long period during which it has been subjected to leaching.

Probably 50 per cent of this soil is under cultivation, the rest being used for grazing. Some of the land is in an unimproved state, with a scattered growth of oak, maple, hickory, and basswood. Most of the merchantable timber has been removed. General farming in conjunction with dairying is the chief type of agriculture. Corn, hay, oats, barley, and some wheat are grown, and fair to good yields are obtained. The supply of organic matter is somewhat lower than it should be and the supply of phosphorus is also below the average. The improvement of this soil can be conducted along the lines suggested for the Fox loam.

BELMORE GRAVELLY FINE SANDY LOAM.

The surface soil of the Belmore gravelly fine sandy loam consists of 6 to 10 inches of a brown gravelly fine sandy loam. This layer is underlain by a yellowish-brown material of about the same texture. At 15 to 20 inches the texture in many places becomes heavier, but there may be no change or in some places the change may be to a gravelly fine sand or gravelly sand. There are many included patches of Belmore fine sandy loam the extent of which did not warrant their separation on the soil map. The gravel in this type is small and well rounded and mostly of limestone. The underlying gravelly and sandy beds are highly calcareous. The type is found in many parts of the Lake Michigan Terrace, where it occupies old beach lines that usually extend in a north and south direction, roughly parallel to the present shore line of the lake.

The loose open structure of the soil and the small quantity of organic matter present tend to make the drainage excessive, and even during normal seasons crops are apt to suffer from lack of moisture.

This soil is of very small extent. It is used principally in the production of early truck crops, but the yields are usually rather low except where large quantities of fertilizer are used.

An area of the Belmore gravelly fine sand occurs in the old beach line at the southeastern corner of Kenosha County. It is not extensive enough to show as a separate type. The soil to a depth of 6 inches consists of a brown to dark-brown gravelly fine sand. This is underlain by a brownish-yellow fine sand that grades at about 18 inches into a loose yellow fine sand. The area is from 200 to 600 feet wide and about 2½ miles long and extends approximately north and south. Probably 75 per cent of the area is devoted to trucking. With heavy applications of manure and commercial fertilizers fairly good yields are obtained. The suggestions offered for the improvement of the Waukesha fine sand will apply equally well to this soil.

PLAINFIELD FINE SAND.

The Plainfield fine sand consists of 6 to 8 inches of a brown to yellowish-brown, loose, fine sand grading into a yellow fine sand that extends to a depth below 3 feet. In basinlike areas lying between sand ridges or sand dunes the surface material has a darker color than elsewhere, owing to the accumulation of more organic matter.

This type occurs on the Lake Michigan Terrace, where it is confined to long low narrow belts running parallel with the lake shore. The surface is level to gently undulating, but everywhere there is evidence of wind action, and in many places a dune topography has developed. Because of its loose, open structure the drainage is excessive.

Only a small part of this soil is under cultivation. Its chief use is for trucking. With heavy applications of stable manure, supplemented by commercial fertilizers, fair yields are obtained. The soil is deficient in nitrogen and the mineral plant food elements and requires very careful management to show a profit. It is doubtless better suited to trucking than to any other sort of farming.

Plainfield fine sand, loamy phase.—The Plainfield fine sand, loamy phase, consists of 9 inches of somewhat loamy fine sand, underlain by a yellow fine sand that extends to a depth of more than 3 feet.

This soil is well distributed along the lake front on the Lake Michigan Terrace. Its surface is level to gently undulating. In many places it occurs as low, broad ridges with gentle slopes, having their long axes roughly parallel to the shore of the lake. Owing to the loose character of the material the natural drainage is excessive.

Probably 90 per cent of the type is under cultivation and devoted to trucking and light general farming. The soil, according to tests made by the State, is deficient in organic matter and nitrogen and low in the mineral plant-food elements. It is a soil, however, that responds readily to fertilization; it warms up quickly in the spring, and so is well adapted to the quick-growing truck crops, which can be forced to an early maturity. The suggestions made for the improvement of the light soils of the Waukesha series will apply to the improvement of this soil. The chief difference is that the Plainfield has somewhat less organic matter in the surface soil, and may therefore require heavier applications of humus-forming material.

SUPERIOR FINE SANDY LOAM.

The Superior fine sandy loam consists of a brown fine sandy loam or very fine sandy loam, underlain at about 9 inches by a yellow fine sand. This at about 20 inches passes into a purplish to reddish plastic clay, which at about 26 inches grades into a very calcareous red clay with white seams or splotches of calcium carbonate interspersed through it. From 26 to 36 inches there is no important change. There are shallow basins where the surface soil is a dark-brown to almost black fine sandy loam, like the Poygan fine sandy loam. In these basins the upper subsoil is a mottled gray and yellow fine sand grading at about 20 inches into a mottled purple and gray clay, which becomes red at about 26 inches.

The Superior fine sandy loam occurs chiefly in small areas in Caledonia Town along Root River, and near Wind Point on the Lake Michigan Terrace. The surface of these areas is level or only very gently undulating, and the natural drainage in places is somewhat deficient.

The Superior fine sandy loam is of mixed origin. The heavy red clay subsoil is doubtless lacustrine, but has been modified more or

less since its original deposition by the action of the ice sheet. The surface sandy material is probably mostly of glacial origin. The subsoil is usually well supplied with lime carbonate, but the surface is in places slightly acid, owing to its thorough leaching.

Probably 80 per cent of this soil is under cultivation at the present time. The rest is covered with a growth of oak, maple, elm, and hickory. The chief crops grown are corn, oats, barley, hay, sugar beets, and cabbage. Where well drained this is a very good soil. It is not difficult to cultivate, a good seed bed being prepared with little effort. Moisture is also retained well because of the heavy subsoil. In the improvement of the type the same methods may be used as in the case of the best Miami soils.

Superior fine sandy loam, heavy phase.—The Superior fine sandy loam, heavy phase, consists of a brown loam about 6 inches deep underlain by a yellow or yellowish-brown material of the same texture to about 10 inches. Below this the material grades into a mottled yellow, brown, and gray silt loam or silty clay loam, and then at about 14 inches into a pinkish-red plastic clay, which extends to depths greater than 3 feet, becoming redder with increase in depth. This is the typical subsoil of the Superior series, as found in other parts of Wisconsin. Only a small area of the Superior loam exists in the present survey. It is found chiefly in small patches along Root River in Caledonia Town. These areas are fairly typical of the Superior loam, but were mapped as a phase of the Superior fine sandy loam on account of their limited extent.

The surface is flat and the natural drainage is somewhat deficient. The original forest growth was chiefly maple, oak, and hickory. About 70 per cent of this land is under cultivation, and where drainage is adequate it is an excellent soil, well adapted to most of the crops common to the region. Because of its small extent no farms are located entirely upon it, and no system of rotation or cultivation has been worked out especially for it. The practices followed are those followed on the more extensive adjoining soils.

In its improvement drainage is of importance. The supply of organic matter is somewhat deficient, and the phosphorus content is below normal. Suggestions made for the improvement of the heavy Miami soils will also apply to this land.

SUPERIOR SILTY CLAY LOAM.

The Superior silty clay loam, to a depth of 6 inches, consists of brown silt loam containing sufficient coarse material to make it feel slightly sandy. This material grades into a yellowish-brown silty clay loam, sometimes mottled, and at about 14 inches into the heavy pinkish-red clay characteristic of the Superior subsoil. The clay,

which extends to an undetermined depth, is quite uniform throughout the soil section below 18 inches.

Only two small bodies of this soil occur in the area. One lies along the Root River in Caledonia Town and the other about 2 miles east along the lake shore. The surface is level and the natural drainage is somewhat deficient. The subsoil is calcareous, but the surface may be slightly acid in places. A forest chiefly of oak, hickory, and maple formerly covered this type, but most of this has been removed, and probably 80 per cent of the type is under cultivation. The crops common to the region are grown with success, but the yields would be increased by the installation of tile drains. The other methods of improvement mentioned for the heavy soils of the Miami series are well suited to this soil.

CARRINGTON SILT LOAM.

The Carrington silt loam, to an average depth of 12 inches, consists of a dark-brown or nearly black friable silt loam, containing a comparatively large amount of organic matter. This layer according to the litmus test is in an acid condition. The subsoil consists of an upper layer of dark yellowish brown silty clay loam extending to a depth of about 18 inches and a lower layer of yellowish-brown clay, in many places carrying small quantities of limestone gravel. The subsoil becomes quite calcareous below 27 to 30 inches, and normally in this layer there is a slight mottling of grayish color caused by the excess of calcium carbonate present.

Along the boundary lines between the Carrington silt loam and the Carrington loam or fine sandy loam the surface soil normally carries considerably more fine sand than away from these boundaries and the clay subsoil is comparable to that of the Bellefontaine silt loam, being much more sandy and porous than is typical. Where this type is associated with the Carrington silty clay loam, as is the case in the towns of Bristol and Mount Pleasant, the subsoil is heavier and is more mottled in the lower part than typical, and where it borders the Miami soils it is lighter in color and runs lower in organic matter.

Included with this type as mapped are small areas of Miami silty clay loam, silt loam, Carrington silty clay loam, and Clyde silt loam. All of these, however, are in areas too small to be indicated on the soil map.

Several small areas of the Carrington loam and Carrington fine sandy loam also are included with the Carrington silt loam, because their small size does not warrant showing them as separate types.

The surface soil in these loam areas consists of 10 inches of a dark-brown to almost black friable loam, containing a comparatively large amount of organic matter and relatively large proportions of fine sand and silt. The upper part of the subsoil is a dull-brown to

lighter colored clay loam, passing at about 18 inches into a yellowish-brown sandy clay that becomes heavier with increasing depth. This continues to a depth of 36 inches or more. Considerable quantities of fine gravel are encountered in both soil and subsoil.

In the fine sandy loam areas the surface soil to a depth of 8 to 10 inches is a dark-brown fine sandy loam, like the loam rich in organic matter. A small quantity of gravel is scattered over the surface of many areas. Tests indicate that the soil is in an acid condition. The upper subsoil is a yellowish-brown fine sandy loam grading at about 20 inches into a yellow clay or sandy clay loam. In the lower subsoil a yellowish sandy clay is often encountered.

The principal occurrences of the Carrington silt loam are southwest of Pleasant Prairie, northeast of Bristol, northwest of Waterford, and northwest and southeast of Corliss. Small areas are mapped in all parts of Kenosha County, except in the southwest corner and in the extreme eastern part. Areas also occur in the towns of Waterford, Rochester, Burlington, Dover, and Mount Pleasant in Racine County.

The loam areas lie in the towns of Wheatland, Brighton, Pleasant Prairie, Yorkville, Mount Pleasant, Raymond, and Burlington, and the fine sandy loam areas in a few small patches in the towns of Wheatland, Brighton, Pleasant Prairie, and Waterford.

The topography of this soil and of the included loam and fine sandy loam is gently rolling to rolling. The drainage is usually well established, though in some of the more level areas it is somewhat deficient and tiling is needed. The structure of both the soil and subsoil is usually favorable for the retention of moisture. Although comparatively inextensive, the Carrington silt loam is an important type. It has been derived from the glaciated limestone material which covers the region. The dark color is due to an accumulation of organic matter resulting from the decay of rank vegetation in the presence of considerable moisture.

Almost all of this type and small inclusions of other types occurring in the western part of the area is devoted to dairying in conjunction with general farming, and about 10 per cent of it in the towns of Mount Pleasant and Bristol is used for the production of sugar beets and cabbage.

As in the case of the Carrington silty clay loam, this is a prairie soil, the native growth consisting almost exclusively of grasses.

Corn, hay, oats, barley, wheat, sugar beets, and cabbage are the leading crops, with yields slightly higher than on the Carrington silty clay loam.

The land is handled and fertilized under the methods prevailing on the Carrington silty clay loam.

Land of the Carrington silt loam type sells for $100 to $250 an acre, the price varying with the location, improvements, and condition of the soil. With the exception of tiling, the suggestions made for improving the typical Carrington silty clay loam are applicable to this soil.

CARRINGTON SILTY CLAY LOAM.

The surface soil of the Carrington silty clay loam consists of 12 inches of dark-brown to almost black heavy silt loam, containing a large quantity of organic matter. The upper subsoil is a brown silty clay loam grading into a brownish-yellow plastic clay which is slightly mottled with yellow and gray. At a depth of about 2 feet the material is a heavy plastic pale yellowish gray clay, interspersed with white splotches of calcium carbonate. At this depth there is a strong reaction with hydrochloric acid, but both Truog's test and the litmus test indicate that the surface soil is acid.

As mapped, this type is subject to some variation. On steep slopes and narrow ridges, where there has been wash, the surface soil is a silty clay loam of a rather stiff and plastic structure. Along the lower parts of slopes, where there has been an accumulation of washed material, the dark-brown silt loam layer may extend to a depth of 18 inches. Where the Carrington silty clay loam is associated with the Carrington silt loam or the Miami silt loam, as is often the case in Dover and Norway Towns, the surface soil is lighter and somewhat more friable and the subsoil is less plastic than typical. There are some inclusions of Miami silty clay loam, Miami silt loam, Carrington silt loam, and Clyde silt loam.

The Carrington silty clay loam is the most extensively developed soil of the area. It is the predominating soil in all parts of the area except some of the towns bordering Lake Michigan and those bordering Walworth County.

The topography ranges from almost level to undulating and gently rolling. Drainage is somewhat deficient on account of the heavy compact nature of the subsoil and tile drains have been installed in a number of places. Little serious erosion takes place as the run-off is usually gentle. All of this soil has been derived from glaciated material formed by the grinding action of ice upon limestone rock. The lime has been leached from the surface soil in almost all places.

The native vegetation on this soil consists chiefly of prairie grasses, the only timber occurring near the contacts with other types along a few of the streams. The forest growth consists of oak, maple, basswood, elm, and hickory. Practically all this type is or has been under cultivation. The prevailing system is based upon general farming combined with dairying, although sugar beets are grown ex-

tensively and cabbage to a less extent in the central and eastern parts of the area. Corn, hay, oats, and barley are the leading crops, corn and hay occupying the largest acreages. Many farmers have a few acres in wheat and a few in alfalfa, buckwheat, and hemp. Hemp is grown chiefly in the vicinity of Union Grove where there is a hemp factory. There is also a pickling and canning station there, and cucumbers and cabbage are grown to a considerable extent also. The yields of the general farm crops on this soil are usually satisfactory, equaling or exceeding the average yields on the other soils in the county.

By far the greater proportion of farmers on this soil do not follow any definite system of crop rotation. The most common rotation consists of corn, followed by a small grain for one or two years and then by timothy and clover. Hay may be cut for two years and the field pastured for a year before again being manured and plowed for corn. Another rotation sometimes followed consists of sod manured and broken for corn, followed by sugar beets or cabbage, then by a small grain, and then by grass for hay. Stable manure is about the only fertilizer used for general farm crops. For special crops, such as sugar beets and cabbage, this is frequently supplemented with commercial fertilizer analyzing 2 per cent nitrogen, 8 per cent phosphorus, and 1 per cent potash, applied at the rate of about 150 pounds per acre for sugar beets and 500 to 700 pounds per acre for cabbage. The use of commercial fertilizers is gradually increasing.

Farms on the Carrington silty clay loam have a selling value of $75 to $250 an acre, depending upon drainage, location, improvements, and character of the soil.

Examinations by the Wisconsin soils laboratory show the Carrington silty clay loam to be deficient in phosphorus and slightly deficient in available nitrogen. Tests also show the soil to be acid. There is an abundance of lime in the deep subsoil and substratum, but this is not near enough the surface to be available to most field crops. The acidity can be corrected by thoroughly mixing with the soil about 3 tons of finely ground limestone per acre. This application of limestone will assist in obtaining a good stand of either clover or alfalfa and will help the other farm crops. The deficiency in phosphorus can be remedied either by the use of raw rock phosphate or some more concentrated form of this element. Where rock phosphate is used a good plan is to mix it with the manure or to plow it in with a green manuring crop. For immediate results acid phosphate can be used to better advantage. It can be mixed with manure or applied as a top dressing to the land at the time of seeding at the rate of 200 to 300 pounds per acre. For cabbage or sugar beets the application should be 500 to 600 pounds per acre. The nitrogen and humus supply of the soil can be increased by the use of barnyard ma-

nure and by growing crops for plowing under. More definite systems of crop rotation should be planned, so that clover sod, or possibly a second crop of clover, may be plowed under about once every second rotation.

The drainage of the Carrington silty clay loam is somewhat deficient and tile drains are found to be very beneficial in most cases. Tile drainage makes the land warm up earlier in the spring, aerates the soil so that organic matter can decompose more rapidly, removes injurious acids, and favors a better root development of plants, thus helping the plant to withstand the droughts that usually come in the latter part of the season. Where drainage has been provided the yields also have been materially increased by deeper plowing and a more thorough preparation of the seed bed, which are made easier by the improved physical condition of the soil that has been tiled.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Carrington silty clay loam:

Mechanical analyses of Carrington silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
313201	Soil	0.6	1.6	1.9	8.5	6.6	50.5	30.1
313202	Subsurface	.4	1.0	1.2	6.3	5.6	41.9	43.6
313203	Subsoil	.7	1.0	.9	4.1	6.2	44.8	42.2

WAUKESHA FINE SAND.

The Waukesha fine sand consists of 9 to 12 inches of a dark-brown loamy fine sand, underlain at about 12 inches by a rather incoherent yellow fine sand, which continues to a depth of more than 3 feet.

The type is developed in the Lake Michigan Terrace from Kenosha south to the Illinois-Wisconsin State line. The topography is level to very gently undulating, with low, narrow ridges extending approximately north and south and parallel with the lake shore. The drainage is excessive and the type is somewhat droughty. The material forming this soil was deposited in the lake when that body of water stood at a much higher level than at present.

Probably 70 per cent of the type is now under cultivation, and is devoted chiefly to truck farming, combined with general farming. Sugar beets yield from 6 to 12 tons per acre, potatoes about 125 bushels, cabbage from 6 to 12 tons per acre, onions from 200 to 500 bushels, corn from 15 to 35 bushels, oats from 20 to 40 bushels, rye 15 to 25 bushels, and clover and timothy hay about 1 ton per acre. Tomatoes, parsnips, beans, carrots, and melons are also grown with success.

No systematic rotation of crops is followed. Onions are commonly grown on the same fields for several years in succession. Onion, potato, and cabbage land receives from 15 to 20 tons of stable manure per acre. Ordinarily stable manure is not used on sugar beets. Commercial fertilizer of the formulae 2–10–2 or 1–8–1 is usually applied to sugar beets, potatoes, and cabbage at the rate of 500 to 1,000 pounds per acre, although much heavier applications are sometimes made. Commercial fertilizer is seldom applied for such crops as corn and small grains, the residual effect of application in growing the truck crops being depended on.

The selling price of this land ranges from $50 to $300 or more an acre, depending upon improvements, condition of soil, and location.

This soil is very acid, is droughty, and, according to State tests, quite deficient in the mineral plant-food elements. Clover can not be grown successfully for an extended period without the application of lime. The requirement is 2 to 3 tons per acre. To increase the nitrogen content liberal use should be made of stable manure, and where the supply is inadequate clover should be grown and an occasional crop plowed under. If clover can be plowed under about once in five years, the humus and nitrogen content can be increased and maintained. The mineral plant-food elements can best be supplied in the form of commercial fertilizers, and even where stable manure is available it should be supplemented by the use of acid phosphate, and in some cases by a complete fertilizer. In the trucking industry heavy applications of commercial fertilizers can be made to advantage. Most truck crops do best on a soil that is not acid, and the fertilizers will also give best results after the acidity of the soil has been corrected. The first step in improving this soil, therefore, is correcting the acidity.

WAUKESHA FINE SANDY LOAM.

The surface soil of the Waukesha fine sandy loam has an average depth of 10 or 11 inches, and consists of a dark-brown or almost black fine sandy loam, containing a relatively high percentage of organic matter. The subsoil is a brownish-yellow fine sandy loam, which at about 16 to 20 inches is underlain by a yellow sandy clay loam. This becomes lighter in texture with increasing depth, and passes into a bed of stratified sand and gravel at 30 to 36 inches.

As mapped the type is quite variable, the surface soil of included areas ranging from fine sand to loam. The stratified beds of gravel and sand may be within 12 inches of the surface or may not be encountered within the 3-foot section.

The type is developed most extensively in the Lake Michigan Terrace, where it forms long narrow strips, extending parallel with the

lake shore. Other areas occur on the terraces of the Fox, Desplaines, and Root Rivers, and their tributaries.

The surface is level to very gently undulating, and the drainage is good, except in a few cases where the ground water level is very near the surface.

Practically all the Waukesha fine sandy loam is under cultivation. On the Lake Michigan Terrace it is devoted to trucking, and in other localities to general farming in conjunction with dairying. Cabbage yields from 6 to 15 tons per acre, corn from 28 to 38 bushels, oats from 25 to 45 bushels, barley from 25 to 40 bushels, rye 15 to 20 bushels, buckwheat from 12 to 18 bushels, wheat 15 to 20 bushels, timothy and clover hay 1½ tons per acre, and potatoes about 100 bushels. The rotations followed are practically the same as on the Waukesha silt loam, deep phase, and the methods of improvement suggested for that type are applicable to this soil.

Reports of the Wisconsin soils laboratory show this type in need of phosphorus. It is also acid and clover can not make its best growth until this condition has been corrected. From 2 to 3 tons of finely ground limestone per acre should be applied and thoroughly worked into the surface soil. The nitrogen content of the soil can be maintained by applications of manure, which will greatly assist in the growing of clover. When the soil is in a run-down condition and sour it would be well to use, in seeding, a mixture of 3 quarts of timothy, 3 quarts of medium red clover, and 1 quart of alsike clover per acre. This combination does better on an acid soil than medium red clover alone. After the soil has been thoroughly limed red clover with some timothy should be grown instead of alsike. The low phosphorus content can be corrected by using from 400 to 500 pounds per acre of acid phosphate on the corn land and about 200 pounds per acre on small grains. The best results can be obtained from this fertilizer by spreading it broadcast after the land is plowed, especially after the soil has been limed.

WAUKESHA LOAM.

The Waukesha loam consists of 10 to 12 inches of a dark-brown to almost black loam, high in organic matter, underlain by a yellow heavy fine sandy loam to silty clay loam, which at about 18 inches passes into a yellow sandy clay. At about 30 inches stratified beds of gravel and sand are encountered, and these continue to a depth of 3 feet or more. The gravelly substratum is calcareous.

Variations in this type are numerous. The surface soil of included areas ranges in texture from fine sandy loam to silt loam. The subsoil may be a fine sandy loam, passing into a stratified bed of gravel and sand at 12 to 15 inches, or it may be a fine sandy loam or sandy clay loam to a depth of 3 feet or more.

The main occurrences of the Waukesha loam are on the Lake Michigan Terrace, on the terraces along Fox and Desplaines Rivers and their tributaries, and between Marshall and Camp Lakes. The surface of these areas is flat to very gently undulating. The drainage is well established.

Almost all the Waukesha loam is under cultivation. It is used for general farming in connection with dairying. The same crops are grown as on the Waukesha silt loam, but the yields appear to average a little lower. The fertilizer treatment suggested for the Waukesha fine sandy loam, will also apply to this soil.

WAUKESHA SILT LOAM.

The surface soil of the Waukesha silt loam, which has an average depth of 12 inches, consists of a dark-brown to black, friable silt loam, containing a relatively large proportion of organic matter. The upper subsoil is a yellowish-brown silt loam grading into brownish-yellow silt loam or silty clay loam. At about 20 inches a layer of sandy clay is encountered and this at 20 to 30 inches passes into gravelly sandy loam. From 30 to 36 inches there occur stratified beds of gravel and sand in which limestone material predominates. In places the dark-brown silt loam of the surface grades at about 10 inches into a yellow sandy loam which passes at 16 to 24 inches into stratified beds of gravel and sand. The Waukesha silt loam as mapped includes patches of Waukesha loam too small to warrant separation.

The Waukesha silt loam, which is not extensively developed in this area, has its chief occurrences between Twin and Powers Lakes, in the terrace or bench lands along the Fox and Desplaines Rivers and their tributaries. It is also mapped on an outwash plain west of Waterford. Other very small patches are found in practically all towns of the area.

The surface of the Waukesha silt loam varies from level to very gently undulating, and the natural drainage is good. Practically all the type is under cultivation. It is used chiefly in general farming combined with dairying. It is comparatively easy to plow, and a very good seed bed can be prepared without difficulty.

Corn, hay, oats, and barley are the chief crops, corn occupying the largest acreage. Wheat and potatoes are grown on a small scale, but the type is not so well adapted to these crops as those of lighter texture. Corn yields an average of about 40 bushels, oats 45 bushels, barley 40 bushels, and clover and timothy hay from 1 to 1½ tons per acre.

The selling price of this land ranges from $100 to $200 an acre, depending upon the location, improvement, and condition of the soil.

The methods of improvement suggested for the Waukesha silt loam, deep phase, are well suited also to the Waukesha silt loam.

Waukesha silt loam, deep phase.—The surface soil of the Waukesha silt loam, deep phase, consists of dark-brown to almost black, smooth silt loam, high in organic matter and relatively high in silt. The upper subsoil is a dull-brown silt loam, grading downward into a yellowish-brown silt loam. This may continue to a depth of 3 feet, but ordinarily a yellow silty clay loam is encountered at about 30 inches. At depths ranging from 3½ to 7 feet beds of gravel and sand occur.

The only important development of this phase is found in a comparatively large area lying between Twin Lakes and Powers Lake. This area represents a part of a rather extensive glacial outwash plain. Other areas lie northwest of Waterford and southeast of Browns Lake.

The surface, like that of the typical soil, is flat to very gently undulating, and the natural drainage is for the most part good, but there are places where tile drains would be beneficial.

Practically all the phase is under cultivation. It is devoted to the same uses as the typical soil. Corn, hay, oats, and barley are the leading crops. Sugar beets and cabbage are important special crops. Small amounts of wheat and potatoes are produced. Corn yields 30 to 70 bushels, barley 30 to 50 bushels, oats 30 to 65 bushels, and clover and timothy hay about 1½ tons per acre. Sugar beets produce from 8 to 22 tons per acre and cabbage from 8 to 20 tons.

Comparatively few farmers follow a carefully worked-out crop rotation. Where corn is followed by small grain, the land then seeded to clover and timothy and this sod is well manured before plowing again for corn, there is a marked improvement in crop yields. Sugar beets and cabbage commonly take the place of corn in the rotations.

Farms on this type range in selling value from $125 to $250 an acre, depending upon the improvements and location.

NEWTON LOAMY FINE SAND (CLYDE).

The Newton loamy fine sand consists of a surface layer of dark to almost black loamy fine sand 10 to 12 inches thick, grading into a gray, yellow, and brown mottled fine sand, which at about 24 inches passes into a bright-yellow fine sand, showing no change to a depth of 3 feet or more.

As mapped there are included areas of Waukesha loamy fine sand and Newton fine sandy loam. On the slight elevations the surface soil is inclined to be lighter in both texture and color than in the depressions, and the subsoil is a yellow fine sand, slightly mottled

with gray and brown. In the depressed areas the surface soil is nearly black and varies in texture from a loamy fine sand to a fine sandy loam. At about 12 inches this passes into a mottled yellow and gray fine sand, the gray color predominating. With increasing depth the color becomes more pronounced, until at about 24 inches it is a bright yellow.

The Newton loamy fine sand occurs on the Lake Michigan Terrace, in the extreme eastern part of Caledonia Town, and in a small area just south of Racine. The surface of these areas is level to very gently undulating, with low, broad ridges, having very gentle slopes. The drainage is adequate and frequently excessive.

Most of this soil is now under cultivation and the crops grown, and methods of cultivation and fertilization, are practically the same as on the Waukesha fine sand. The suggestions made for the improvement of the latter apply equally well to this Newton soil.

Newton loamy fine sand, mucky phase.—Only one area of this soil was mapped in Racine County, and none at all in Kenosha County. The total extent is about 40 acres. The area lies on the north shore of Wind Lake. The soil consists of a layer of grayish loose sand 16 to 30 inches deep, overlying a bed of Peat. Except in having a peaty substratum this soil is very similar to the Calumet fine sand mapped in Lake County, Ind.

The surface is level, and only a few feet above the waters of the lake, and the natural drainage is only fair. In the spring when the water in the lake is high the drainage is poor, as the water table is then quite near the surface.

The vegetation on this soil consists of coarse grasses, which afford some grazing. The area has never been under cultivation.

NEWTON LOAM (CLYDE).

The Newton loam consists of a dark-brown to nearly black loam, containing a considerable amount of organic matter, underlain at an average depth of 10 inches by a brownish-yellow silty clay loam or silty clay mottled with yellow and gray, extending to 24 to 30 inches. Below this occurs a yellow sandy clay loam, or sandy loam, also mottled. This layer extends to depths greater than 3 feet. In many places beds of sand and gravel occur in the lower subsoil. In the eastern part of Caledonia Town the soil included with this type approaches a heavy loam in texture, while the subsoil is a mottled clay or sandy clay.

Areas of the Newton loam are distributed throughout the Lake Michigan Terrace. They have level or very nearly level topography and are naturally poorly drained.

Practically all of the Newton loam is devoted to trucking and light general farming. Sugar beets, cabbage, onions, and corn are the leading crops. Carrots, parsnips, tomatoes, and some melons are grown. The methods of cropping and fertilizing are about the same as on the heavy Maumee and Carrington soils, and the recommendations made for the improvement of these will apply equally well to this soil.

NEWTON SILT LOAM (CLYDE).

The Newton silt loam, to an average depth of about 12 inches, consists of dark-brown to almost black heavy silt loam, running high in organic matter. This surface layer is underlain by an upper subsoil layer, 4 inches thick, of brownish silty clay loam, mottled with shades of yellow and gray. Below this the material becomes a brownish-yellow clay loam or clay, mottled with gray, and at 24 to 30 inches a very calcareous yellowish-gray clay, continuing to 3 feet or more. In places beds of gravel or sand occur in the lower subsoil.

This type is one of the more extensive soils on the Lake Michigan Terrace. It is derived from water-laid material and resembles the Waukesha silt loam, except for the gray mottled subsoil. The areas have a level to very gently undulating surface, and the natural drainage is in most places somewhat deficient.

Practically all this soil is farmed. It is largely devoted to trucking in conjunction with general farming. Sugar beets, cabbage, and corn, ranking in the order named, are the leading crops. Onions, potatoes, tomatoes, carrots, parsnips, and beans are also important products. Hay also is produced to a considerable extent on this soil. Sugar beets yield from 12 to 30 tons, cabbage from 10 to 20 tons, corn from 35 to 90 bushels, onions about 400 bushels, with a range from 150 to 1,000 bushels, potatoes from 125 to 150 bushels, and hay about 1½ tons per acre.

On account of the nearness of the type to Kenosha and Racine, the value of it is high, ranging from $250 to over $500 an acre.

Suggestions offered for the improvement of the Maumee silt loam will apply equally well to this type.

NEWTON CLAY LOAM (CLYDE).

The Newton clay loam consists of 12 inches of a dark-brown to nearly black clay loam, containing a considerable amount of organic matter, underlain by a yellowish clay mottled with gray, grading at about 24 inches into a mottled silty clay loam. In a number of places there are beds of gravel and sand in the lower part of the 3-foot section. With this type there are many small inclusions of

Newton loam and silt loam, and also some of the Maumee clay loam, the last a dark-gray to black soil with a gray calcareous deep subsoil.

The Newton clay loam occurs on the Lake Michigan Terrace in the southern part of Racine and to the south and north of that city. The type has a level or very nearly level surface and the natural drainage is deficient.

Practically all the type is used in the production of truck crops, but trucking is supplemented with light general farming. Sugar beets, cabbage, onions, potatoes, tomatoes, carrots, strawberries, and beans are the principal products on the trucking areas. Oats, barley, and hay are also grown. Sugar beets and cabbage are especially adapted to this soil, and very satisfactory yields are obtained on thoroughly drained land.

Large quantities of manure, brought from Chicago and Milwaukee, are used, from 15 to 20 tons per acre being applied to cabbage, potatoes, and onions. Commercial fertilizers, commonly with the formula 2–8–2, are applied to sugar beets, and sometimes to cabbage, instead of manure, the applications ranging from 500 to 1,000 pounds per acre.

This soil requires about the same treatment as the Maumee silty clay loam and Carrington silty clay loam.

CLYDE SILT LOAM.

The surface soil of the Clyde silt loam consists of 12 to 14 inches of dark-brown to black silt loam, running very high in organic matter. The upper subsoil is a mottled gray, brown, and yellow silty clay loam or silty clay, and grades into a lower subsoil layer of gray, rather stiff clay, mottled with yellow and brown. This soil occupies a rather small total area, but occurs in small bodies in Waterford, Norway, Rochester, Burlington, Dover, and Mount Pleasant Towns in Racine County and in practically all the towns of Kenosha County.

The soil characteristically occupies poorly drained, shallow depressions along small intermittent streams traversing the silt loams of the Miami, Burlington, and Carrington series. The material composing this soil is practically the same as that forming the Carrington and Miami soils, except that owing to its poorly drained condition there has accumulated a larger amount of organic matter.

Practically 50 per cent of the type is farmed, the rest being so poorly drained at present that cultivation is impracticable. The more poorly drained parts are utilized as pasture, and to some extent for the cutting of marsh hay. The Clyde silt loam is a well-balanced soil and, when drained, well adapted to all of the general farm crops of the area.

Clyde silt loam, marsh phase.—The marsh phase of the Clyde silt loam is practically the same in both soil and subsoil as the typical soil, the chief difference being in drainage, which is so poor as to result in a swampy condition.

Because of the lack of drainage none of the phase is used at present for cultivated crops. It has some value for pasture and for the production of marsh hay. When thoroughly drained it will be equal in productiveness to the typical Clyde silt loam.

Clyde silt loam, sandy phase.—The Clyde silt loam, sandy phase, consists of 7 to 12 inches of black or dark-brown fine sandy loam, underlain by gray sandy clay loam mottled with brown and yellow, and this at 18 inches by gray mottled sandy clay continuing to a depth of 3 feet or more. As mapped there are many inclusions of the loam and sandy loam types of the series.

The Clyde silt loam, sandy phase, is found in a few very small areas in Caledonia and Yorkshire Towns. Had there been a more extensive development of this soil it would have been mapped as the Clyde fine sandy loam.

The surface is flat and the natural drainage is very poor. Because of its small extent and its wet condition the type is of little importance. Before it can be placed under cultivation thorough drainage is absolutely necessary. None of it is cultivated at present, but it has some value as pasture.

CLYDE SILTY CLAY LOAM.

The surface soil of the Clyde silty clay loam to an average depth of 8 inches consists of an almost black heavy silt loam which passes into an almost black or very dark gray silty clay loam extending to a depth of 12 or 14 inches. The soil grades into a subsoil of dark-gray material mottled with yellow and brown, which becomes a lighter gray with depth and at 30 inches is a very calcareous gray plastic clay mottled with yellow.

Some variations occur in the type, chiefly in a few areas along small intermittent streams receiving the wash from areas of the Carrington and Miami silty clay loam. In such places the black surface soil may extend to a depth of 8 inches or more.

The Clyde silty clay loam is confined to depressions along intermittent streams and to shallow basins in the areas of Carrington and Miami silty clay loam. It occupies a rather large total area, but the individual areas are mostly small; very few exceed 100 acres in extent and probably 90 per cent each cover less than 10 acres. The native forest of this soil consists of bur oak, soft maple, willow, ash, and sycamore.

Probably 80 per cent of this soil is under cultivation and the rest is in permanent pasture. Corn, sugar beets, and cabbage are the lead-

ing crops. Oats and barley do well, but are likely to lodge. The quality of the grain is not equal to that grown on the better drained light-colored soils. Alsike clover and timothy do well. Hemp, to which this soil apparently is well adapted, is an important crop in the vicinity of Union Grove.

A rotation practiced by some of the better farmers consists of corn, planted on land previously in sod and manured before plowing, followed by corn, and then by a small grain in which the field is seeded with timothy and alsike clover. Where truck farming is practiced the soil is usually heavily manured and either sugar beets or cabbage planted for one or two years. Frequently the supply of manure is supplemented with a complete commercial fertilizer.

Land of this type of soil sells for $100 to $300 an acre. It is naturally a very strong productive soil, and its greatest need is drainage. A conservative estimate places the cost of tiling at $30 to $60 an acre.

Clyde silty clay loam, marsh phase.—The soil and the subsoil materials of the marsh phase of the Clyde silty clay loam are essentially the same as those of the typical soil. The features distinguishing the phase are its somewhat lower position and prevailing swampy condition. Because of the very poor drainage the phase is used only for pasture at the present time. The area of land of this phase is very small.

MAUMEE FINE SANDY LOAM (CLYDE.)

The surface soil of this type consists of a dark-brown to almost black fine sandy loam, about 10 inches deep. The upper subsoil is a yellowish-brown fine sandy loam, which at about 15 inches passes into a yellow fine sandy loam, fine sand, or a gravelly fine sand. The lower subsoil, from 26 to 36 inches, is a gray fine sandy loam, mottled with yellow, or a bluish-drab sandy clay. Included with this type as mapped are small areas of Maumee fine sand, Maumee loam, Newton fine sandy loam, and Wabash fine sandy loam.

This is an unimportant soil occurring chiefly along the Fox and Desplaines Rivers and their tributaries. The areas have a flat or basinlike surface and poor drainage.

The Maumee fine sandy loam is a water-laid soil deposited largely by stream action. The material comes from glaciated limestone débris, but some of the type is in an acid condition.

The native vegetation consists of elm, ash, sycamore, willow, soft maple, alder, and coarse grasses and other water-loving plants.

Probably 10 per cent of this type is in cultivation; the remainder is used for cutting marsh hay and as a range for cattle. Where open ditches have been constructed and the land drained fair crops of corn, oats, and timothy and clover hay can be obtained. Cab-

bage, onions, and sugar beets should also do well on this type of land where it has been reclaimed from its poorly drained condition.

MAUMEE SILT LOAM (CLYDE).

The Maumee silt loam has a surface soil that extends to an average depth of 12 inches and consists of a nearly black silt loam, containing a high percentage of organic matter. The subsoil in the upper part is a brown to dark-gray silty clay loam, and in the lower part, below 24 inches, a gray clay loam or clay, mottled with brown and yellow.

As mapped this type is subject to many variations. A surface layer, 1 to 8 inches thick, may consist of peaty material, and layers of like material may be found in either the upper or lower subsoil. South of New Munster and at a number of other places in the western part of the area the surface is a dark-colored marly silt loam which passes at 14 inches into a gray marly silt loam, which may continue to a depth of 3 feet or more.

In the broad terraces along Lake Michigan and the Fox and Desplaines Rivers, beds of sand and gravel are in many places present at depths of 18 to 36 inches. The surface soil sometimes carries considerable sand and gravel. In such cases there are many included patches of clay loam. There are places where the subsoil is drab or bluish in color. On Lake Michigan Terrace in the eastern part of the town of Somers there are inclusions of the Superior silt loam. In a few small scattering areas the soil is a loam instead of a silt loam.

The principal occurrences of this type are north of Kenosha on the Lake Michigan Terrace, along the Desplaines, Fox, Pike, and Root Rivers and their tributaries, and in the broad shallow basins of the outwash plains of Waterford Town. Many other areas ranging in size from a few acres to several hundred acres are found in the flood plains of streams and their shallow basins in the western part of the area, and in the central parts of the towns of Caledonia and Mount Pleasant.

The areas of the Maumee silt loam are flat or basinlike. The type is confined to depressed areas along streams, and the natural drainage is very poor. Much of the land is subject to annual overflow, and may remain under water for some time each year.

In origin the material is partly lacustrine and partly fluvial. It occurs in shallow basins, outwash plains, ponded valleys, and old sloughs. It is similar to the Waukesha soil except that it is much more poorly drained.

The original vegetation on this type consisted of ash, soft maple, elm, willow, alder, coarse grasses, and other water-loving plants. Practically all the merchantable timber has been removed.

Probably 60 per cent of the Maumee silt loam is under cultivation, very little of the low-lying areas subject to overflow being used. The large area near Kenosha on the Lake Michigan Terrace is practically all devoted to truck farming and general farming. The uncleared areas which commonly support a thin forest growth are used for pasture.

The Maumee silt loam is one of the strongest soils of the area and when properly drained is especially adapted to corn, grass, cabbage, and sugar beets. Small grains can be grown with profit, but are apt to lodge, and the quality of the grain is not equal to that grown on the light-colored soils. Alsike clover and timothy give an excellent grade of hay. The average yields obtained from drained areas of this land are somewhat above those obtained from most of the other soils of the area. The methods of farming followed are about the same as on the silty clay loam of the series.

From the standpoint of the plant food contained this is a well-balanced soil; the chief question is that of availability. In the improvement of this land the first step, of course, is drainage. All the areas should be thoroughly underdrained. When efficient drainage systems are installed it would be difficult to find a better soil for general farming purposes. The selling price ranges from $100 to $300 or more an acre. Unimproved land sells for $60 to $100 an acre, depending upon location, drainage possibilities, and general condition of the soil.

Maumee silt loam, marsh phase.—The marsh phase of the Maumee silt loam consists of water-laid material occupying marshy depressions. The soil and subsoil are essentially like those of the typical soil, except that there is a surface layer of peaty material 2 to 8 inches thick. The chief difference is that the marsh phase is much more poorly drained than the typical soil.

In its present condition this land has no value for cultivated crops, and until drained will be of use only for pasturing cattle and the production of marsh hay.

MAUMEE SILTY CLAY LOAM (CLYDE).

The surface layer of the Maumee silty clay loam consists of 2 to 8 inches of a dark-gray or black silt loam underlain by a silty clay loam of the same color. At 12 to 13 inches this grades into dark-gray silty clay with a few yellow mottlings. The color becomes lighter and the mottling increases with depth. At 30 inches a gray or bluish calcareous silty clay is present.

Some variations occur in the type, chiefly in the areas near streams, where both the soil and subsoil may be heavier than typical. There are also shallow depressions in which the surface may be covered with a few inches of peaty material and other places where beds of

gravel and sand occur at depths of 2 to 3 feet. Calcareous material may occur at any depth, there being areas in which soil and subsoil are high in lime, and others in which neither show an alkaline reaction.

This soil is the most extensively developed of the black terrace and alluvial plain soils. Its principal occurrence is along the principal drainage ways in the eastern half of the area.

The surface is flat or slightly depressed and the natural drainage is always poor. The areas along the streams are subject to frequent floodings and sometimes water stands on the surface for several days at a time.

The original timber growth consisted of willow, elm, ash, alder, sycamore, and soft maple. The merchantable timber has practically all been cut.

Probably 70 per cent of the type lying above overflow is under cultivation, the remainder being used chiefly for pasture. The leading crops are corn, sugar beets, cabbage, and onions. A considerable area about Union Grove is in hemp. A luxuriant growth of native grasses affords good pasture where the land is not cultivated. Land under cultivation is improved with tile drains; where efficient, these insure excellent yields of all crops adapted to the soil. Without such drainage crops are very uncertain.

A common crop system on land of this type consists of hay for one or two years, the sod plowed for corn, usually after manuring, and corn followed by corn. A small grain is usually sown after the second year of corn and the field again seeded to clover and timothy. Where truck farming is practiced, the sod usually is heavily manured and either cabbage, sugar beets, or onions planted for one or two years. The manure is often supplemented with a commercial fertilizer, analyzing about 2–8–1. This is applied at the rate of 500 to 800 pounds per acre for cabbage and 1,000 pounds for onions. After using the fields one to three years for trucking a small grain is sown and the land seeded to clover and timothy.

The selling price of land of this type ranges from $100 to $300 an acre.

The Maumee silty clay loam is a heavy soil of high natural productiveness. It breaks into good tilth under favorable moisture conditions, but if plowed when too wet it forms clods that are pulverized later with difficulty. Tiling is essential to its successful cultivation. The cost of installing drains ranges from $30 to $60 or more an acre.

According to tests made by the Wisconsin soils laboratory, this type shows some indication of acidity, but it is seldom more than slight.

The following table gives the results of mechanical analyses of samples of the soil, subsurface, and subsoil of the Maumee silty clay loam:

Mechanical analyses of Maumee silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
313251	Soil	1.1	4.7	4.5	13.3	6.6	50.6	19.3
313252	Subsurface	.0	5.7	5.3	14.9	6.3	45.1	22.9
313253	Subsoil	.2	.8	.7	4.4	5.6	56.6	31.7

GENESEE SILT LOAM.

The Genesee silt loam consists of an upper layer of a brownish-gray to brown silt loam, 12 inches thick, resting upon a layer of pale-yellow or yellowish-gray silty clay loam passing at about 20 inches into a grayish-yellow silty clay, mottled with various colors and extending to a depth of 3 feet or more. In some places the lower silty clay layer is underlain with beds of sand or gravelly sandy loam. As is likely to be the case with alluvial soils, this type is somewhat variable, and it includes small patches of loam, clay loam, and fine sandy loam texture.

The Genesee silt loam forms only a small area in the present survey. It occupies the flood plains along the Root River in Caledonia Town. The surface is level and the natural drainage poor. The soil is frequently flooded, and because of this very little of it has been placed under cultivation. With adequate drainage it would be an excellent soil, but this will involve in many cases diking or lowering the bed of the streams, and the cost of such work would hardly be justified for the reclamation of this soil alone.

Genesee silt loam, sandy phase.—The Genesee silt loam, sandy phase, to an average depth of 8 to 10 inches, consists of a light-brown fine sandy loam containing only a moderate amount of organic matter. The subsoil is a yellowish sandy loam grading at about 18 inches into a yellow sandy clay, in places strongly mottled. This may continue to a depth of more than 3 feet, but in many places beds of sand and gravel are present in the lower subsoil.

Only a few small areas of this type occur. They lie chiefly along the Root River in Caledonia Town.

This phase is of very little importance. Little of it is under cultivation, and its total area is small. It is subject to annual overflow, and crops are uncertain. If the land should be thoroughly drained and protected from floods it would make an excellent soil for both general farm and special crops. As with the silt loam, however, the cost of drainage would be prohibitive at present.

DUNESAND.

Dunesand consists of yellowish-brown incoherent siliceous fine sand, passing at 4 or 5 inches into a yellow fine sand of the same general character extending to a depth of 3 feet or more. In basinlike areas lying between ridges the surface has a dark-gray color, as a result of a larger content of organic matter.

Areas of Dunesand lie immediately along the Lake Michigan shore, between Kenosha and the Illinois State line. It consists of a series of broken ridges extending parallel with the lake. Because of the loose open structure of the soil and subsoil the drainage is excessive.

Dunesand is extremely droughty and is constantly being shifted by the wind. It is not farmed, but affords a little grazing.

In the northeastern quarter of section 28, Waterford Town, is an area consisting in part of Dunesand and in part of Coloma sand. Except in the freshly formed dunes the soil consists of a light-brown sand, 5 to 7 inches deep, which grades into pale-yellow loose fine sand extending to a depth of 3 feet or more. In a few places the subsoil contains sufficient clay to make it somewhat sticky.

Probably 50 per cent of this area is cultivated, the remainder being covered with scrub oak and used as pasture. The crops grown are corn, oats, rye, and hay, but the average yields are low.

PEAT.

Peat consists of a black or dark-brown fibrous to rather finely divided vegetable matter mixed with a small proportion of mineral matter, mainly of the grades silt and fine sand. The deposits range in depth from 18 inches to about 20 feet, with an average depth of about 4 feet. Over the greater part of the deposits the material is fibrous, though in a number of places it is fairly well decomposed and tenacious, so that it can be molded into forms by the hands. When dry this well-decomposed Peat somewhat resembles black carbonaceous clay. In regions of sandy soil the underlying material is usually of a sandy nature, and in regions where heavy upland soil occurs the underlying material is heavy in character. Fully 90 per cent of the Peat in this survey is underlain by material as heavy as a loam or heavier.

Peat areas are most extensive in the vicinity of Powers, Camp, Lily, and George Lakes, southeast of Wheatland, north of Brighton, east of Paris, along the State line, in the towns of Salem and Brighton, northeast of Burlington, southeast of Caldwell, and around Wind Lake. Small beds are scattered throughout the remainder of the area, but are most numerous in the western part.

In the morainic western part of the area the beds occupy old lake basins, ponded valleys, kettle basins, glacial sloughs, and other de-

pressions in the uneven surface developed by the glacial ice. Along the Fox and Desplaines Rivers and tributaries the beds occur mainly in the flood plains.

The Peat areas are low, level, and very poorly drained. During each spring the marshes and swamps occupied by the soil are entirely covered with water, but during the summer many of the tracts are sufficiently dry and firm to bear the weight of farm animals, so that they can be pastured, or where there is a growth of wild grasses these can be cut for hay.

The Peat has been formed through the rank growth of vegetation and its partial decay in the presence of water. The black or dark-colored material is formed largely from the remains of grasses and sedges, and that having a brown color chiefly from sphagnum moss. About the margin of the larger marshes and over the greater part of the smaller ones varying quantities of soil from the adjoining higher land has been washed in and incorporated with the vegetable matter. Although the Peat beds of this area occur within a region where the upland soils are made up in part of limestone material, some of it is in an acid condition. This is usually the case in the center of the large marshes; many of the smaller ones are not acid.

The native vegetation on the Peat consists of several varieties of grasses, sedges, arrowhead, cat-tail, various reeds, rushes, and sphagnum moss. Tamarack in these two counties is comparatively rare, though some of the marshes supported this tree. Alder and willow also are present in places.

Only a small proportion of the Peat of this area has been ditched and reclaimed. Where thoroughly drained, well fertilized, and properly handled such beds in other regions produce good yields of corn, potatoes, onions, celery, sugar beets, cabbage, and peppermint. Potatoes grown on Peat are not as good as those grown on sandy soils, and small grains are likely to lodge and to be of somewhat lower grade than where grown on upland soils.

Peat is very rich in nitrogen and the best practice is to use commercial fertilizers in preference to stable manure, which can be used to better advantage on the upland soils. The application of stable manure for a year or two on newly reclaimed areas is, however, very helpful in promoting decomposition of the fibrous material and converting unavailable nitrogen into an available form. Peat runs very low both in phosphorus and potassium. It has been found advantageous to apply at first 1,000 pounds of finely ground rock phosphate, followed by 400 or 600 pounds every three or four years thereafter. Acid phosphate may be used and will give more immediate returns. For sugar beets or cabbage 250 or 300 pounds of either muriate or sulphate of potash should be applied per acre, for corn

and for potatoes about 150 pounds, and for cereals and grasses about 100 pounds per acre. Before any of this land can be cultivated it is of course necessary to drain it thoroughly. The development of this class of land is a big problem in these two counties, as well as through much of Wisconsin, and it is one which should be given much more serious consideration. Land values are becoming so high that it is poor economy to allow extensive areas of land to remain unproductive, when there is a possibility of their being made to produce nearly as well as the upland soils.

Peat, shallow phase.—The shallow phase of Peat is essentially the same as the typical soil except in depth, which is only from 10 to 18 inches instead of several feet.

Areas of this phase are small, but occur in practically all the towns of Racine and Kenosha Counties. They occur around the margin of all the marshes, but usually are so narrow that they can not be indicated on the map. There are, however, many areas that consist entirely of the shallow phase.

In topography, drainage, character of vegetation and origin, this phase is similar to typical Peat. The methods of improvement and the fertilizer requirements for the first few years after reclamation from the undrained state would be the same as for typical Peat, but the material underlying the organic soil is heavy, and where the roots of plants will reach this in their growth the need for potash and phosphate fertilizers is less. When drained the material settles and with but 18 inches or less to begin with, this layer will in time be sufficiently thin to allow the plow to turn up some of the underlying material. Mixing this with the organic layer will greatly increase the value of the land for production and to some extent do away with the need for fertilization.

MUCK.

The material mapped as Muck consists of partly decomposed vegetable matter with which there has been incorporated a considerable quantity of mineral matter. The most common occurrence in the present area is where from 1 to 5 inches of silty material has been deposited over beds of Peat. Other areas consist of Peat beds that have been drained for a long time, with further decomposition of the fibrous organic matter and a concentration of the mineral constituents sufficient to produce Muck. In other places there is a mixture of a marly substance and Peat throughout the 3-foot section.

Only a small total area of Muck occurs in the survey. Small scattered areas are mapped in all towns bordering Walworth County, and the soil also lies along the bottom lands of the Desplaines River. The areas are low lying and have a level surface, and are naturally poorly drained.

None of the Muck is under cultivation at the present time, but it is used for pasture and for the production of marsh hay. In places there is a growth of willow, aspen, sumac, ash, soft maple, and elm.

When drainage is established this soil will be well suited to the production of a number of crops. It may be considered somewhat better than Peat land, because it is more thoroughly decomposed and also because it contains more mineral matter and hence larger quantities of the mineral plant food elements.

SUMMARY.

This area comprising Racine and Kenosha Counties is located in the southeastern part of Wisconsin. It has an area of 606 square miles, or 387,840 acres.

The topography ranges from flat to level or gently undulating, as in the prairie terraces and outwash plains, to broken, as in the kame, kettle-basin, and terminal moraine country. The eastern part of the area drains into Lake Michigan and the rest, through the Fox and Desplaines Rivers, into the Illinois River.

Racine County was established in 1836 and Kenosha County was cut off from it in 1850. Settlement began in 1834. The population of the two counties is given in the 1920 census as 130,245, of which 27,554 is classed as rural. The two largest cities, Kenosha and Racine, have populations of 40,472 and 58,953, respectively. They are well provided with railroads and public highways. All sections are well settled; the average density of the rural population is 45 persons to the square mile.

The climatic conditions are favorable for the development of general farming and dairying. The mean annual temperature as reported at Racine is 47.4° F., and the mean annual precipitation is 29.65 inches. There is a normal growing season of approximately 170 days free from killing frosts.

The agriculture consists of general farming combined with dairying. A considerable trucking industry has developed in the vicinity of Racine and Kenosha. The common farm crops are corn, oats, barley, clover, timothy, alfalfa, rye, and buckwheat. In addition a number of special crops are grown, including cabbage, sugar beets, potatoes, and onions.

The sale of dairy products in 1919 amounted to nearly $3,000,000. In addition to dairying, the raising of hogs, the feeding of beef cattle, and feeding of sheep in the western part of the area are all more or less important.

Land values range from $30 an acre in the sandy and more broken areas to $300 an acre in the sections having the better soils and most highly improved farms.

The soils of the area are derived from glacial drift, water-laid materials, and cumulose deposits. Thirteen distinct soil series, 28 soil types, and 12 soil phases, exclusive of Peat, Muck, and Dune-sand are recognized and mapped in this area.

The Bellefontaine series occurs in the western part of the area. The material composing the soils of this series consists largely of glacial débris deposited in the form of moraines, kames, and eskers. The series as a whole is very well drained. The silt loam is rather extensive, and is the leading alfalfa soil of the area. Other general farm crops do well on this soil. The loam and fine sandy loam give fairly good yields of corn, alfalfa, oats, and barley.

The Rodman series includes light-colored forested glaciated limestone soils occurring chiefly in the form of kames, eskers, and terrace escarpments. The Rodman gravelly loam is best suited to the growing of alfalfa or to grazing. The areas as a whole are extremely rough and broken and there is but little of this type under cultivation.

The Miami series consists of light-colored forested glaciated soils carrying some limestone material. The silt loam and silty clay loam occur in large areas and are well adapted to all farm crops common to the region.

The Fox series consists of light-colored forested soils mainly in the glaciated limestone regions. They are derived from outwash plain, stream terrace, or lake terrace deposits. The silt loam and loam are well adapted to the production of the general farm crops. The gray sandy phase of the silt loam is well suited to truck farming.

The Belmore soils occupy the old beaches of Lake Michigan. They are used almost entirely in the production of truck crops.

The Plainfield series consists of light-colored terrace soils. With heavy applications of fertilizer they can be used successfully in the production of truck crops.

The Superior soils occur in only a few small areas, all in Caledonia Town. These soils are all well adapted to general farming.

The soils of the Carrington series include dark-colored upland prairie glaciated limestone material. The silty clay loam and silt loam are extensively developed and constitute some of the best agricultural soils of the State.

The Waukesha series comprises the dark-colored prairie soils derived from reworked glacial material deposited as outwash plains or terraces. The silt loam constitutes some of the best agricultural land in the area. Corn, oats, wheat, sugar beets, and cabbage do very well on this soil. The loam and fine sandy loam are used for general farming and also for trucking. The fine sand is used only for trucking.

The Newton series is confined to the Lake Michigan Terrace. The silt loam and clay loam rank among the best soils of the area and are

used for trucking, combined with light general farming. The loam is very well suited to onions, while the loamy fine sand with proper fertilization gives moderate yields of most of the truck crops commonly grown here.

The Clyde soils are dark-colored glacial till soils occurring in shallow basins and poorly drained depressions. When drained, the silt loam and silty clay loam are the best till soils for corn, sugar beets, and cabbage in the area.

The Maumee series includes dark-colored soils that have developed from water-laid material within the glaciated limestone region, under conditions of poor drainage. The silt loam and silty clay loam are extensively developed in this area, and when properly drained are among the best corn, sugar beet, and cabbage soils of the region. But little of the fine sandy loam is under cultivation.

The Genesee series includes soils derived from the lighter colored materials occupying the flood plains of streams. In the present survey only the silt loam is mapped. It covers a very small area and is used only for pasture.

Peat consists of vegetable matter in various stages of decomposition, mingled with varying proportions of mineral matter. On well-drained, well-fertilized, and properly cultivated areas good yields of corn, timothy and alsike clover (mixed), oats, potatoes, onions, sugar beets, and cabbage have been obtained.

Muck is partially decomposed vegetable matter with which there has been incorporated a considerable amount of mineral matter. It contains more mineral matter than Peat and the organic matter is in a more advanced stage of decay. Muck is a somewhat better soil than Peat. Most crops common to the region can be successfully grown on areas of reclaimed Muck.

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