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UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF CHEMISTRY AND SOILS
In Cooperation with the Wisconsin Geological and Natural History Survey
and the University of Wisconsin College of Agriculture

SOIL SURVEY
OF
MONROE COUNTY, WISCONSIN

BY
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and Natural History Survey

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COUNTY SURVEYED

Monroe County is a little south of the west-central part of Wisconsin. Its area is about 924 square miles or 591,360 acres. Sparta, the county seat, is 108 miles northwest of Madison and 178 miles from Milwaukee.

Physiographically, Monroe County consists of three parts. The southern part, including a little less than half the total area of the county, consists of a dissected plateau in which remnants of the original plateau surface still exist as flat watershed ridges attaining a maximum width, on the main watershed, of somewhat more than a mile.

FIG. 43.—Sketch map showing location of Monroe County, Wis.

The elevation of these remnants ranges from about 1,300 to about 1,440 feet above sea level. The county, except on these remnants, has been so thoroughly dissected that it consists mainly of valley slopes, steep immediately below the plateau level and becoming gradually less steep down the slopes. The upper slopes are steep enough to justify mapping them as non-agricultural land. The main area of the plateau is fringed on the northeast, north, and northwest by a hilly belt, in places as much as 6 miles in width, which is very similar to the hilly country along the streams within the plateau.

The northwestern quarter of the county can best be described as moderately hilly. It is made up of broad, gently rolling or rolling valley plains, bordering each of which is a fringe of hills. This region was originally very similar in character to the southern part of the county, but it has suffered much more from erosion. Not only have all recognizable remnants of the original surface of the plateau disappeared, but the watersheds between the creek valleys have been reduced to narrow ridges. The slopes of these ridges have retained the general character of the valley slopes in the southern part of the county. They are all steep near the top. They have become so narrow that there is no level land between the steep slopes facing two adjacent valleys. Each valley consists of a comparatively broad, rolling plain, wide in its lower part, becoming narrower toward the head of the valley, and finally ending in a more or less open cove inclosed, except on the downstream side, by a

steep-sloped ridge. La Crosse River occupies a wide valley lowland running southwestward across this part of the county.

The northeastern part of the county consists of an undulating plain with an occasional isolated hill rising from its floor, especially in the northwestern part of its area. These hills, sometimes consisting of ridges, are remnants of the plateau which once extended over this area.

The first settlement in what is now Monroe County was made about 2 miles north of the present site of Oil City on Kickapoo River, in 1842. In 1850 a settlement was made at Castle Rock, near Sparta, and following this date numerous settlements were made in various parts of the county. Between 1849 and 1851 a new road was opened from Hudson to Prairie du Chien, passing through the county near Sparta. Another road was opened from Portage to La Crosse. These roads greatly aided early settlement. In 1854, La Crosse, Buffalo, and Monroe Counties were formed from La Crosse County. In 1859 the Chicago, Milwaukee & St. Paul Railway from La Crosse to Milwaukee was completed, and in 1873 the Chicago & North Western Railway through the county was finished.

In 1920 the population of the county was 28,666. Of these 3,076 were foreign-born white. Sparta is the county seat and largest city in the county. It is an important distributing center for a good agricultural region and is a railroad center of considerable importance. Other towns within the county are Tomah, Cashton, Wilton, Kendall, Summit, Norwalk, Leon, Melvina, Warrens, Wyeville, and Valley Junction.

Two railway systems serve Monroe County. The main line and branches of the Chicago & North Western Railway and of the Chicago, Milwaukee & St. Paul Railway cross the county in several directions. The northwestern corner of the county, which is not highly developed, is the most remote from railways.

Several State trunk highways cross the county and are supplemented by a number of county trunk highways, all of which are kept in good repair at all times. Where the soils are heavy, as is the case in the southern part of the county, the ordinary dirt roads are usually in fairly good condition. Many of these are graded but are not kept in such good repair as the county and State trunk highways. In the sandy areas of the county, the roads are very sandy in many places. Where shale is available, it is used with good results as road-building material.

The towns within the county afford markets and shipping points for farm produce, only a small proportion of which is consumed within the county. Wyeville is 226.4 miles distant from Chicago, 182.1 miles from Minneapolis, 153.9 miles from Milwaukee, and 48.9 miles from La Crosse, all by way of the Chicago & North Western lines. Considerable farm produce is sold through cooperative associations.

CLIMATE

The climate of the northeastern part of Monroe County is typical of a large area in central Wisconsin. This region is rather low, sandy, and marshy and has been described in a bulletin of the Wisconsin station on the climate of Wisconsin and its relation to agri-

culture, as the Wisconsin River Basin. This region appears to be slightly cooler than the Mississippi Valley to the west or the Michigan shore to the east, being cooler than the former in summer and colder than the latter in winter. The frost-free season is somewhat shorter, owing probably to the altitude and the sandy and marshy condition of much of the land. Mauston, which is the county seat of Juneau County, to the east, has an average season of 146 days between killing frosts, as compared with 164 days at La Crosse, to the west, 160 at Oshkosh, and 179 at Sheboygan, on the east side of the State. The high lands in the southern part of the county and the hilly areas of the northern part have an elevation ranging from 200 to more than 400 feet greater than that of the low, sandy plains and marshes of the northeastern part, and the frost-free season is somewhat longer.

The appended tables give the normal monthly, seasonal, and annual temperature and precipitation at Mather, Juneau County, and at Valley Junction. The country surrounding these stations is generally level, and no bodies of water are near by. The soil is, for the most part, sandy. It will be seen that the records are similar. The average annual temperature at Mather is 42° F., and the average yearly precipitation is 33.2 inches. At Valley Junction the average yearly precipitation is 34.21 inches. The average snowfall at both stations is a little more than 40 inches. The rainfall is so distributed that the greater part of it comes during the growing season when it is most needed, but although this is true, in many years, during the latter part of summer, crops suffer from lack of moisture, especially on the lighter-textured soils which predominate in the northern half of the county.

The average date of the last killing frost at Mather is May 16 and at Valley Junction is May 14. The average date of the first killing frost at Mather is September 17 and at Valley Junction is September 18. This gives an average frost-free season at Mather of 124 days and at Valley Junction of 123 days. The frost-free season at these stations is somewhat shorter than that given for the Wisconsin River Basin as a whole, and is probably 10 days shorter than in the southwestern part of the county.

Normal monthly, seasonal, and annual temperature and precipitation at Mather, Juneau County

[Elevation, 962 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1921)	Total amount for the wettest year (1905)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	18.6	55	−28	1.25	1.41	1.26	7.4
January	12.1	49	−37	1.32	.40	.94	12.2
February	13.2	50	−39	1.19	.45	1.70	9.7
Winter	14.6	55	−39	3.76	2.26	3.90	29.3

Normal monthly, seasonal, and annual temperature and precipitation at Mather, Juneau County—Continued

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1921)	Total amount for the wettest year (1905)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
March	28.5	83	−31	1.72	.88	1.67	6.2
April	43.0	86	10	2.48	2.90	1.35	2.3
May	54.0	92	16	4.81	3.45	6.65	Trace.
Spring	41.8	92	−31	9.01	7.23	9.67	8.5
June	63.8	101	30	4.55	1.85	6.08	0
July	67.9	100	37	3.84	2.26	4.69	0
August	65.3	98	29	3.60	1.78	5.67	0
Summer	65.7	101	29	11.99	5.89	16.44	0
September	58.3	94	19	3.83	3.19	3.85	0
October	46.2	85	12	2.60	1.39	3.18	1.3
November	33.2	68	−4	2.01	1.24	2.64	5.0
Fall	45.9	94	−4	8.44	5.82	9.67	6.3
Year	42.0	101	−39	33.20	21.20	39.68	44.1

Normal monthly, seasonal, and annual temperature and precipitation at Valley Junction

[Elevation, 930 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1895)	Total amount for the wettest year (1911)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	19.8	57	−32	1.23	1.30	1.85	8.4
January	14.5	59	−37	1.05	.85	.87	8.4
February	15.3	61	−44	1.14	.56	1.34	9.8
Winter	16.5	61	−44	3.42	2.71	4.06	26.6
March	29.6	83	−22	1.86	.38	1.80	7.3
April	45.4	88	2	2.92	1.57	3.09	3.2
May	56.8	95	19	5.24	3.87	8.10	.6
Spring	43.9	95	−22	10.02	5.82	12.99	11.1
June	65.3	101	26	4.03	2.59	8.58	0
July	69.5	101	37	4.37	1.75	4.29	0
August	67.0	100	26	3.67	4.31	4.47	0
Summer	67.3	101	26	12.07	8.65	17.34	0
September	60.0	99	14	4.06	2.48	8.26	0
October	48.5	87	1	2.91	.15	9.19	.3
November	33.1	74	−17	1.73	1.36	2.26	3.8
Fall	47.2	99	−17	8.70	3.99	19.71	4.1
Year	43.7	101	−44	34.21	21.17	54.10	41.8

AGRICULTURE

Among the most important farming industries in Monroe County may be mentioned grain growing, general or mixed farming, dairying, tobacco growing, cranberry growing, the growing of small fruits and berries such as strawberries, raspberries, and blackberries, apple culture, and to some extent the growing of cherries, plums, pears, and other fruits. Grain growing is at present the chief type of agriculture but is combined with dairying and general farming on most farms. Grain growing for the market is declining, whereas the dairy industry has been gradually increasing for a number of years. In 1869 the yield of wheat amounted to nearly half a million bushels, whereas in 1909 it was only 57,581 bushels. In 1919 the total yield was double this quantity, partly because of the war-time stimulation of production. At present, general farming and dairying are practiced in all parts of the county. Dairying is probably most highly developed where silos are most numerous, and this is in the township of Sparta where there are 181 silos. The number of silos in other townships is as follows: La Grange, 106; Tomah, 102; Wellington, 97; Glendale, 96; Wilton, 95; and Ridgeville, 92. Silos are least numerous in Scott, Grant, and Greenfield Townships. Dairying is most highly developed on heavy soils, and such soils predominate over the county, except in the northwestern corner, along the north border, and in the northeastern part. In these sections sandy soils or sand and marshy tracts are rather extensive. The heavy soils are better adapted to dairying than to grain growing for several reasons, chief among which is that all the land can be better utilized for the dairy industry. When grain growing is practiced exclusively, it is impossible to fully utilize the steep, rocky slopes, but when dairying is followed these slopes are used for grazing. Thus the smooth land and more gentle slopes may be used for growing winter feed for livestock, and pasture, which is a very important item to dairymen, is provided by land which, in an exclusively grain-growing program, would not be utilized. Another feature favoring dairying in this region is that steep slopes may be kept more permanently in grass, thus preventing erosion.

Tobacco culture is another distinct type of farming which is practiced in conjunction with general farming and dairying, though there are some small acreages devoted almost exclusively to this crop. Most of the tobacco is grown in the townships of Portland, Leon, Jefferson, and Sparta, in the southwestern part of the county.

The trucking industry is most highly developed in the vicinity of Sparta and Warrens, where strawberries and bush berries are grown on a commercial scale.

Apple growing is well distributed and many farms have home orchards. The greatest development of orcharding is probably in the vicinity of Sparta and in the southwestern part of the county.

Cranberry growing, an industry of long standing, is carried on exclusively on the marshes in the northeastern part of the county.

Centers of farming have started on areas of better soil and around a few small towns, and considerable tracts of land are still covered with brush and are unimproved. This is the result largely of the poor quality of the soil or of poor drainage, sometimes of both. The

main crops in the region of heavy soils, where agriculture is most highly developed, are small grains, corn, and hay. All of these are used largely for feeding cattle. The cash crops consist of tobacco, potatoes, wheat, oats, and barley. In the region of sandy and marshy soils, livestock farming does not succeed so well because of the inferior pasturage produced. Clearings are small on many farms, only a few head of livestock are kept, and a little oats, rye, and corn are grown. Many farm families supplement their income by gathering wild blueberries, by picking berries in the trucking region and on cranberry marshes, and by cutting wild hay from marshy land.

A study has been made of the 1922 report of all of the assessors from Monroe County, and from this report, largely, the following acreages and comparative importance of the various crops have been taken. This information has been correlated with the data collected by the soil survey party.

The three most important crops in the county, in the order of their importance, are hay, oats, and corn. In 1922, 58,887 acres were devoted to clover and timothy. This crop is grown to some extent in all parts of the county, but the largest acreages are in the townships of Sparta, Glendale, and Lafayette. The soil of Glendale Township is mostly loam, but in the other two townships mentioned heavy soils and a considerable area of sands and sandy loams are present. The townships producing the least timothy and clover are Scott, New Lyme, and Angelo.

Oats were grown on 51,358 acres, well distributed over the county. The largest acreages are in the townships of Sparta, Ridgeville, Portland, and Jefferson, each of which has more than 3,100 acres in oats. The townships of Scott, New Lyme, and Grant, in which sandy soils predominate and in which there is considerable unimproved land, have the lowest acreages.

Corn is grown in all parts of the county and on a great variety of soils. The total acreage in 1922 was 35,212 acres. The townships of Sparta, Little Falls, and La Grange lead in acreage devoted to this crop. Scott, Grant, and New Lyme Townships have the lowest acreage.

Barley was grown on 6,349 acres, chiefly in the townships of Ridgeville, Portland, and Sparta. The lowest acreages are in the townships of Scott, Byron, and New Lyme.

Rye was grown on 5,225 acres with Sparta, Grant, and Byron Townships leading, and Scott, Lincoln, Lafayette, Adrian, and La Grange Townships having the smallest acreage. Rye does better on sandy soils than do other small grains, and in some townships having fairly heavy soils no rye is reported.

Winter wheat was grown on 984 acres, with the townships of Wellington, Glendale, and Jefferson leading and with five or six townships, including Adrian, Lafayette, La Grange, New Lyme, and Scott, reporting no wheat grown.

Spring wheat was grown on 1,450 acres, with the townships of Clifton, Oakdale, and Portland leading and those of Adrian and Lafayette reporting no wheat grown.

Potatoes were grown on 2,660 acres, with Glendale, Oakdale, Byron, and Clifton Townships leading in acreage and Scott, Angelo,

and Leon having the least acreage. Potatoes give the best yields on sandy loam soils but are grown on a great variety of soils.

Buckwheat was grown on 525 acres, chiefly on new lands and on much recently reclaimed marshland. The townships of Byron, Grant, Oakdale, and Scott lead in acreage, and at least six townships reported no buckwheat grown.

Tobacco was grown on 799 acres, with the townships of Portland, Leon, Jefferson, and Sparta leading. Eleven townships reported no tobacco grown.

Peas for canning were grown on 100 acres, 95 acres of which were in Leon Township.

Soy beans were reported on 332 acres, with the townships of Byron, Lincoln, Little Falls, Grant, and Sparta leading. Several townships reported no land in soy beans. This is one of the important crops for building up sandy lands, and the acreage on such soil is gradually increasing.

Cabbage was grown on 17 acres, all in the township of Byron. Most of this crop was grown on drained marshland.

In 1922 only 268 acres of alfalfa were reported, but the acreage of this crop is rapidly increasing and a large number of farmers are giving alfalfa a trial on a few acres. The townships leading in alfalfa acreage were Leon, Sparta, and Wells; five townships reported no alfalfa grown during 1922. In 1919 onions were grown on 30 acres, chiefly in the northeastern part of the county on reclaimed marshlands.

Farm tractors are in use in most parts of the county. The 1922 report shows 228 in the county.

The production of small fruits and truck crops is an important industry in Monroe County. As reported by the 1920 census, cranberries, which in 1919 were grown on 230 acres, produced 268,435 quarts. These were grown exclusively on the marshes in the northeastern part of the county. Raspberries were grown on 28 acres and produced 18,787 quarts. Strawberries were grown on 201 acres and yielded 660,204 quarts. Raspberries, strawberries, and similar small fruits are grown mainly in the vicinity of Warrens and Sparta. In 1919 there were 16,409 apple trees not of bearing age and 46,137 trees of bearing age in the county. The total yield of apples in 1919 amounted to 33,261 bushels. Some plums are grown. In 1919 there were 933 trees too young to bear fruit and 2,566 trees of bearing age which produced 156 bushels. Cherries are also grown to a small extent, there being 715 trees too young to bear fruit and 1,407 bearing trees which yielded 165 bushels. Some grapes are grown, there being 169 young vines and 1,909 bearing vines which produced 3,844 pounds of grapes. Most of the apples are grown about Sparta and in the country around Kickapoo Valley. The fruit and trucking industry gives promise of being extended to considerably larger proportions since the region is well suited to this phase of agriculture.

According to statistics of the Wisconsin Department of Agriculture, there were 33,459 cows in the county in 1920. These produced more than 1½ million hundredweight of milk, with a value of $4,072,964. The average production for each cow was 4,578 pounds, and this had a value on the farm of $121.73 a cow. In 1919 there were 1,190 silos in the county, in 1920 there were 1,375, and by 1922

this number had increased to 1,664. In 1920 it was reported that 48 per cent of the corn crop was harvested for silage, with an average of 98 tons to the silo. In 1920, 17 butter factories, 3 cheese factories, and 2 milk condenseries were located in the county. The value of the butter produced was nearly $2,500,000. The report covering pure-bred cattle shows that there were then 1,058 purebred cows and heifers in the county. It will be seen from the data given that most of the cattle are of grade or mixed breeding. Most of them can be classed as well-bred grade stock.

Along with the dairy industry hog raising has grown to considerable proportions. In 1920 there were 36,866 head of swine in Monroe County. A considerable proportion of skimmed milk, buttermilk, and whey is fed to hogs. On account of the large production of butter, a good supply of skim milk is available for feeding hogs.

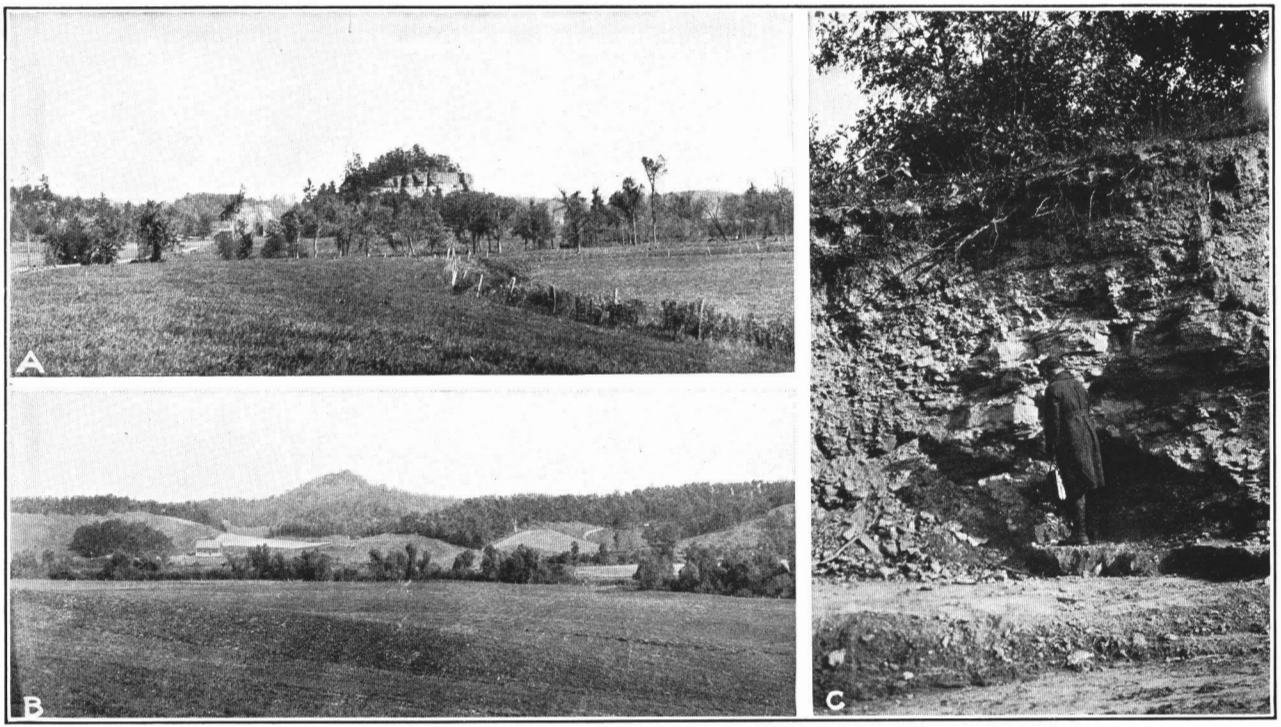
Much of the large acreage of steep land in the county may best be utilized for grazing. On steep land the raising of sheep is an important industry, although it is not so extensively engaged in as might be expected. The total number of sheep on the farms, according to the report of 1920, was 15,058.

In 1920, 12,546 head of horses were reported in the county. These furnish most of the power for carrying on farm work, although the number of tractors is gradually increasing. No farms are devoted exclusively to horse raising, but colts are raised on many farms, and some farmers keep up their own supply of work animals and frequently have a team to sell.

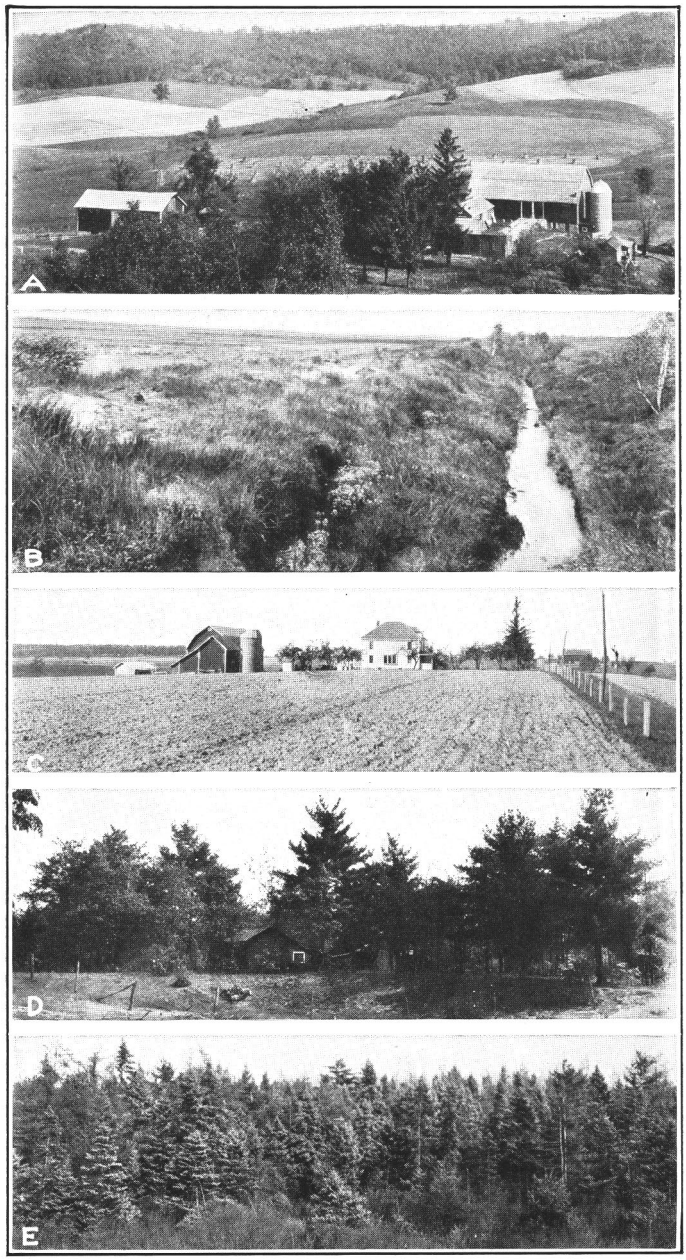
In 1920 there were 3,519 farms, with an average size of 133.1 acres, in Monroe County. The land area of the county is 591,360 acres, of which 468,553 acres or 78.1 per cent is actually in farms. Only 49.3 per cent of the land in farms is improved. This makes an average of 65.7 acres of improved land to the farm. The land in farms has an average acre value of $54.25, and the average value of all farm property to the farm is $12,504. The total value of livestock on farms was reported as $5,731,964. Of the farms in the county, 81.5 per cent are operated by the owners, 17.6 per cent by tenants, and only 30 farms by managers. Of the farms operated by tenants, 436 are on a share basis, 173 are on a cash basis, 2 are on a share-cash basis, and 9 did not report. Of all farms operated by owners, there are 1,586 which reported a mortgage debt, 992 reported no mortgage debt, and nearly 300 did not report. On these owned farms reporting a mortgage debt, the total debt amounted to $6,027,466, representing 40.8 per cent of the value of the farm properties covered by the indebtedness. The average rate of interest paid on the mortgage debt was 5.3 per cent.

According to the United States census report of 1920, 2,111 farms in the county reported an expenditure for labor of $706,501 in 1919. This is an average of $334.68 for each farm reporting. Of this total amount, more than a half million dollars was paid in actual cash.

Reports for 1919 show that 116 farmers bought fertilizers for which they paid $12,383. Two thousand fifty-one farms reported the purchase of feed at a total expenditure of $305,587. A large part of this feed bill could be saved by growing such a crop as alfalfa,



A.—Limestone capping sandstone butte rising above a sandy plain
B.—Boone silt loam landscape. Rough stony land in the background
C.—Profile of Boone silt loam, showing especially the bedrock of shale and fine-grained sandstone which underlies this soil at a slight depth



A.—Typical Boone silt loam landscape
B.—A typical Dunning sand landscape
C.—Farmstead on Dubuque silt loam. This well-kept farmstead reflects the fertility of the soil plus good farm management
D.—Farmstead on Sparta fine sand. This is a typical Wisconsin sand farm
E.—Native vegetation on peat. This type of tree growth, mostly black spruce, is typical of much of the deep fibrous peat in the county

which has a feeding value about equal to that of wheat bran. The use of more alfalfa in the feeding ration would do away with the necessity of so much high-priced concentrates.

SOILS

The well-drained soils of Monroe County are dominantly light colored, that is, the color of the plowed soil is grayish brown. Small areas of well-drained soil are much darker colored, and larger areas of poorly drained land are nearly black.

Soil textures are extremely diversified, ranging from heavy silt loam to deep dry sand. The sandy soils cover large areas in the northern part of the county. The dry sand plains here are broken by numerous peat bogs bordered by dark-colored, wet, sandy soils. Much of the county is hilly, and there is a considerable total area of rough broken and stony land and steep phases of various soil types.

Monroe County is entirely within the unglaciated part of Wisconsin, and the soils are, for the most part, derived from hard rock formations. Over a large part of the south half of the county the lower magnesian limestone forms the uppermost rock formation and caps all of the highest elevations. (Pl. 48, A.) It is most extensive in the townships of Portland, Jefferson, and Ridgeville, and there are considerable areas in the townships of Wilton, Wellington, Clifton, Glendale, Wells, and Leon. In the north half of the county a few deposits of the lower magnesian limestone cap some of the highest hills, but the total deposit is small. Immediately below the limestone, where it occurs, and forming the uppermost rock where it is not present, is Potsdam sandstone. This predominates as the surface rock in the north half of the county.

The soils of the county have been derived largely from these two formations. It is probable that some of the fine silty material found in the county is of loessial origin, but the covering is thin, and in some places it is difficult to determine whether the material is a loessial deposit or a residue of rock weathered in place. Associated with Potsdam sandstone, in places, is a shaly formation and some of the silty material of the county may have been derived from this source.

In the soil survey of Monroe County the mineral soils have been classified in 13 soil series; the organic soils are mapped as peat, and hilly, nonarable areas are called rough stony land. The soil series are described here briefly. Following this general discussion of the soil series will be found descriptions of all of the soil types.

Soils of the Clinton series, where typically developed, are characterized by an extremely silty, smooth, friable, topsoil of a grayish-brown color and by a subsoil of yellowish material of silty clay loam texture, underlain by lighter-textured, more friable silty material. This in most places rests on limestone or residual material from the limestone, although in places it overlies the sandstone and shale. Clinton silt loam is mapped in this county.

The Tama soils comprise dark-colored upland prairie soils in which the parent material is largely of loessial origin. These soils have the same relation to the underlying rock as have those of the Clinton series. Tama silt loam is mapped in Monroe County.

The Dubuque series includes light-colored upland soils which in the topsoils and upper part of the subsoils are similar to the Clinton soils, but in which the lower part of the subsoils or the substrata are reddish or yellowish-brown clay, underlain by limestone. These soils occur on much of the highest land in the county. Dubuque silt loam, with a steep phase, is mapped.

The Bertrand series includes light-colored soils with silty or clayey substrata. These soils occur on stream terraces or bench lands along the streams. Bertrand silt loam, with a mottled-subsoil phase, is mapped in this county.

The La Crosse soils are similar to the Bertrand except that the substrata consist of sand or fine sand. La Crosse loam, with a dark-colored phase, La Crosse fine sandy loam, and La Crosse sandy loam, with a dark-colored phase, are mapped.

The Boone soils are light colored and were derived from the weathering of Potsdam sandstone and shale associated with this formation. The sand, with a level phase and a steep phase, the fine sand, with a level phase and a steep phase, the sandy loam, with a steep phase, the fine sandy loam, with a steep phase, the loam with a steep phase, and the silt loam, with a steep phase, members of the Boone series were mapped.

The Sparta series includes light-colored forested soils in which the material is of alluvial origin, having been deposited in the form of bench lands, stream terraces, or valley fill. The soils mapped as belonging to this series are Sparta sand and Sparta fine sand.

The Waukesha soils comprise the dark-colored soils in which the material is of alluvial origin but is above present flood flow. The materials have been deposited in the form of valley fill, terraces, and bench lands. The only member of this series mapped in Monroe County is the silt loam.

The Superior soils are derived from material which has been deposited in lake beds in quiet waters. The soils are light colored and all developed under a forest cover. A characteristic feature of all members of the series is the heavy red clay subsoil. The soils mapped are Superior sandy loam and Superior silt loam.

The Poygan soils are similar to the Superior except that the areas are lower and are poorly drained, and that there is a large supply of organic matter in the surface soil, giving it a dark color. Most of the Poygan soils have the characteristic red subsoil. Poygan fine sandy loam and Poygan silt loam are mapped in this county.

The Wabash soils comprise dark-colored bottom lands subject to overflow. Wabash silt loam is mapped.

The soils of the Genesee series are similar to those of the Wabash in origin but include the lighter colored first-bottom lands which are subject to overflow. The Genesee soils mapped in Monroe County are the fine sand, fine sandy loam, loam, silt loam, and silty clay loam.

The Dunning soils comprise marsh border soils and represent a gradation from the light-colored upland soils to the typical peat soils. Areas are low lying, level, poorly drained, and dark colored. The soils have been formed partly by the action of water and are in part residual soils which have been influenced to varying

degrees by the action of water. The members of this series mapped are the sand, fine sandy loam, and silt loam.

In addition to the above soils, there are in the county extensive peat marshes in which the soil is composed of decaying vegetable matter with which have been mixed varying quantities of mineral matter and fine earth. Peat, with a shallow phase, less than 18 inches deep, is mapped. The underlying mineral material is for the most part sandy, but it varies to a considerable degree, depending on the character of the surrounding upland soils.

Rough stony land includes steep or rocky slopes which are unfit for cultivation but which may be utilized to some extent for grazing. Many of the steep slopes are composed almost entirely of rock outcrop. Some of this land, where there is sufficient soil to allow the growth of trees, could be reforested to advantage.

In the following pages of this report the soils of Monroe County are described in detail and their relation to agriculture is discussed; their distribution is shown on the accompanying soil map; and their acreage and proportionate extent are shown in the following table:

Acreage and proportionate extent of the soils mapped in Monroe County

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Boone silt loam	37,312	13.5	La Crosse loam	4,480	0.9
Steep phase	42,304		Dark-colored phase	960	
Boone loam	12,864	5.5	La Crosse fine sandy loam	5,376	.9
Steep phase	19,776		Sparta fine sand	25,984	4.4
Boone fine sandy loam	22,720	5.2	Sparta sand	10,560	1.8
Steep phase	8,192		Genesee silt loam	20,160	3.4
Boone sandy loam	4,672	.9	Genesee loam	6,400	1.1
Steep phase	192		Genesee silty clay loam	576	.1
Boone fine sand	64,384	14.9	Genesee fine sandy loam	2,624	.4
Level phase	16,704		Genesee fine sand	1,152	.2
Steep phase	7,296		Dunning fine sandy loam	14,592	2.5
Boone sand	1,984	.6	Dunning sand	11,456	1.9
Level phase	1,280		Dunning silt loam	3,520	.6
Steep phase	64		Poygan fine sandy loam	4,032	.7
Dubuque silt loam	52,480	10.8	Poygan silt loam	1,536	.2
Steep phase	11,008		Superior sandy loam	1,728	.3
Tama silt loam	1,024	.2	Superior silt loam	128	.1
Waukesha silt loam	4,800	.8	Peat	28,032	6.0
Bertrand silt loam	9,344	1.7	Shallow phase	7,808	
Mottled-subsoil phase	640		Rough stony land	98,368	16.6
Clinton silt loam	11,648	2.0			
Wabash silt loam	7,360	1.2	Total	591,360	
La Crosse sandy loam	3,200	.6			
Dark-colored phase	640				

BOONE SILT LOAM

Where cultivated Boone silt loam is light-brown or light yellowish-brown smooth silt loam to a depth of 8 or 10 inches. In many places it contains a rather high proportion of very fine sand. In the virgin state, considerable organic matter is incorporated in the upper layer, to a depth of 1 or 2 inches. When dry, the soil is grayish brown. It is composed of uniform particles, contains very little gritty material, and has a soft, floury feel. The topsoil grades to less friable yellowish-brown heavy silt loam or silty clay loam. This layer, at an average depth of 16 or 18 inches, grades in most places to yellow or brownish-yellow friable silty clay containing very faint grayish

mottles or streaks and occasional specks of limonite yellow. At a depth ranging from 18 to 36 inches, the subsoil grades to gray fine sandy shale containing layers of green glauconitic sandstone. In most places the shale is underlain by disintegrated sandstone. (Pl. 48, C.) In some areas mapped with Boone silt loam the depth to disintegrated rock is 5 or 6 feet. On the lower parts of the slopes the soil may be derived from colluvial material which has been deposited over the sandstone. Scattered sandstone and shale are found on the surface and in the soil and subsoil. These are most common on the slopes, and only on eroded areas are they sufficiently abundant to interfere with cultivation. One variation in Boone silt loam is the quantity of very fine sand in the soil. The content of fine sand is commonly greater in areas bordering the coarser soils of the Boone series, especially on the lower parts of the slopes. In many places the soils grade to Boone loam.

Boone silt loam is the most widely distributed soil in Monroe County. Areas are scattered over much of the county, but the most extensive ones are in the east-central part, southwest of Warrens, and north of Sparta. None of this soil was mapped in the northwest or northeast parts and very little in the southwest part of the county.

Areas of Boone silt loam range from gently rolling to hilly. (Pl. 48, B.) None of the soil is steep enough to interfere seriously with cultivation or to make it susceptible to erosion, if ordinary care is taken in cultivation. Areas on steeper slopes are separated as a steep phase. In most of the county this soil is underlain by soft sandy shale, whereas the coarser members of the Boone series occur in the valleys where the coarser sandstone crops out.

In the southwest part of the county Boone silt loam occurs mostly on slopes below level areas of Dubuque silt loam. The soil material is probably derived largely from shale.

Surface drainage is good over nearly all of this soil. The subsoil is retentive of moisture and is sufficiently porous to absorb the surface water and hold it for the use of crops. Crops suffer from lack of moisture only during the extended periods of drought.

Boone silt loam is probably the most important farming soil in the county, and 85 per cent or more of it is cultivated. (Pl. 49, A.) The rest is in farm wood lots and permanent pasture. The most common trees are white oak and black oak, and there are a few hickory, aspen, birch, white pine, cherry, maple, and other trees, and some elderberries, hazelnuts, and other underbrush. Most of the trees are small, averaging between 6 and 8 inches in diameter, though a few are large enough to be sawed into lumber. Much of the forest is said to have grown up since the county was first settled about 60 years ago. Thirty per cent or more of the cultivated area is devoted to clover and timothy for hay, and about 15 per cent is in pasture. Yields of clover have been low in recent years, and it seems to be more difficult every year to establish a stand. Yields of hay range from 1½ to 2½ tons to the acre. The soil proved to be strongly acid in nearly every place it was tested. Many farmers are beginning to use lime to correct the acidity and increased yields of clover have resulted from its use. Many farmers are beginning to grow alfalfa. The soil must be limed nearly everywhere before alfalfa will thrive. A little more than one-fourth of the cultivated area is devoted to

small grains, and about 19 per cent is used for corn. The most common rotation in use is: First year, corn; second year, small grain (used as a nurse crop for clover and timothy); third year, clover and timothy for hay; and fourth year, timothy and clover for pasture or hay. Corn does especially well on this soil, and returns a higher yield than on any soil in the county, except on some small, selected areas of bottom land. Most of the corn is used for silage. Farmers report that it usually requires 7 or 8 acres to fill a 10 by 30 foot silo, and that the average yield of grain is about 45 bushels to the acre. About 28 per cent of the cultivated area is devoted to oats, by far the most common small-grain crop grown. Yields average about 40 bushels to the acre. Some small patches of wheat are grown, giving average yields of about 20 bushels to the acre. Barley is not grown so extensively as it formerly was. It yields 30 or 35 bushels to the acre. A small acreage of winter rye is grown, and averages about 17 bushels to the acre. Potatoes are grown for home use, and also on a commercial scale near Warrens. Yields range from about 40 to more than 200 bushels to the acre, but the average is about 110 bushels. Strawberries are grown extensively for a cash crop near Warrens and Sparta. Boone silt loam is considered one of the best strawberry soils in the county. Many small patches of blackberries near Warrens produce berries for shipment to the large markets. Most of the blackberries in the county are grown on Boone silt loam or on Boone loam. Garden crops are grown for home use. Apples are produced on nearly every farm and are the only large fruit grown. They do well but not so well as on Dubuque silt loam. Very few are marketed. A few patches of green peas are grown for the canning factory in Leon Township. This is considered one of the most desirable soils in the county for this crop. Some tobacco is grown, but plantings are not so extensive as on the La Crosse soils and on Dubuque silt loam.

The most extensive dairy farming in the county is conducted on this soil. The crops grown are nearly all fed on the farm and much additional feed is purchased for feeding dairy cattle. The manure is usually carefully saved and hauled back to the land as soon as it accumulates. When tobacco is grown, most of the manure is put on the tobacco ground. Practically no commercial fertilizer is used, though a few farmers have tried superphosphate (acid phosphate) the last few years and have found its use profitable, especially with alfalfa and clover.

The fields are mostly rectangular or fairly regular in shape. Plowing is done mostly by straight strips or "lands" going up and down hill, without regard to surface features. Very little of the plowing or cultivating is done on the contour system, in which the furrows follow the levels around the hills rather than up and down the slopes. At present (1923) land values are unstable, and very little of this land is being sold. The current selling price ranges from $75 to $150 an acre. Shortly after the war, it sold for as high as $200 an acre.

Boone silt loam, steep phase.—Boone silt loam, steep phase, was separated from Boone silt loam on the basis of surface features only. The two soils are everywhere closely associated. This phase of soil includes areas of Boone silt loam having a slope ranging from rolling

to hilly. Most areas having a slope of 25 per cent or more were included with rough stony land. This soil is very similar to the typical soil, except that it is more variable as to depth. Many areas of coarser soils, too small to map, occur within mapped areas of this soil. Sandstone rock and chert gravel are more common on the surface and scattered throughout the soil, but these are in few places sufficiently numerous to interfere with cultivation.

Most areas of this soil occur about the heads of streams that extend into the rough stony land, and on the rolling areas lying between the high table-land and the valley bottoms. The soil is unusually resistant to erosion, but on account of the steepness of the long slopes many cultivated fields have been badly gullied. Exposures of unweathered shale are abundant in some fields, especially northwest of Sparta where some of the steepest cultivated areas are located. Narrow bottoms of the draws may be flooded temporarily during heavy rains, but on most of this soil drainage is excessive.

Probably 50 per cent of this soil is farmed at the present time. The rest is in farm wood lots and permanent pasture. It supports the same forest growth as typical Boone silt loam. About the same crops are grown as on Boone silt loam, except that more of the steep land is devoted to hay and pasture crops, owing partly to the desire to prevent erosion, but more largely to the fact that the land is more difficult to cultivate on account of its hilly nature, and crops requiring the least cultivation are more easily grown. The crops look fully as flourishing as on the more level areas, except on the bare spots where the surface soil has been washed away.

Some of this soil is cultivated on the contour system, but most of it is plowed and cultivated up and down the slopes without regard to the surface relief.

Steep Boone silt loam is seldom sold alone. It is held at a price ranging from about $40 to $90 an acre, including the farm buildings.

The greatest need of this soil is special care in farming to prevent erosion. It should be more largely devoted to hay and pasture crops, so that the land would need to be plowed very seldom. Such crops would help to increase the fertility and the supply of organic matter and would make the soil more drought resistant. Lime should be used to correct acidity to make alfalfa and clover profitable crops.

BOONE LOAM

Boone loam, to an average depth of about 10 inches, is light-brown loam, in most places containing a considerable proportion of very fine sand. When dry it approaches light brownish gray in color. The subsoil is in most areas brownish-yellow or yellow rather heavy loam, to a depth of about 18 inches. Between depths of 18 and 36 inches the material in most places is brownish-yellow or yellow firm friable silty clay which may contain faint grayish mottles. The substratum may be either shale or disintegrated sandstone. It commonly occurs at a depth ranging from 4 to 6 feet. Sand may approach within 20 inches of the surface, especially near areas of Boone fine sand or Boone fine sandy loam. In this region the shale overlies the sandstone, hence the heavy layer of soil derived from

shale becomes thinner down the hillside, the lower fringe being mostly colluvial material derived from shale washed over the sandstone.

Small flat sandstone rocks and chert fragments are abundant on the surface and in the soil and subsoil.

This soil occurs in small areas scattered over the county. The larger areas are in the south-central, in the west-central, and in the north-central parts of the county. Boone loam is closely associated with and is found in the same localities as Boone silt loam. It commonly occurs on slopes between the rough stony land bordering the high table-land and the valleys. It rarely extends over the tops of the hills. In general, areas are gently rolling or undulating. Areas having steep slopes were mapped as Boone loam, steep phase.

This soil is all well drained. It is sufficiently porous to allow thorough underdrainage and is fairly retentive of moisture but is not so drought resistant as Boone silt loam.

About 85 per cent of this soil is now farmed. The rest is in permanent pasture and in farm wood lots. The varieties of trees are about the same as on Boone silt loam, except that aspen and birch are more plentiful.

The comparative acreage of the various crops is about the same as on Boone silt loam. Yields average slightly lower. About one-half of the cultivated area is devoted to timothy and clover for hay and pasture, about one-fourth to oats, one-fifth to corn, and the rest to barley, rye, and other crops. Alfalfa averages about 3 tons to the acre from two cuttings, but only a small acreage is grown. Oats average about 40 bushels to the acre, barley between 25 and 30 bushels, wheat 16 or 17 bushels, potatoes 110 bushels, and clover and timothy hay between 1 and 2 tons. Blackberries, raspberries, strawberries, and tobacco seem to do especially well.

Most of the crops raised are fed to dairy cattle. The soil is managed in practically the same way as Boone silt loam. The barnyard manure is all conserved and hauled back on the land, but very little commercial fertilizer is used. Most of this soil is very acid and requires lime before alfalfa can be grown successfully.

The current selling price for this soil ranges from $70 to $100 an acre, with the buildings and improvements.

Boone loam, steep phase.—Boone loam, steep phase, was separated from Boone loam entirely on the basis of surface features. It includes areas having slopes sufficiently steep and rough to interfere with cultivation or to make the land susceptible to erosion. The soil is very similar to typical Boone loam but is considerably more variable in depth, because of erosion.

This soil is closely associated with typical Boone loam. It was mostly mapped on more or less eroded hillsides between areas of rough stony land and valley bottoms. Drainage is excessive, and to prevent excessive erosion the soil should be kept in sod as much of the time as possible. Most farmers realize this and keep it in hay and pasture crops more than they do the more level areas.

Between 55 and 60 per cent of this soil is cleared. Probably 60 per cent of the cleared area is used for hay and pasture, and the rest is devoted to the same crops as are grown on Boone loam and Boone

silt loam. Yields are about the same or are slightly lower than on Boone loam.

Dairy farming is practiced almost exclusively on this soil, which is farmed in connection with other soil types. A very small acreage is plowed or cultivated on the contour system. In most fields furrows run up and down hill without regard to surface features.

The current selling price of Boone loam, steep phase, ranges from $50 to $75 an acre.

More permanent crops like alfalfa should be grown on this soil to prevent destructive washing.

BOONE FINE SANDY LOAM

The topsoil of Boone fine sandy loam is light grayish-brown loose fine sandy loam 8 or 10 inches deep. It contains very little organic matter. The subsoil, to a depth of 36 inches, is in most places brownish-yellow material of fine sandy loam or loamy fine sand texture. It becomes coarser with depth and grades, at a depth of 4 or 5 feet, to loamy fine sand, fine sand, or disintegrated sandstone. In places a heavier layer of fine sandy loam or loam is present at a depth of about 24 inches. There is a sprinkling of sandstone and chert gravel on the surface and through the soil and subsoil.

Boone fine sandy loam occurs in scattered areas, largely near the lower part of slopes and on comparatively level areas at lower elevations, in the northern half of the county. In most places soil has been formed in place from sandstone or shaly sandstone. In places the surface soil is partly colluvial material washed down from heavier soils at higher elevations or possibly from thin deposits of loessial material.

Boone fine sandy loam in many places is a gradational soil between Boone silt loam or Boone loam and Boone fine sand, and for this reason is somewhat variable in texture. It occupies nearly level or gently rolling areas. Areas having rather steep slopes were mapped as the steep phase.

The natural drainage is good or excessive. The soil and subsoil are rather porous, absorb water very rapidly, and retain it fairly well. Crops, however, suffer from drought during long periods of dry weather.

This soil was formerly all forested. About 70 per cent of it is now under cultivation. The rest is in wood lots and permanent pasture. In the wooded areas the larger trees have mostly been cut and the present growth consists mainly of trees 6 or 8 inches in diameter. The most common trees are black oak, white oak, red oak, white birch, aspen, and white pine. Some hazelnut grows on the better areas and briers and other underbrush on the poorer areas.

The usual farming industry on this soil is dairying, together with the production of special cash crops in small patches. Probably one-fourth of the cultivated area is used for corn, nearly one-fourth for oats, another one-fourth for clover and timothy for hay, and 10 or 15 per cent for timothy and clover for pasture. Probably 5 per cent is devoted to rye and 3 per cent to potatoes. Potatoes do well and are an important cash crop. They average about 110 bushels to the acre but may yield as high as 250 bushels. Some

tobacco is grown in the southwestern part of the county. Average crop yields to the acre are about as follows: Corn, 35 bushels; oats, 30 bushels; clover and timothy hay, between 1 and 2 tons; rye, 17 bushels; and barley, 25 bushels. Patches of cucumbers and strawberries are common. This soil is one of the best in the county for cucumbers, and they are said to give an average profit of about $150 an acre. This soil is well adapted to strawberries, which yield from 100 to 125 crates to the acre. In the southwestern part of the county this is a favorite soil for tobacco. This crop is grown in sheltered positions or valleys where there is little danger of damage by the wind. A thin leaf of good quality is produced. This is a favorite soil for the garden patch.

Although yields are not very high on this soil it is easy to cultivate and is adapted to a wide variety of crops. If a farmer has only a small area of this soil he often uses it for special crops. Where it covers a large part of his farm he usually practices a 3-year or 4-year rotation of, first year, corn; second year, grain; third year, clover and timothy for hay; and sometimes, fourth year, clover and timothy for pasture. Alfalfa can not be grown successfully without the use of lime, and the acreage of this crop is small.

This soil is all very strongly acid. Lime should be used to correct the acidity, especially for alfalfa and clover. Very little commercial fertilizer is used. The use of phosphorus and possibly potash should prove profitable.

Boone fine sandy loam in 1923 sold at prices between $50 and $100 an acre.

Boone fine sandy loam, steep phase.—Boone fine sandy loam, steep phase, was separated from Boone fine sandy loam entirely on the basis of surface features. The soil is more variable on account of the steep slopes, and more gravel and rock are present.

This soil occurs in small, scattered areas in close association with Boone fine sandy loam, mostly on eroded slopes between the valleys and higher uplands. It includes rolling and hilly areas. Although the drainage is excessive, the soil does not wash badly, because it is rather porous and absorbs water very rapidly.

Probably 45 per cent of this soil is cultivated. The rest is used for wood lots and pasture. The crops grown are about the same as those on the typical soil. Yields are slightly lower.

The current selling price of Boone fine sandy loam, steep phase, ranges from $30 to $75 an acre but varies considerably with the locality. This soil is seldom sold alone.

BOONE SANDY LOAM

Boone sandy loam, to a depth ranging from 7 to 10 inches, is commonly light grayish-brown or yellowish-brown sandy loam or loamy fine sand which grades to yellowish-brown or yellow loamy fine sand. At a depth ranging from 18 to 30 inches, it becomes somewhat light colored, usually yellow, brownish yellow, or reddish yellow, and the texture may become coarser. It may grade to fine sand at a depth of about 30 inches. Some small rock fragments are nearly everywhere present.

This soil occurs in scattered areas, though most of it was mapped in the northwestern corner of the county. It occupies undulating or gently rolling country and is closely associated with Boone fine sand.

The drainage is inclined to be excessive. The soil and subsoil are porous and do not have a large water-holding capacity. Crops suffer quickly from drought. About 50 per cent of the soil is under cultivation. The uncultivated areas support a small growth of red, black, and white oaks, jack pine, aspen, a few white pine, and other trees. Much of the soil formerly supported a heavy growth of white pines.

Of the cultivated area, about 25 per cent is used for corn, 20 per cent for oats and barley, 10 per cent for rye, 20 per cent for clover and timothy, Sudan grass, or brome grass for hay, and about 20 per cent for tame pasture.

Corn on Boone sandy loam probably averages about 25 bushels to the acre, oats from 20 to 25 bushels, and rye 16 bushels. Cucumbers, watermelons, potatoes, and strawberries do well. Only small patches of these crops are grown, but they are important cash crops. Other crops are mostly fed to dairy cattle.

All the manure is hauled back on the land. Very little commercial fertilizer is used. The soil is strongly acid and should be limed to grow clover or alfalfa successfully.

Boone sandy loam currently sells at prices ranging from about $20 to $60 an acre.

Boone sandy loam, steep phase.—This phase was separated from typical Boone sandy loam on the basis of surface features. It includes rolling and hilly areas. The soil characteristics are practically the same as those of Boone sandy loam, and utilization is similar to that of Boone fine sandy loam, steep phase.

BOONE FINE SAND

Boone fine sand, where cultivated, is light-brown, loose fine sand to an average depth of about 10 inches. It may range from 2 to 14 inches in depth and from grayish brown to yellowish brown or brownish yellow in color. A surface layer, about 2 inches thick, of dark grayish-brown or, in places, nearly black fine sand containing considerable leaf mold and undecomposed organic material is found in virgin areas. The soil is very loose, and "blow-outs" and small dunes are found in many places on the high elevations. The soil particles consist mostly of medium, fine, and very fine quartz sand with sufficient finer material to make the soil appear loamy where it is not cultivated. The subsoil, to a depth ranging from 18 to 36 or more inches, is loose, porous, brownish-yellow or yellow fine sand underlain by yellow or light-yellow fine sand which continues to a depth ranging from 8 to 25 feet and is underlain by sandstone. Scattered fragmentary sandstone and chert gravel are present in the soil and subsoil.

This soil is coarser than typical in much of Scott Township in the northeast part of the county. There the soil ranges from loose fine sand to medium sand. It is also coarser than typical between Sparta and Tunnel City, especially on the military reservation where it is largely loose, rather coarse fine sand. Over most of the rest of the county, the soil is somewhat loamy fine sand. The coarser material

contains a higher percentage of chert in the northeastern part of the county, particularly around Watermill, than in other parts.

Boone fine sand is the most extensive soil in the northern part of Monroe County. A large area is in the middle-western part south of Sparta, and a few scattered areas are in other parts of the county. The soil has been formed from the coarser layer of Potsdam sandstone which crops out at the lower elevations in the southern part of the county and over the entire northern half.

As mapped, this soil is mostly undulating or gently rolling. Large flat areas were mapped as the level phase, and considerable areas having steep slopes were mapped as the steep phase. The soil ranges in slope from less than 7 per cent to as much as 14.1 per cent. Areas are more nearly level in the northwestern part of the county than elsewhere.

Surface drainage on this land is good, and underdrainage is excessive. The soil and subsoil are so porous that they do not retain water, consequently crops suffer very quickly from drought. This soil was formerly covered with a heavy forest of white, Norway, and jack pine, and some scrubby red oak, aspen, and white birch. White pine predominated on the areas where the soil was more loamy and Norway pine and jack pine in areas where the soil was coarser. An almost pure stand of Norway pine was found on this soil in the locality of Norway Ridge. Most of the virgin timber was cut between 1865 and 1900. That in the northeast part of the county was the last to be cut and it is said to have averaged about 15,000 board feet to the acre. Very few of the original trees are now left, and most of the soil is now covered with a growth of small jack pine, scrub oak, aspen, white birch, and other trees, and with brush. Blueberries, sweet fern, wintergreen, and other plants which thrive on acid soils are numerous. Fires have destroyed most of the white pine and Norway pine that were left after the region was cut over and have greatly retarded the growth of jack pine. Where fire has been kept out, some stands of jack pine, producing as high as 10,000 feet to the acre, have been cut on land cut over 50 years before.

Only between 5 and 8 per cent of this soil, which is very droughty and unproductive, is cultivated. Fully as much more has been cultivated but has been abandoned. The yields are so low that the growing of general farm crops is unprofitable. A larger percentage of drought-resisting crops like rye, corn, buckwheat, cucumbers, and watermelons are grown on this soil than over the rest of the county.

Probably about 25 per cent of the cultivated area of this soil is devoted to corn, about 15 per cent to oats, 18 per cent to clover and timothy, Sudan grass, and brome grass for hay, and about an equal acreage to pasture. Probably 8 per cent is used for rye and 6 per cent for special crops like cucumbers, potatoes, watermelons, and strawberries. Some barley, buckwheat, and other crops are grown. More or less of the cultivated area lies idle each year.

The average yields to the acre are about as follows: Corn, 20 bushels; oats, from 15 to 20 bushels; hay, from one-half to 1 ton; rye, from 10 to 16 bushels; and potatoes, 75 bushels. Strawberries yield from 100 to 125 crates to the acre, when well cared for, and when markets are favorable are considered about the best-paying

crop on this land. In 1923 prices did not pay the cost of the crates, picking, and shipping. Buckwheat yields 10 or 12 bushels to the acre, but only a small acreage is grown. Navy beans and soy beans do fairly well but are raised only for use on the farm.

Sudan grass has been tried the last few years and seems to give better yields than other hay crops. A stand of clover is hard to establish, because the soil is too sour and is lacking in fertility. Most farmers have a small patch of cucumbers, strawberries, or watermelons to provide some cash. The great disadvantage of these crops is that the market is so easily oversupplied.

Yields of crops depend greatly on the season, the location of the land, and the method of farming. The yields are higher at the foot of slopes where the soil receives some run-off from higher land but is not too wet. Where only Boone fine sand is found in a locality very little is cultivated. It is usually farmed in connection with other soils. The presence of somewhat better soils in the locality encourages the cultivation of this soil, even where it is not profitable. Large uncultivated areas of Boone fine sand provide cheap but poor pasturage for livestock. Most farmers on this soil are making a very poor living. Houses are dilapidated and most of the work animals and cattle look unthrifty.

All the manure produced on the farm is hauled back on the soil, but very little commercial fertilizer is used, except for cucumbers. Some farmers are beginning to use lime to correct the acidity of the soil and to help the growth of clover.

Where found in large areas, there is very little sale for Boone fine sand. Unimproved areas can be bought for $5 or $10 an acre or even less. Improved areas, sold in connection with other land, may bring from $10 to $30 or more an acre.

Boone fine sand is better adapted to forestry than to general farming. Most of it should be brought back into the production of timber as rapidly as possible. Fires should be kept out and an effort should be made to grow the more valuable trees, such as white pine and Norway pine, in preference to the inferior jack pine.

Boone fine sand, level phase.—Boone fine sand, level phase, was separated from Boone fine sand on the basis of surface features. The level phase includes areas that are flat or nearly level and have an average slope of less than 3 per cent. The soil is about the same as the typical. In most places it consists of light-brown or light grayish-brown fine sand 10 inches deep, underlain to a depth of 36 or more inches, by somewhat brownish yellow loose fine sand. This is underlain in most places by solid sandstone rock at a depth of 12 or 15 feet. In places, the substratum is largely fragmentary sandstone and occurs at a depth of 3 or 4 feet from the surface. On the more poorly drained areas, the topsoil is dark-brown fine sand from 4 to 6 inches thick and the subsoil, to a depth of 36 or more inches, is yellow fine sand containing scattered traces of reddish or grayish mottling. A sprinkling of small, angular rock fragments, mostly chert, is found on all this soil, and there is a greater variation than typical in the size of the soil particles. This soil is closely associated with Boone fine sand and occurs chiefly in the northeastern part of the county, in the west-central part, and between Sparta and Tunnel City.

Drainage is usually sufficient. The surface is flat, but any excess of moisture is absorbed by the porous subsoil. Some areas in the northeastern part of the county were formerly poorly drained because of a high water table, but the water table has now been lowered by a system of canals. The value of this land, however, has been increased very little by drainage.

A somewhat lower percentage of this land is farmed than of typical Boone fine sand, because the areas are not so intermingled with areas of better soils. Probably 5 per cent of the Boone fine sand, level phase, is cultivated. On the cultivated areas the crops grown, the yields obtained, and the system of farming correspond in every way to those on Boone fine sand.

Unimproved areas of Boone fine sand, level phase, sell at $5 or $10 an acre, and the price of improved areas may range from $15 to $25 or more an acre.

Boone fine sand, steep phase.—Boone fine sand, steep phase, was separated from Boone fine sand on the basis of surface features and includes areas of Boone fine sand which have steep slopes. The topsoil is practically the same as that of the typical soil but the subsoil is, on the average, somewhat more brownish than typical. The soil is more variable, due to its rolling surface, and may include outcrops of sandy or shaly sandstone. It has been subject to some erosion and to deposition of materials washed down from heavier soils at higher elevations. It is underlain by sandstone at a depth ranging from 3 to 12 or more feet.

This soil occurs in small, scattered areas, mostly in the west-central and northwestern parts of the county. In many places it occurs in belts below areas of rough stony land, and in the northern part of the county in places it extends over the tops of low hills. It includes rolling or hilly land which is steep enough to make its cultivation with modern farm machinery somewhat difficult and to make it wash rather easily. Drainage is excessive. So much of the water is lost by the surface run-off and by rapid percolation through the subsoil that this soil is even more droughty than typical Boone fine sand. A thick growth of small jack pine, scrub oak, and brush covers most of the soil.

Not more than 2 or 3 per cent of this land is cultivated. Practically the same crops are grown as are common on Boone fine sand. Yields are about the same or slightly lower. The same methods of farming prevail, and in other respects the soil corresponds to Boone fine sand.

Boone fine sand, steep phase, is mostly held at about $5 or $10 an acre. It should, as far as possible, be devoted to forestry rather than to farming. Pine trees will grow on this soil, but it lacks fertility and is too droughty to be farmed profitably.

BOONE SAND

Boone sand is light-brown or grayish-brown medium sand or fine sand to an average depth ranging from 3 to 8 inches. In virgin areas, the surface layer, about 2 inches thick, contains some leaf mold and undecayed leaves and rootlets. The subsoil is loose, clean sand to a depth of 40 or more inches. It is in most places brownish yellow

or yellow to a depth ranging from 18 to 36 inches but becomes lighter in color with increased depth.

A sprinkling of sandstone fragments is found on most of the soil. Only a few areas were mapped, the most extensive ones being in Angelo Township. This soil occurs most commonly in localities where there is little surface relief, and most of the areas are undulating. Flat areas were mapped as level Boone sand and areas having steep slopes as steep Boone sand.

This soil was derived from disintegrated sandstone. Surface drainage is good, and underdrainage is excessive. The subsoil is very porous and much water is lost by percolation.

Boone sand is a droughty, unproductive soil of very low value for general farming. Possibly 5 per cent is cultivated at the present time. Some of the soil is farmed only every two or three years and is left to volunteer grass and pasture the rest of the time. Many areas that were formerly cultivated are now abandoned. Cultivated areas are mostly in Angelo Township. Uncultivated areas are covered with scattered small jack pines, scrubby oaks, an occasional aspen, and in some places with brush. Few trees are of merchantable size. The jack pine has grown up since the heavy growth of virgin Norway pine, jack pine, and white pine was cut over, from 25 to 50 years ago.

Corn and rye are the most important crops. Corn yields from 15 to 20 bushels to the acre and rye 10 or 15 bushels. Small acreages of oats and other farm crops are grown, and yields are less than half of the average for the county. Watermelons and cucumbers are grown to a small extent for cash crops and do fairly well. This soil is usually farmed by men who live on it for only two or three years and then become discouraged and move to some better location. Most of them earn part of their living by working out, and they keep three or four cows that get much of their pasturage on surrounding idle land. This soil would need to be fertilized heavily to produce good crops, and since it is very acid, lime is necessary to grow clover or alfalfa. Practically no commercial fertilizer is used.

Uncultivated areas of Boone sand are held at $5 or $10 an acre. Improved areas have sold for $25 or more an acre.

Boone sand should be devoted to forestry rather than to farming. Jack pine, Norway pine, and white pine will grow on this soil, and farming has not proved profitable.

Boone sand, steep phase.—Boone sand, steep phase, was separated from Boone sand in mapping entirely on the basis of surface features and includes areas having rather steep slopes. The soil is practically the same as Boone sand. None of it is cultivated. It is held at $5 or $10 an acre.

Boone sand, level phase.—Boone sand, level phase, includes flat or nearly level areas of Boone sand. The soil is practically the same as typical Boone sand. Although very level, this soil is well drained through the porous subsoil. Practically none of it is farmed, as it occurs in a very poor country in the northeast corner of the county. Some areas have been farmed but are now abandoned. The selling price ranges from $5 to $10 an acre.

DUBUQUE SILT LOAM

Dubuque silt loam is light-brown, smooth, soft, friable silt loam to an average depth of 8 or 9 inches. It varies from grayish brown or brownish yellow to somewhat reddish brown. The surface layer ranges from 3 to 18 inches in thickness, being deepest on the crests of the divides and becoming shallower toward the border of the area near the breaks or on the border of the steep phase of this soil. A surface layer, from 1 to 3 inches deep, of dark-brown silt loam containing much leaf mold is present in virgin areas. This dark layer is mixed with the underlying soil when the land is broken. Chert fragments are everywhere present on the surface. The soil in most places is underlain by a subsurface layer of yellow, brownish-yellow, or yellowish-brown smooth, even-textured, friable silt loam which continues to an average depth of about 16 inches. In places this layer is almost entirely missing, and on the crests and divides it may extend to a depth of nearly 36 inches. It grades to more reddish brown material of silty clay loam or silty clay texture, which contains a few fragments of chert. At an average depth of about 24 inches it is underlain by a layer, 3 or 4 inches thick, of brownish-yellow or reddish-brown silty clay containing about 35 per cent chert. This grades directly to dull brownish-red stiff, plastic, refractory material of clay texture, containing much chert rock and gravel. The red clay commonly continues to a depth of about 20 feet, where it is underlain by solid limestone. In places the limestone approaches to within 6 feet of the surface, and in other places the red clay continues to a depth of 150 feet. According to well drillers, the limerock ordinarily ranges from 60 to 100 feet in thickness but may be as much as 150 feet thick. On the border of this soil it may have been almost evenly eroded away.

Considerable chert rock and chert gravel are found over most of the land. Surface rock has largely been hauled off the cultivated areas, but most farmers haul off 5 or 10 loads a year from an 80-acre farm. In general, the friable soil and subsoil are progressively deeper toward the southern and southwestern parts of the county and contain progressively more chert rock and angular chert gravel to the northeast, where more of the original limestone has been eroded away leaving the insoluble chert behind.

In Wells Township, a part of some areas of this soil is somewhat more than 36 inches deep. In places where much of the soil has been washed off the red clay is exposed, giving a decided red cast to the soil. Such areas are much more common on the steep phase than on the typical soil. They have a stiff, refractory soil and are rocky and hard to farm.

Dubuque silt loam occurs almost exclusively in the southern half of the county, but two patches were mapped in the southern part of Little Falls and the northern part of Sparta Townships, and one in the northern part of Greenfield Township. This soil occurs only in mesalike areas on the higher elevations where the underlying rock is the lower magnesian limestone. The region of its occurrence has the appearance of a plateau or table-land greatly dissected by erosion. The subsoil is entirely residual, having been developed in place from weathered lower magnesian limestone. The topsoil may

have been somewhat modified by thin deposits of wind-blown material, but the large quantity of rock and gravel found on the surface indicates that it must be predominantly residual. Most areas are undulating, though some are nearly level, and the borders are in places gently rolling. Areas having sufficient slope to interfere with cultivation or to be subject to washing were mapped as the steep phase. The surface relief is ideal for farming, there being just sufficient slope to give good surface drainage. Limestone sink holes are very common.

There is practically no underdrainage in this soil, as the red clay subsoil is almost impervious. This does not affect the good drainage, except in places where surface drainage is deficient. As the subsoil does not absorb water readily, the soil is less drought resistant where the clay approaches the surface.

Dubuque silt loam is one of the most valuable farming soils in the county. Probably 90 per cent or more of it is cultivated. The rest is used for wood lots, permanent pastures, roads, and building lots. White oak and black oak are the most common trees on the wooded areas, and hickory, maple, aspen, cherry, box elder, and white birch are less common. Much hazelnut brush is found in places, as well as an occasional white-pine tree. Most of the trees are from 6 to 10 inches in diameter, and although they are too small for saw timber they are of sufficient size for posts and firewood. When the county was settled, about 70 years ago, the trees were said to be mostly small and the forests not nearly so dense as they are on the uncleared areas at the present time.

Dubuque silt loam is usually considered about the best soil in the county for growing small grains and apples. It is not so well adapted to corn as is Boone silt loam and the silt loam soils on the bottoms and terraces.

Probably 32 per cent of the cultivated area of this soil is devoted to oats, 25 per cent to clover and timothy or alfalfa for hay, about 10 per cent to timothy and clover for pasture, 13 per cent to corn, probably 2 per cent or more each to potatoes, wheat, and tobacco, and a smaller percentage to barley, rye, apples, and other crops. The crop yields to the acre are about as follows: Oats, 40 or 42 bushels; corn, 35 or 40 bushels; winter wheat, 22 bushels; spring wheat, 18 or 19 bushels; barley, 35 bushels; potatoes, 105 bushels; tobacco from 1,000 to 1,500 pounds; clover and timothy hay from 1 to 2 tons; and alfalfa, about 3 tons. Most of the corn is grown for silage, and that from 7 to 10 acres is usually required to fill a silo. Some corn is cut for fodder, but very little is husked. Most of the oats are fed on the farm. The yield of clover and timothy hay was formerly much higher but has decreased in recent years, as it has on other soils in the county. Alfalfa has been grown only in recent years, but is now rapidly taking the place of clover because of the much higher yield of hay it gives. The finest fields of alfalfa seen in the county were observed on this soil. Alfalfa can not be grown successfully without the use of lime to correct the acidity. From 2 to 4 tons of crushed limestone to the acre are required in most cases. This soil is derived from limestone, but most of the lime has been leached out, and much that was left has been utilized by crops over the many years of cultivation since the region was settled.

This is the most important tobacco soil in the county. The percentage of the cultivated area devoted to tobacco is not very high, but the income to the acre of tobacco makes it rank among the leading crops from a financial viewpoint.

Apples do better and more are grown on this soil than on any other in the county, although they are grown primarily for home use. Most farmers have a dozen or more bearing trees to which they give practically no care. The surplus crop is sold if the markets are good, otherwise it goes to waste.

The most common systems of farming on this soil are dairy farming in the eastern part of the county and dairy farming supplemented by growing tobacco as a cash crop in the southwestern part. (Pl. 49, C.) A 4-year rotation consisting of a small grain, clover and timothy for hay, clover and timothy for pasture, and then a cultivated crop such as corn, potatoes, or tobacco is a typical rotation. Most of the plowing is done in strips or "lands." The land is sufficiently level to make contour cultivation unnecessary.

Prosperous-looking communities are always found on this soil. The farm buildings are unusually commodious and are in good repair, and most of the livestock is in good condition.

All the barnyard manure is put back on the land but, except for a very small quantity on tobacco, very little commercial fertilizer is used. On the farms where tobacco is grown, all the manure is often spread on the tobacco field to the detriment of other crops. The quantity of crushed limerock used is being greatly increased at the present time. Some quarries can be located on the breaks bordering areas of this land, in outcrops of the underlying limestone.

Dubuque silt loam is generally sold with more or less rough stony land. With the farm buildings it brings from $100 to $175 an acre. Where very little rough stony land is included, it usually brings from $125 to $175 an acre. Select areas for tobacco growing sell for $200 or more an acre.

Dubuque silt loam, steep phase.—Dubuque silt loam, steep phase, includes areas of Dubuque silt loam having slopes sufficiently steep to make the land subject to destructive erosion or to interfere with cultivation by modern farm machinery. The soil is about the same as that of Dubuque silt loam, except that it is shallower, averages slightly more reddish in color, is more stony, and is somewhat more variable because of the rolling surface.

This soil is commonly light yellowish-brown silt loam with a faint reddish hue to a depth of 6 or 7 inches, where it is underlain by brownish-yellow or yellowish-brown silt loam or silty clay loam which has a reddish tinge. At an average depth of 12 or 14 inches, this grades to reddish-brown silty clay containing a high percentage of angular chert rock (locally known as flint rock) which makes it difficult to penetrate with an auger. This rocky layer averages about 4 inches in thickness but in many places is missing. It is underlain by dull brownish-red very stiff sticky plastic clay which contains considerable chert rock and gravel. The red clay crops out in spots in nearly all cultivated areas. In some fields nearly all the surface soil has been washed away, leaving nothing but sticky red clay, which is very difficult to cultivate.

There is considerable chert rock on the surface of nearly all of this land. In the cultivated areas, some rock needs to be hauled off every year. The steep phase of Dubuque silt loam is of small extent and occurs in sloping areas around the border of parts of some areas of Dubuque silt loam. The lower boundary of this soil is in most places bordered by rough stony land. Areas of Dubuque silt loam commonly break off abruptly into rough stony land but in places the steep phase occurs as an intermediate soil.

Areas range from rolling to hilly, and broad shallow gullies are very common. Surface drainage is excessive, but the subsoil is rather impervious. This combination, with the silty friable soil and the steep slope, make it particularly susceptible to erosion.

Probably 30 or 40 per cent of this soil is cultivated. The rest is mostly in wood lots and permanent pasture. The uncleared areas are covered with the same kinds of trees that grow on Dubuque silt loam.

The percentage of the cultivated area devoted to different crops is about as follows: Oats, wheat, and barley, 35 per cent; clover and timothy and alfalfa for hay, 35 per cent; timothy and clover and other crops for pasture, 20 per cent; corn, 5 or 10 per cent; and potatoes, tobacco, and other crops, the remainder. Farmers prefer to keep the land in hay and pasture as much as possible in order to prevent it from washing.

Crop yields are about the same or slightly lower than those obtained on Dubuque silt loam. On patches where much of the surface soil has been washed away the yields are much lower. Clover and alfalfa do fully as well as on Dubuque silt loam. The yield to the acre of the most important crops is about as follows: Clover and timothy hay, from 1½ to 2½ tons; oats, 45 bushels; corn, 45 or 50 bushels; and tobacco, from 1,000 to 1,500 pounds.

The system of farming is the same as on Dubuque silt loam. Most of the land is plowed and cultivated on the rectangular system, with the furrows running up and down hill without regard to surface relief.

This soil is somewhat less acid than typical Dubuque silt loam, but lime must be applied before alfalfa can be successfully grown.

Dubuque silt loam, steep phase, is usually sold with more or less Dubuque silt loam and rough stony land. If sold alone it would probably bring from $50 to $100 an acre.

The greatest need of this soil is a system of farming to prevent destructive erosion. The surface soil, which is comparatively thin and easily washed away, needs to be conserved very carefully because when that is gone the soil is of little value. Washing can be largely prevented by a contour system of farming; that is, plowing around the slopes rather than up and down them. The land should be kept in hay and pasture crops as much as possible. This soil is particularly well adapted to alfalfa, which can be grown for several years without plowing.

TAMA SILT LOAM

Tama silt loam is dark-brown, smooth friable silt loam about 12 inches deep, underlain by brownish-yellow, heavy friable silt loam. This continues to a depth of 20 or more inches and is underlain by

yellow or yellowish-brown smooth, friable silty clay, silty clay loam, or clay loam which continues to a depth of 36 or more inches. Faint grayish mottles may occur below a depth of 30 inches. Most of the soil seems to be underlain, at a depth ranging from 4 to 12 or more feet, by fine sand or disintegrated sandstone. The dark surface layer may range in depth from 8 to 15 inches. The color of the soil is mostly dark brown, but this is variable. Some spots approach brown in color and some at the borders of the areas grade to the light brown of the bordering soils.

The topsoil and subsoil are entirely free from rock and gravel. This soil was mapped only in the La Crosse River valley, and most of it is included in two areas, one north of Sparta and the other northeast of Angelo. It occupies undulating or gently rolling benchlike areas near the foot of the hills bordering the La Crosse River valley. These hills appear to be high, very old terraces modified by erosion, by the deposition of some colluvial material along the upper border, and probably by thin deposits of loess.

Drainage is very good. This soil is practically all cultivated, except what is used for roads and building lots. This region was mostly prairie, and before it was settled there were scattered oak trees or clumps of oak trees on it. It was one of the first soils to be farmed and is still one of the most productive. About equal acreages of corn, oats, and timothy and clover for hay are grown on 75 per cent of the cultivated areas. About 10 per cent is used for timothy and clover for pasture, and the rest is devoted to strawberries, tobacco, wheat, barley, rye, and other minor crops of the region. The average yields are about as follows: Corn, 45 bushels to the acre; oats, 40 bushels; timothy and clover, from 1¾ to 2 tons; and other crops, about the same as on Boone silt loam.

This soil is used principally for dairying. A few small patches of strawberries and scattered patches of tobacco are grown as cash crops. Most of the crops are fed on the farm. In poor years much additional feed is bought for the cows.

Improved Tama silt loam is held at prices ranging from $175 to $200 an acre. Its high value results partly from its position near the city limits of Sparta.

WAUKESHA SILT LOAM

Waukesha silt loam is typically dark-brown silt loam to a depth ranging from 10 to 14 or more inches. The soil is smooth and friable and free from gravel or rock, but it may contain a rather high percentage of very fine sand. It is somewhat variable in color, ranging from nearly black to brown. The subsoil is very variable. In the most typical areas on the higher terraces, the subsurface layer, to a depth of 16 or 18 inches, is brownish-yellow material of silt loam texture. It is underlain by grayish or brownish-yellow material of silty clay loam or clay loam texture which, at a depth of 26 or 28 inches, grades to brownish-yellow or yellow silty clay material. This is in places underlain by fine sand at a depth ranging from 3 to 6 or more feet. On the lower terraces the texture of the subsoil, at a depth ranging from 18 to 36 inches, may be very fine sandy loam or sandy loam. In somewhat poorly drained areas gray and brownish or limonite yellow mottles are present in the subsoil.

This soil is free from rock and gravel. It is of rather small extent, most of it being found in the La Crosse River valley between Leon, Sparta, and Trout Falls. Other small areas are scattered over the southern half of the county. This soil was mapped mostly on rather low terraces along small streams having a narrow flood plain or practically no flood plain, and it all lies above normal overflow. The areas northeast of Angelo are located on somewhat higher, gently sloping terraces.

This soil is closely associated with Bertrand silt loam, Genesee silt loam, and other bottom-land soils. Most areas are bordered by Boone silt loam or Boone loam on the upper edge of the terrace and by a bottom-land soil on the lower edge.

Waukesha silt loam is derived from alluvial material, washed partly from the lower magnesian limestone and partly from the Potsdam sandstone and shale. The drainage is usually adequate for ordinary farm crops. Areas receive some of the run-off from the higher country, but that helps to make them more drought resistant.

About 95 per cent of this soil is cultivated. The rest is used for permanent pasture and for building lots. It was originally covered with white oak, black oak, and other hardwoods common to the region. This is one of the most intensively farmed soils in the county. It is considered especially good for corn and tobacco and produces a large proportion of the green peas grown for canning.

Probably 35 per cent of the cultivated area of this soil is devoted to corn, 25 per cent to oats, 20 per cent to timothy and clover for hay, 10 per cent to timothy and clover for pasture, and the rest to tobacco, peas, potatoes, barley, and other minor crops. Corn yields 5 or 6 tons of silage to the acre or 45 or 50 bushels of grain, oats about 45 bushels, and clover and timothy hay from 1½ to 2½ tons. Other crops yield about the same or slightly better than on Boone silt loam. Most of the crops grown are fed to dairy cows on the farm.

Improved Waukesha silt loam sells at prices ranging from $100 to $200 an acre. Most of it is sold with other soils.

BERTRAND SILT LOAM

Bertrand silt loam is brown or grayish-brown friable silt loam to a depth ranging from 6 to 14 inches, or to an average depth of 11 or 12 inches. It grades to yellowish-brown or brownish-yellow slightly heavier and more compact silt loam material which in most places continues to a depth ranging from about 18 to 26 inches but which may continue to a depth of 36 or more inches. This material may vary from silty clay loam to silty very fine sandy loam. The lower part of the subsoil is somewhat lighter colored and coarser in texture and grades to brownish-yellow or yellow silt loam. On the higher terraces the subsoil is of silt loam texture and in most places continues to a depth of 36 or more inches, but on the lower terraces it may grade to material of very fine sand, loamy fine sand, or fine sand texture at a depth ranging from 18 to 36 inches, or at an average depth of 24 or 25 inches. Some faint grayish mottles may be present in the lower part of the subsoil. Areas having a distinctly mottled subsoil were mapped as the mottled-

subsoil phase of Bertrand silt loam. The substratum is distinctly stratified, especially on the lower terraces. The soil and subsoil are free from rock, although traces of gravel are found in the subsoil in a few areas.

This soil occurs in scattered areas on second bottoms along the stream valleys over a large part of the county. It is mapped on level terraces, and the parent material is largely of alluvial origin, although the upper or outer border of the terraces may consist partly of colluvial material washed down the hillsides. The terraces are made up of material derived from the lower magnesian limestone and the Potsdam sandstone. Probably there has been a considerable addition of loessial material in the southern half of the county, and the material comes largely from Potsdam sandstone in the northern half. This soil lies above the normal overflow of the streams, and the drainage is usually adequate for ordinary crops. Some of the lowest areas may be flooded after abnormal rains, and some parts receive some of the run-off from the bordering hill lands. The ground water is too shallow to grow alfalfa successfully on the lower areas. The drainage is just about right to produce maximum crops in this region.

Probably 95 per cent of this soil is cultivated. It is practically all farmed except what is used for roads, lanes, and building lots. It was formerly all forested with white oak, black oak, ash, hickory, and other hardwoods.

Probably 20 per cent of the cultivated area of this soil is devoted to corn, 25 per cent to oats, 30 per cent to clover and timothy for hay, 20 per cent to clover and timothy for pasture, and the rest to potatoes, alfalfa, tobacco, and minor crops. The average yields to the acre are about as follows: Corn, 45 bushels; oats, 40 bushels; clover and timothy hay, between 1½ and 2½ tons; and other crops about the same or slightly higher than on Boone silt loam. Most of the corn is cut for silage. Usually silage from 6 or 7 acres is required to fill a silo measuring 10 by 30 feet. With the exception of potatoes and garden crops, which are grown for home use, and tobacco, which is grown for a cash crop, all crops are fed on the farm. Dairying is the most common farming industry.

All the manure is hauled back on the soil, and practically no commercial fertilizers are used. Most of the soil is slightly acid, and some lime is used for alfalfa and clover.

Bertrand silt loam sells at prices ranging from about $100 to $150 an acre. It is nearly always sold with other soils. Farms which are largely of this soil but which include much rough stony land or other poorer soils sell for less than $100 an acre, whereas other areas favorably located near markets may sell for more than $150 an acre.

Bertrand silt loam, mottled-subsoil phase.—Bertrand silt loam, mottled-subsoil phase, is grayish-brown or light grayish-brown smooth friable silt loam from 8 to 12 inches deep, underlain by yellowish-brown, gray, or drab silt loam somewhat mottled with brown and yellow. At a depth ranging from 20 to 26 inches, this layer grades to strongly mottled drab, gray, limonite-yellow, and rust-brown heavy compact silt loam material. In places, material of sandy clay or silty clay loam texture occurs in the lower part of the subsoil. Below a depth ranging from 40 to 60 or more inches

is stratified, somewhat mottled brownish-yellow and gray fine sand. No rock or gravel is present in the soil or subsoil. This phase of soil occurs in a number of areas lying close together on high, level terraces of Lemonweir River, north of Tomah.

Areas of this soil phase are flat but are broken into small patches by stream channels extending through them. Surface drainage is only fair, and the deep part of the subsoil is water-logged. Much of the land would be benefited by tiling, since it could then be cultivated earlier in the spring and sooner after heavy rains.

About 95 per cent of this soil is farmed. No tobacco and comparatively less corn are grown than on typical Bertrand silt loam, but otherwise the crops grown and the yields obtained are about the same on the two soils. Alfalfa probably would not do well after the first year as the water table is too high.

The selling price of this soil ranges from about $100 to $150 an acre.

CLINTON SILT LOAM

The surface soil of Clinton silt loam, to a depth of about 8 inches, consists of grayish-brown, smooth floury silt loam underlain by more compact silt loam which gradually becomes heavier with depth. Below a depth of 15 inches the material is in most places compact heavy silt loam or silty clay loam which, when fairly dry, crumbles readily under a slight pressure. The heavy yellowish-brown subsoil material is silty clay loam in texture and continues to a depth of about 30 inches. The deep part of the subsoil or the substratum is variable. In places there are lenses of fine sand; elsewhere silty loam may extend to a depth of 6 or more feet. The underlying rock is limestone or sandstone, and both deposits have, in places, contributed to the subsoil. On some of the steeper slopes the soil covering is thin, and the subsoil is heavy, red, cherty material. In a few places the surface soil has been entirely removed by erosion. As a whole, Clinton silt loam is free from rock fragments and angular gravel and is of a loesslike structure and texture.

Clinton silt loam is mapped largely in the south half of the county. A large area occurs in the vicinity of Cashton. Areas range from undulating to gently rolling, and the natural drainage is good. The soil occurs on the rather broad undulating or gently rolling ridge tops.

The material forming this soil appears to be, in part at least, of loessial origin. The surface material is in most places slightly acid, but the deep part of the subsoil in many places contains considerable carbonate of lime.

By far the greater part of this soil is good agricultural land, and about 95 per cent of it is under cultivation and is occupied by well-improved farms. The principal crops are corn, small grain, hay, and some tobacco. Some farmers are beginning to raise alfalfa successfully where proper treatment is given the soil. General farming, with dairying as the main line, is the principal agricultural industry followed, although grain raising is more important than dairying in some regions. The crops grown, rotations, and methods of farming followed are practically the same as those on Dubuque silt loam. The same methods of soil improvement apply to both soils.

WABASH SILT LOAM

The topsoil of Wabash silt loam, to a depth ranging from 8 to 16 inches, consists of black silt loam having a smooth feel and a high content of organic matter. In places, the surface material is somewhat peaty or mucky to a depth of a few inches. This material is underlain by brownish-gray, drab, or mottled loam, silty loam, or silty clay loam. The texture ordinarily becomes heavier with depth and in many places is very heavy at a depth of 3 feet. The soil is rather variable, the surface in places being silty clay loam or clay loam and in other patches being loam. The subsoil may also be variable and where found associated with soils of lighter texture the deep part of the subsoil in many places contains lenses of sand and in some places is underlain by beds of sand.

Wabash silt loam occurs in practically every township in Monroe County, but many of the areas are small and scattered. This is a first-bottom land soil and therefore occurs exclusively on the lowlands along the beds of streams. Adjacent to La Crosse River and Lemonweir River are bottom lands which are in part Wabash silt loam. This soil, although of small total area, may be considered one of the most important bottom-land soils in the county. It covers a total area of 11.5 square miles or 7,360 acres.

Areas of this soil are low, level, or very gently sloping, and the natural drainage is poor. Much of the land is subject to annual overflow and must be drained before it can safely be cultivated.

Wabash silt loam consists of alluvial material washed from higher lands adjoining. The dark color results largely from the large quantity of organic matter which has accumulated under moist conditions.

The native vegetation on this soil consisted in part of willows and marsh grass, in the wettest places, and of a considerable growth of elm and soft maple. Along the margins, where the drainage is better, there were originally some oaks.

Where Wabash silt loam is fairly well drained, parts of it are now under cultivation, a considerable part is in pasture, and some is still covered with brush and wild grass. Where cultivated, such crops as corn, small grains, hay, and potatoes are grown with success, although there is always the danger of an excess of moisture at some time during the growing season. Flooding is very common in the spring. The grain produced is of slightly poorer quality than that grown on the light-colored upland soils. During dry seasons the grain stands up well, but with an excess of moisture it is likely to lodge. Sugar beets and other root crops should do well on this kind of land but they are not now grown to any extent. Hay is the surest crop year in and year out.

In the improvement of this soil, drainage is the first and most important step. A few lines of tile have already been put in, but most of the drainage has been through open ditches. In many cases the straightening and deepening of the drainage ways would afford sufficient drainage, as most of the areas of the soil are long and narrow and lie along drainage ways. When properly drained and protected from flooding this is an excellent farm land well suited to most of the general farm crops common to the region.

LA CROSSE SANDY LOAM

La Crosse sandy loam is grayish-brown, rather loose sandy loam or loamy sand to an average depth of 8 or 10 inches. In virgin areas a darker layer, about an inch thick, of leaf mold covers the surface. At a depth ranging from 10 to 18 inches, the subsurface soil is in most places brownish-yellow or yellowish-brown sandy loam or loamy sand. At an average depth of about 18 inches, this layer grades to yellow or pale-yellow fine sand. A layer of sandy clay or loam may be present in the lower part of the subsoil. Areas having a sandy topsoil and a layer of sandy clay or loam in the subsoil were included with this soil. A sprinkling of coarse sand and a trace of fine waterworn gravel are present in most places. La Crosse sandy loam is of small total extent and occurs in scattered areas on level terraces in the northern half of the county. It is closely associated wth Sparta sand and Sparta fine sand.

The porosity of the subsoil makes this a rather droughty soil. Probably 35 or 40 per cent of it is cultivated at the present time. The rest is covered mostly with a scattered growth of small jack pine, red oak, black oak, white pine, and other trees. It was formerly forested with a heavy growth of white pine. Corn does best of the ordinary farm crops. Probably 35 per cent of the cultivated area is devoted to corn; 25 per cent to oats, rye, and buckwheat; 20 per cent to clover and timothy for hay; and 5 per cent to tame grasses for pasture. Most of these crops are fed to dairy cows. Potatoes and watermelons do very well. Cucumbers thrive and are grown to a rather large extent as a cash crop. The average crop yields to the acre are about as follows: Corn, 30 bushels; oats, 25 bushels; clover and timothy hay, from one-half to 1½ tons; potatoes, between 75 and 120 bushels; rye, 15 bushels; and other crops somewhat below the average for the county. This soil is easily cultivated and can be farmed profitably even though the yields are lower than the average.

The selling price of improved areas of La Crosse sandy loam ranges from $25 to $50 an acre. Unimproved areas are held at $10 or $15.

La Crosse sandy loam, dark-colored phase.—The surface soil of La Crosse sandy loam, dark-colored phase, consists of dark-brown or nearly black sandy loam of medium or fine texture, ranging in depth from 8 to 12 inches. This is underlain by brown or reddish-brown sandy loam which becomes lighter in color and texture with depth. The substratum below a depth of 2 feet is commonly yellow sand which may contain some gravel in places.

La Crosse sandy loam, dark-colored phase, occurs chiefly in the north half of the county. In section 15 of Angelo Township there is a tract of 160 acres. Small areas are in sections 22 and 23 of Sparta Township and in section 30 of Greenfield Township. Other scattered patches occur, but altogether the soil is of minor importance. Small areas of La Crosse fine sandy loam, dark-colored phase, in the La Crosse River valley and in the southern part of the county are mapped with La Crosse sandy loam.

Areas of this soil are level or nearly so, and the natural drainage is good. In fact, the land is somewhat droughty, because of the openness of the substratum. Areas occupy benches above present

stream flood plains. Litmus-paper tests indicate that the soil is acid in reaction.

The original forest growth consisted chiefly of bur, black, and white oaks. Most of the timber has been cut, and the land is now under cultivation. La Crosse sandy loam, dark-colored phase, is rather sandy for general farming purposes, but most of the general farm crops common to the region are grown on it. Some farmers prefer this to the heavier soils. It is best adapted to trucking and special crops and where suitably located should be devoted to more intensive agriculture. In the improvement of this soil for general farming the acid condition should be corrected by the use of ground limestone. When the acidity is neutralized, clover and alfalfa can be grown, and with these legumes as a foundation a profitable agricultural practice can be built up in a few years. It may be found advisable to use some economical fertilizer to supplement the small supply of stable manure available. The soil is deficient in phosphorus and will doubtless respond to a phosphatic fertilizer. Where potatoes are grown, potash fertilizers may also be used with profit.

LA CROSSE LOAM

The topsoil of La Crosse loam is light-brown or brown loam 10 or 12 inches deep. The material of the subsoil is somewhat more compact yellowish-brown or brownish-yellow silt loam and grades, at an average depth of about 24 inches, to brownish-yellow or yellow material of fine sandy loam or fine sand texture. In places, the brownish-yellow loam continues to a depth of 36 or more inches. In some areas compact material, silty loam or silty clay in texture, is present in the upper part of the subsoil. The substratum is stratified and is rather variable, several layers of different material being found in one boring. There is no rock on this soil, but a trace of gravel is found in places in the lower part of the subsoil.

La Crosse loam occurs in small, scattered areas on level well-drained terraces in different parts of the county, mostly in the southern half. Probably 85 per cent of it is cultivated, and some of it is used for wood lots and permanent pastures. Probably 20 per cent of the cultivated area is devoted to corn, 25 per cent to oats, 30 per cent to clover and timothy for hay, 10 per cent to timothy and clover for pasture, and the rest to potatoes, tobacco, and minor crops. In the southwestern part of the county this is a favorite soil for tobacco. Perhaps 2 or 3 per cent of the total area is devoted to this crop. Crop yields to the acre are about as follows: Oats, 35 or 40 bushels; corn, 40 or 45 bushels; clover and timothy hay, 1 or 2 tons, and other crops about the same as the average for the region. Most of the crops are fed on the farm. Manure is returned to the soil regularly, but very little commercial fertilizer is used.

La Crosse loam, dark-colored phase.—La Crosse loam, dark-colored phase, to an average depth of about 12 inches, is rather dark brown loam containing considerable fine sand. It is underlain by more compact brownish-yellow or brown loam or clay loam which in most places grades, at a depth of 15 or 18 inches, to brownish-yellow or yellow, rather coarse loam underlain by a yellow sandy layer which continues to a depth of 5 or more feet. The substratum is composed of stratified material.

The soil and subsoil are free from rock and gravel. This phase of soil is found in a few small, scattered areas on level terraces in the southern part of the county. It is not subject to flooding in ordinary rains, and drainage is adequate for farm crops. In places the ground water may be too shallow for alfalfa.

Probably 95 per cent of this soil is cultivated. It is about the most favored soil in the county for tobacco growing and is said to produce a good yield and a fine quality of leaf. Ordinary dairy farming is practiced on most of the soil, and with the exception of tobacco most of the crops are fed on the farm.

Probably 6 or 7 per cent of the soil is devoted to tobacco. Otherwise, the comparative acreages of crops grown are about the same as on typical La Crosse loam. From 1,200 to 1,500 pounds of tobacco to the acre is a normal yield; corn yields 40 or 45 bushels; oats, 35 or 40 bushels; and other crops about the same as the average for the county. All the manure from the dairy barns is used on the tobacco fields in addition to considerable commercial fertilizer.

LA CROSSE FINE SANDY LOAM

La Crosse fine sandy loam is typically light-brown fine sandy loam to a depth of about 8 inches. This is underlain by brownish-yellow or yellowish-brown fine sandy loam or loamy fine sand which may continue to a depth of 36 inches. At a depth of about 18 inches, however, this material commonly grades to brownish-yellow or yellow loamy fine sand or fine sand. Stratified layers of finer or coarser materials occur in many places in the substratum.

A trace of fine gravel is present in the subsoil in some places. A few areas, mostly north of Tomah, having a mottled yellowish-gray, drab, brownish-yellow, and rust-brown subsoil of sandy clay or silty clay loam texture were mapped with this soil. A trace of red clay is found in places in the lower part of the subsoil. The color of the soil varies somewhat with the drainage. On some of the more poorly drained patches it is dark brown. La Crosse fine sandy loam occurs in small scattered areas on level terraces along the smaller streams in different parts of the county, although very little was mapped in the southern part.

This soil lies above the normal flow of the streams. Drainage is usually adequate for the ordinary farm crops, and underdrainage is in places excessive. The subsoil is a little too open to have a good water-holding capacity.

About 85 or 90 per cent of this land is farmed. The rest is used mostly for permanent pasture. Probably 20 or 25 per cent of the cultivated area is devoted to corn, 25 per cent to oats, 30 per cent to timothy and clover for hay, 15 per cent to timothy and clover for pasure, and the rest to potatoes, alfalfa, and other minor crops. Much of the clover and timothy is rather thin. The average crop yields to the acre are about as follows: Corn, 35 bushels; oats, 30 or 35 bushels; clover and timothy hay, from 1 to 1½ tons; and other crops slightly below the average for the region. Dairy farming is conducted on most of the land. A little tobacco is grown in the southwestern part of the county, and the soil is especially well adapted to potatoes, garden crops, and cucumbers.

Very little fertilizer, except barnyard manure, is used. Some very fine alfalfa has been grown with the use of ground limestone and superphosphate (acid phosphate).

Improved La Crosse fine sandy loam sells at prices ranging from $75 to $125 an acre.

SPARTA FINE SAND

Sparta fine sand, where undisturbed, is dark grayish-brown fine sand containing considerable organic matter to a depth of 1 or 2 inches. This layer grades to brownish-gray, loose, but somewhat loamy fine sand, which has a rather high content of very fine sand. Where the land has been farmed, the thin surface layer has been mixed with the soil below and a grayish-brown color results. At a depth varying from 10 to 15 inches this layer grades to light-yellow or gray loose porous fine sand. In many places it is underlain by light-gray fine sand, at a depth of 10 or 12 inches. On the higher terraces the light-brown fine sand may continue to a depth of 14 or more inches before it grades to light-yellow or grayish-yellow loose, porous fine sand underlain, at a depth varying from 20 to 30 or more inches, by light-gray loose porous fine sand. On the lower-lying areas, the upper part of the subsoil is in many places bright yellow or chrome yellow and is underlain by white fine sand. The substratum is commonly distinctly stratified. This soil is free from rock and rather free from gravel, though a trace of fine water-worn gravel may be found in the soil and subsoil.

This soil resembles the level phase of Boone fine sand in many respects. It differs in showing marked stratification in the substratum, which Boone fine sand does not show. The surface soil is dark colored to a greater depth than that of the Boone soil. The subsoil is lighter colored, being light yellow, gray, or white, whereas that of Boone fine sand is brownish yellow or reddish yellow. This soil also is free from rock fragments. The boundary between the two soils is generally not distinct, and they are in places difficult to separate in mapping.

Sparta fine sand is an extensive soil. The largest areas occur on high terraces in the La Crosse River valley, east and northeast of Sparta. Rather large areas occupy very high dissected terraces along Big Creek in Little Falls Township. Many scattered areas occur in the northeast part of the county on broad, level terraces but slightly lower than the surrounding upland. In that part of the county this soil is associated with Dunning sand. The soil, as a whole, is closely associated with Boone fine sand and other sandy soils of the region.

Along the northern boundary of the county in R. 3 W. some areas mapped as Sparta fine sand in Monroe County join areas mapped as Plainfield fine sand in Jackson County. Since Jackson County was mapped, in 1918, further study of the sand soils of southwestern Wisconsin has led to the recognition of the Sparta series of sand soils. These were formerly mapped in places with the Plainfield series. They differ from the Plainfield soils chiefly in the much greater depth of the dark-colored surface soil which contains appreciable quantities of organic matter.

The parent material of Sparta fine sand is derived largely from Potsdam sandstone, disintegrated, washed down, and deposited on level or nearly level areas. Over most of the soil, drainage is excessive. The subsoil is too porous and leachy to hold moisture, and crops suffer quickly from drought.

Sparta fine sand is a rather unproductive soil and is very low in fertility. Probably 10 or 15 per cent is cultivated, and probably 10 per cent more has been farmed at some time and abandoned. Many areas are farmed rather intermittently. One farmer may cultivate a farm for a few years, then abandon it, leaving it idle until some one else moves on it and farms it again.

A heavy forest of white pine and Norway pine formerly covered the land. The greatest part of it now is covered with second-growth jack pine, scrubby red oak, black oak, aspen, and a few white pine or Norway pine. (Pl. 49, D.) Sweet fern and wintergreen are very common. Very few blueberries grow on this soil, although they are common on Dunning sand and on Boone fine sand.

Mixed dairy farming and the growing of special cash crops are usually conducted on this soil. Most farmers keep a few cows which are pastured, as much as possible, on surrounding unimproved land.

Probably 35 per cent of the cultivated area is devoted to corn, 20 per cent to oats, 20 per cent to clover and timothy for hay, 10 per cent to rye, 5 per cent to timothy, clover, brome grass, and quack grass for pasture, 3 per cent to cucumbers, 3 per cent to potatoes, and the rest to buckwheat, strawberries, watermelons, garden crops, soy beans, and other minor crops. The average acre yield is about as follows: Corn, 20 bushels; oats, from 15 to 18 bushels; rye, 10 or 12 bushels; hay, from one-half to 1 ton; and potatoes, 70 bushels.

The average yields are slightly lower than on Boone fine sand. The localities where this soil predominates have a rather desolate appearance. Most of the farm buildings are dilapidated and unpainted, and the cattle and work animals are usually poor. Farming on this soil has not usually proved profitable. White pine, Norway pine, and jack pine thrive, and it seems that the land could be used much more profitably for the production of timber.

Because of its sandy texture this soil is very easy to manage. It is usually plowed shortly before seeding, to prevent drifting. It is often disked in preference to being plowed. All the manure produced on the farm is returned to the soil, but very little commercial fertilizer is used, even though this soil, because of its low fertility, responds very well to its use.

Improved areas of Sparta fine sand have sold for between $10 and $25 an acre. Unimproved areas are held at $5 or $10. If the land supports any merchantable timber, the value is correspondingly higher.

SPARTA SAND

Sparta sand, to a depth ranging from 10 to 14 inches, is grayish-brown, very loose fine sand or medium sand containing many particles of coarse sand. A thin, rather dark grayish-brown surface layer, 1 or 2 inches thick, which contains considerable forest litter, is found in many places in virgin areas. The subsurface layer is

typically brownish-yellow loose sand or fine sand to an average depth of 20 inches, where it grades to very light gray or grayish-yellow sand or fine sand. Considerable coarse sand and a trace of very fine waterworn gravel are found in the subsoil, though the soil is free from rock or coarse gravel.

Most of this soil was mapped in one large area in the La Crosse River valley northeast of Sparta. Many scattered areas occur in the northeastern part of the county, on level, rather high terraces. This soil is of the same origin as Sparta fine sand. Drainage is excessive. The land was formerly covered with a heavy forest growth of Norway pine and white pine. The original timber has all been cut, and a second growth of jack pine, with some scrubby oaks, aspen, and white birch, has taken its place. Probably 6 or 7 per cent of the soil, very little of which is in the northeastern part of the county, is cultivated.

The same crops are grown as on Sparta fine sand, and the yields to the acre are about the same. Improved areas of Sparta sand sell at prices ranging from $10 to $25 an acre. Unimproved land is held at about $5 or $10 an acre, plus the value of any timber it supports.

A small acreage of this soil can profitably be used for growing special crops, such as cucumbers and watermelons. General farming has not proved profitable, and it seems that the soil can be used to better advantage for the production of timber, since pine trees thrive.

GENESEE SILT LOAM

Genessee silt loam is typically brown or light-brown silt loam to a depth ranging from 10 to 14 inches. This material grades to silty clay loam or silt loam showing striking mottles or streaks of various combinations of yellowish brown, grayish drab, limonite yellow, reddish brown, yellow, and gray. The yellowish brown and yellow are more pronounced in the upper part of the subsoil. The limonite yellow, gray, and drab become more pronounced with depth. In places the subsurface layer is silty clay, loam, very fine sandy loam, or fine sandy clay.

At an average depth of about 30 inches, the subsoil commonly becomes gray or drab mottled with limonite yellow and is of silt loam or silty clay loam texture. The lower part of the subsoil is commonly lighter in texture than the upper part. In many places the subsoil grades to gray fine sand at a depth of 30 or 36 inches. Layers of peat or black mucky silt loam may be found in any part of the subsoil. On low areas the lower part of the subsoil is usually saturated with water. Both the soil and the subsoil are variable in texture. The soil occurs mostly near meandering stream channels where it varies greatly within short distances. The subsoil is irregularly stratified and two cross sections some distance apart are seldom the same. Some areas of Genesee loam were mapped with Genesee silt loam. Much of the surface soil consists of material that has been washed down from cultivated fields. Practically no gravel or rock is found on this soil.

Genesee silt loam is the most important first-bottom soil in the southern half of the county, and a few small areas occur in the north-

central part. This soil occurs in long, narrow areas on level stream bottoms where the surrounding uplands are Boone silt loam or Dubuque silt loam.

Most of this soil is flooded in the spring and after unusually heavy rains during the summer. The drainage is too poor to allow the cultivation of most of it, since it is wet and soggy at all times of the year. The best-drained parts are nearly all cultivated. The drainage of cultivated areas has been greatly improved by ditching. About 20 per cent of the soil is cultivated. Probably 25 per cent is wooded; the rest is open grass with some patches of willow and alder brush and is used for permanent pasture. Most of the brush grows near the stream channels. Much more of the area of this soil could be farmed if it was drained by ditching, but it is valued nearly as highly for permanent pasture as for farming land. It makes about the best permanent pasture in the county. Nearly all of it could be drained sufficiently by canals and ditches to allow cultivation, but it would be too expensive to be profitable at the present time, because of the comparatively narrow stream bottoms on which it occurs and of the extreme hilliness of the surrounding country, with its attendant quick run-off. Most areas are cut up to a considerable extent by meanders of the stream channels. Probably 20 per cent of the cultivated area is devoted to corn, 25 per cent to oats, 30 per cent to clover and timothy for hay, 10 per cent to timothy and clover for pasture, and the rest to barley, wheat, and minor crops. Some tobacco is grown in the southwest corner of the county.

In dry years the crop yields are much above the average for the county, but in wet years the yields are lower because of poor drainage. In the long average the yields are as high as on the best upland soils. The average yields to the acre are about as follows: Oats, 40 or 45 bushels; corn silage, 8 or 9 tons; corn, 45 bushels; barley, 30 bushels; and wheat, 16 or 18 bushels.

Dairy farming is practiced on most of this soil, which is naturally very fertile. Barnyard manure is the only fertilizer used. Improved Genesee silt loam ranges in value from about $75 to $125 an acre. Some select areas have sold at considerably higher prices, but the wettest parts are of very little value. This soil is nearly always sold with some adjoining soil.

GENESEE LOAM

Genesee loam is brown or light-brown loam to a depth ranging from 6 to 14 inches. Very fine sand is one of the principal constituents of this layer. It grades to yellowish-brown or brownish-yellow material, mottled with gray and dull yellow and of loam, fine sandy loam, or fine sandy clay texture. The dull-yellow and drab mottles become more pronounced to a depth varying from 24 to 30 inches below the surface. The subsoil has a wide range of texture and color, as it consists of interstratified layers of various colors and textures. It commonly becomes coarser with depth. The lower part of the subsoil, at a depth ranging from 28 to 36 or more inches, is grayish-yellow or gray very fine sand or sandy loam material. No rock and very little gravel are found on this soil.

The lower part of the subsoil in many places is saturated with ground water. Layers of peat and mucky loam are present in the

subsoil. The soil is usually coarse near the stream channels and finer near the outer border of the areas. Owing to its variability, small patches of other soils of this series and patches of peat too small to map are included with mapped areas of this soil. Genesee loam was mapped only in the southern part of the county and occurs chiefly on the bottoms of small tributaries of Kickapoo River, in the south-central part. It occupies level first bottoms where the streams have a higher gradient than where Genesee silt loam has developed. It is closely associated with Genesee silt loam and Genesee fine sandy loam. The bordering soils toward the upland are, in most places, Bertrand silt loam, Boone loam, or Boone silt loam. This soil occurs exclusively in a region where the uplands are very hilly and consist mostly of Boone silt loam, Boone loam, and Dubuque silt loam, and the soil material has been washed down from these surrounding uplands and deposited along the flood plains of the stream.

Most of this soil is subject to flooding in the spring and after unusually heavy rains in the summer. The lower areas are wet and soggy at all times. Nearly half of the soil is now sufficiently well drained to allow it to be cultivated.

Probably 30 per cent of this soil is cultivated. The rest is in woods and permanent pasture. It is considered of about the same value for pasture as for farming. The acreage of the crops grown is about the same as on Genesee silt loam, but the average yields to the acre may be slightly lower. The methods of farming are the same as on Genesee silt loam. Some of the best-drained areas are worked more than the slushy spots.

Improved Genesee loam sells at prices ranging from $75 to $125 an acre.

GENESEE SILTY CLAY LOAM

The topsoil of Genesee silty clay loam, to a depth of about 12 inches, consists of brown or grayish-brown silt loam or silty clay loam. Between depths of 12 inches and about 30 inches the subsoil is brown, grayish-brown, or mottled silty clay loam material. Below a depth of 30 or 36 inches, gray fine sand is present. This fine sand may continue to a greater depth or there may be more clay loam in the subsoil. The soil, as a whole, is subject to considerable variation in texture, color, and supply of organic matter. In places there is a thin covering of peat, and in others the soil is dark, resembling the Wabash silt loam into which it grades. Both soils occupy the stream bottoms.

Genesee silty clay loam is widely distributed throughout the county, occurring in strips rarely more than one-fourth mile in width which extend for some distance along stream bottoms. Some of this soil is in nearly every township in the county. Where it occurs in the northern and most sandy part of the county, there is usually more sand and fine sand in the subsoil than in the southern part of the county where most of the upland soils are heavy.

Areas of this soil are low, level, or very gently sloping, and the natural drainage is poor. This is all first-bottom land and is nearly all flooded at least once each year.

This soil consists of alluvium deposited by the flood waters of the streams along which it occurs. The parent material of the sandy

phases is largely sand which came from Potsdam sandstone. The silty material has come largely from the residual limestone and shale material and possibly in part from loessial deposits found in the southern part of the county.

The native vegetation on this soil was elm, soft maple, willow, and alder. There were also numerous open areas where a heavy growth of coarse marsh grass flourished. The great part of the merchantable timber has been removed, but there are still some trees of fair size, and considerable brush grows in places.

Where the natural drainage is best or where ditches have been constructed, some of this land is under cultivation and is producing fair crops. The first and most important step in its improvement is drainage. When well drained, it is adapted to all general farm crops common to the region. It is good land for corn and is also well suited to hay. At present it is better suited to pasture and hay than to cultivated crops. Even after drainage has been supplied, it may be necessary to protect the land from flooding during the heavy spring rains. It is doubtful if the expenditure necessary is justified in all areas. In the largest areas considerable money could be expended to advantage, but on small tracts it is probably better to get what pasture and hay the land affords and not attempt to make tillable land out of it under present conditions.

GENESEE FINE SANDY LOAM

Genesee fine sandy loam is mostly light-brown or grayish, yellowish, or reddish-brown fine sand, 8 or 10 inches deep, which grades to brownish-yellow material. The subsoil is mostly brownish-yellow, fine sandy loam material containing some grayish, reddish, or brown mottles. The lower part of the subsoil in many places is grayish-yellow fine sand. The subsoil is irregularly stratified with fine and coarse layers, and the soil varies according to its position from the meander of the stream.

This soil occurs in only a few small, scattered areas on level stream bottoms of small streams and is cut up considerably by the meander of the stream. Most of it is subject to overflow after very heavy rains.

About 10 per cent of the Genessee fine sandy loam is cultivated. The rest is largely covered with brush and small trees and is used for pasture. Probably 80 per cent could be drained sufficiently well to allow cultivation. At the present time, it is valued about as highly for pasture as for farming.

The crops grown are about the same as those produced on Genesee silt loam, but yields are considerably lower. The selling price of Genesee fine sandy loam ranges from about $25 to $75 an acre.

GENESEE FINE SAND

Genesee fine sand is mostly grayish-brown or brownish-gray slightly loamy fine sand, 4 or 5 inches thick, underlain by slightly yellowish or brownish-gray, loose fine sand or sand which continues to a depth of 36 or more inches. Tan and reddish or brownish mottles occur in places in the subsoil. Much coarse sand is found

on the surface near stream channels and little patches of fine sandy loam may be found on the lower areas away from the stream channels.

This soil occurs on small stream bottoms where the gradient is high. Only a few scattered areas were mapped. Genesee fine sand is flooded after all heavy rains, but artificial drainage would be impractical on account of the large volume of water which comes down the narrow bottoms where this soil occurs.

Areas are rather hummocky, are badly cut up by stream meanders, and none of the soil is cultivated. Most of it is covered with brush and a scattered growth of trees and is now used for permanent pasture. The stumps remaining indicate that large white pine trees were common on much of it. This soil is adapted to pasture and wood lots.

Genesee fine sand ranges in selling price from about $10 to $20 an acre. It is usually sold with other soils.

DUNNING FINE SANDY LOAM

The topsoil of Dunning fine sandy loam, to a depth ranging from 8 to 16 inches, consists of black loam or fine sandy loam which contains a high percentage of organic matter. In many places, peat or muck, a few inches thick, is present on the surface. The subsoil consists of brown or grayish-brown sand which may be mottled in places. In some areas clay is found at a depth ranging from 30 to 36 inches below the surface, especially in the region where the Superior and Poygan soils occur, as in parts of Byron and Oakdale Townships. This soil varies also in having, in a few places, a loamy, peaty, or mucky sand surface soil, underlain by light-colored sand. Such areas, however, are small and are therefore of minor importance.

Dunning fine sandy loam occurs chiefly in the north half of the county and is most extensive in the northeast quarter, in Scott, La Grange, Byron, Oakdale, and Lincoln Townships. One of the larges areas is in the township of Byron in sections 15, 22, and 23. There are many small areas. The soil has a total area of 14,592 acres, or about 2.5 per cent of the entire county.

This is a marsh border soil, and areas are low lying, level, or very nearly so, and the natural drainage is poor. Dunning fine sandy loam occurs between the peat areas and the light-colored sandy soils. It is only a very little higher than the peat bogs, and in the spring and during wet seasons parts of it are covered with water a few inches deep.

The material forming this soil is partly residual from Potsdam sandstone. Part of it has been worked over and deposited by water and practically all of it has been influenced to some extent by excessive supplies of moisture. This moist condition has favored the growth of a rank vegetation, and the decay of this vegetation has supplied the organic matter which now is present in the soil.

Tests with litmus paper and the Truog test show that this soil is acid and needs lime. The vegetation consists of willows, alder, some jack pine in places, poplar, and soft maple, and various kinds of coarse marsh grasses in the numerous open areas.

The greater part of this soil, in its present condition, is considered to have a low agricultural value, partly because of its low, poorly drained condition, and partly because the most sandy areas are low in fertility. Part of the soil has been cleared, and in a number of places fair or good crops are grown. In section 16 of Lincoln Township, near Warrens, a good patch of strawberries was seen. Some commercial fertilizers are used in places. In Byron Township, one farm on this soil was reported to have yielded from 40 to 60 bushels of oats and from 30 to 45 bushels of corn to the acre. Such yields are possible under the most favorable conditions, but they seem to be above the average. Hay is frequently grown. Alsike and timothy appear to make the best hay crops. The native bluestem also supplies fairly good feed for livestock. At Valley Junction, on a farm made up partly of this soil, onions, potatoes, corn, and small grains have been grown successfully, so far as production was concerned, by the use of manure and commercial fertilizers in addition to drainage, but it is understood that because of unfavorable marketing conditions and high costs of labor and fertilizers this farm failed. There are thousands of acres of this land in this county and throughout the sand and marsh section of central Wisconsin. This land is still unimproved and is considered by most people as rather unpromising for agricultural development in the near future. The greatest and first need is drainage. The soil is acid and needs lime. It is also poor in the mineral plant-food elements.

DUNNING SAND

The topsoil of Dunning sand, to a depth ranging from 6 to 10 inches, consists of medium or fine black or dark-gray loamy sand. This is underlain by grayish medium or fine sand which continues to a depth of more than 3 feet. This soil is subject to some variation, but it is everywhere dark colored and the subsoil is lighter in color and texture than the topsoil. In places there is a surface covering of peat a few inches thick, and in other places the surface material is loamy and approaches sandy loam. This covering of loamy material is shallow and, if plowed, would become mixed with the underlying sand. In many places, deep plowing would turn up the lighter colored sand. In a few areas there are lenses of clay or silty material in the deep part of the subsoil, especially in the region where the Superior or Poygan soils are associated with the Dunning soils.

Dunning sand is rather inextensive and is of minor importance. It occurs chiefly in the northeastern part of the county, where it is associated with marshes and other low-lying types of soil. In many places it grades to Dunning fine sandy loam, which it somewhat resembles.

This is a marsh border soil, and areas are low, level, and naturally poorly drained and are sometimes very wet. In the spring, part of the soil may be covered with standing water. In some places, open ditches (pl. 49, B) have been installed so that the drainage situation is relieved somewhat, but little of the land is sufficiently drained to allow the growing of cultivated crops.

The native growth was chiefly alder and willows, with coarse marsh grass in open places. Some elm, soft maple, and ash trees originally grew on this soil, but few remain.

Considered agriculturally, this soil has a low value under present conditions. Where utilized at all, it is mainly given over to pasture, and in only a few places has cultivation been attempted. Some hay is cut, but the improved area is very small.

In the improvement of this soil, drainage is the first step. The soil is poorly supplied with mineral plant foods and when cultivated both potash and phosphatic fertilizers are needed. The soil, when drained, is best suited to special crops, such as cabbage, carrots, onions, and celery. It will always have a low value for crop production.

DUNNING SILT LOAM

The topsoil of Dunning silt loam, to a depth of about 14 inches, consists of black silt loam which contains a large quantity of organic matter. The topsoil is in many places covered with a layer of peaty or mucky material 2 or 3 inches thick. The subsoil is in places gray, drab, or whitish sand and in other places is brownish silt loam which, at a depth of about 2 feet, grades to mottled drab and yellowish silty clay loam. Between these two extremes, all kinds of subsoil variations are found, though none of them are of great extent. In a few places the topsoil was found to be clay loam, but this variation was too limited to be mapped separately.

This soil occurs mainly in the northeast quarter of the county, in the townships of Byron, Oakdale, Lincoln, Tomah, La Grange, and Scott. It commonly lies between the peat marsh and the light-colored upland soils and forms a gradation from the upland into the marsh. It is frequently termed marsh borderland.

Areas are low and level, and the natural drainage is poor. The surface is only a little higher than that of the peat areas, and the drainage is slightly better than on the peat. Artificial drainage is necessary over practically all of the soil before cultivated crops can be grown safely from year to year.

Dunning silt loam has developed in old lake beds or under marshy conditions which have favored the growth of a rank vegetation, the decay of which accounts for the large supply of organic matter. The sandy part of the soil material has come from Potsdam sandstone but has been influenced to varying degrees by the action of water. The heavy material, such as the silt and clay particles, has been washed in from higher land. Acidity tests indicate that Dunning silt loam shows varying degrees of acidity, and the soil would doubtless respond to the use of lime.

The native vegetation consisted of willows, elms, soft maple, and alder, with coarse marsh grasses growing in the open places. Most of the valuable timber has been cut, and a small part of the land has been placed under cultivation.

Only a small part of this soil is producing crops at present. Before it can be farmed, drainage is necessary. After drainage is established, it is believed that with good management this can be made a productive soil. It needs lime and will also respond to commercial

fertilizers containing potash and phosphorus. When drained, it should be well suited to corn, hay, root crops, and small grains. Potatoes, onions, sugar beets, and cabbage are crops which could well be grown under favorable conditions.

POYGAN FINE SANDY LOAM

The topsoil of Poygan fine sandy loam consists of dark-brown or black loam or fine sandy loam. The upper part of the subsoil is lighter in color and in texture than the surface soil. At a depth of 2 or 3 feet this lighter material grades to heavier material which resembles that of the subsoils of the Superior soils. It is heavy reddish clay loam or clay in places but contains some lenses of fine sand. As may be expected, this soil, or rather the group of soils included under this type name, is subject to considerable variation, both in the surface and the subsoil. In many places a surface layer of peaty or mucky material from 1 to 3 inches thick is present. After the land is brought under cultivation, this surface layer soon disappears.

Poygan fine sandy loam occurs exclusively in the northeast quarter of the county, largely in the townships of Scott, Byron, and Oakdale. It is closely associated with the Superior soils but occurs in slightly lower positions. The total area of this soil in the county is 6.3 square miles or 4,032 acres.

Areas of Poygan fine sandy loam are level, low, or depressed, and the natural drainage is deficient. Artificial ditches must be constructed before profitable yields can be obtained. In a number of places, open ditches have been dug and in a few places tile drains have been installed. Tile drainage is the best method of draining this land, all of which is so situated that it is possible to get a good outlet.

The subsoil of Poygan fine sandy loam is well supplied with lime but the topsoil in places is slightly acid. In the growing of clover it may be found advisable to use lime. If there is difficulty in getting a stand of clover where the land is well drained, tests should be made on each field to determine the need of the soil for lime.

The native vegetation on this land consisted chiefly of elm, some soft maple, willow, and alder brush. On some of the lower areas there were no trees, but the ground was covered by a dense growth of several varieties of marsh grass. Most of the timber has been cut, and some of the land has been brought under cultivation.

Part of this land is in farms, and where well drained it produces good crops. It is well suited, where drained, to corn, hay, small grains, sugar beets, cabbage, and other crops. In the improvement of this soil, drainage is the first and most important step. In its present condition, it is best adapted to grass for pasture and hay.

POYGAN SILT LOAM

The surface soil of Poygan silt loam is black silt loam, commonly from 10 to 18 inches deep, and is underlain by heavy red clay. In the lower part of the subsoil it is common to find lenses of fine sand. The surface soil is somewhat variable and ranges from loam to clay

loam. The depth of the black covering also varies, and in the lowest places it is not uncommon to find a covering from 1 to 3 inches thick of peaty or mucky material.

Poygan silt loam is of small extent and of minor importance in this county. It occurs exclusively in the northeast quarter of the county, chiefly in the townships of Oakdale and Byron. It is closely associated with the soils of the Superior series, with the Dunning soils, and with peat. It may be classed as one of the marsh border soils.

Areas of Poygan silt loam are low, level, and naturally poorly drained and occur between areas of the Superior soils and areas of peat. This soil is only a little higher than the peat beds, but drainage is somewhat better although it must be improved before cultivated crops can be grown safely with profit from year to year.

The material forming this soil was deposited by water in an old lake. The marshy condition which existed favored the growth of a rank vegetation, and the decay of this vegetation accounts for the large supply of organic matter. The subsoil, which is heavy, commonly contains a considerable quantity of lime carbonate, but the topsoil has been leached to such an extent that it is in many places somewhat acid. The peaty areas, especially, are apt to be sour and in need of lime.

The native vegetation consisted largely of elm, soft maple, ash, willow, and alder brush, with marsh grass growing in the open, treeless patches. Most of the timber has been removed, and some of the land is now under cultivation.

Part of the land, where drainage has been installed, is cultivated, but the greater percentage is in pasture or is unimproved. When drained, this is one of the best soils in the county. After drainage is established it is suited to corn, small grain, hay, cabbage, sugar beets, and other crops. It is a good general-farming soil, but most areas are so small that no farms are composed entirely of it.

SUPERIOR SANDY LOAM

The surface soil of Superior sandy loam consists of brownish sandy loam, loamy sand, or fine sand, from 4 to 8 inches deep. This is generally underlain by yellowish sand or fine sand which continues to a depth of 30 or 36 inches, where there occurs the bed of heavy red clay characteristic of the subsoil of the Superior soils. In some places it was impossible to reach the bed of clay with the 3-foot soil auger, and in a few places the clay came to within 2 feet of the surface. The supply of organic matter in the surface soil is small.

Superior sandy loam is of small extent and therefore of minor importance. It occurs exclusively in the northeastern part of the county, chiefly in the townships of Byron, Oakdale, and Scott. The largest tract is probably near the village of Shennington, which is close to the Juneau County line.

Areas of this soil are level or nearly level, but the drainage is adequate. Superior sandy loam suffers less from drought than most sandy loam soils because of the bed of clay in the subsoil.

The native forest growth consisted principally of oak, maple, and some pine, with a little elm and ash on areas where the clay comes nearest to the surface and influences the drainage.

Most of the soil is cleared and cultivated. It is devoted to growing most of the general farm crops common to the region and gives fair yields. It is well suited to potatoes and is a fair soil for corn. Rye does better than the other small grains. Hay is grown to a small extent, and some of the land is still in native pasture. In improving the soil, more legumes should be grown to increase the supply of organic matter.

The topsoil is in many places slightly acid, but the clay subsoil typically contains a good supply of lime. By liming and using some commercial fertilizer, good clover and alfalfa can be grown. Where these crops succeed the land can be highly improved.

SUPERIOR SILT LOAM

The topsoil of Superior silt loam, to a depth ranging from 6 to 12 inches, consists of grayish-brown or light-brown silt loam containing a comparatively small supply of organic matter. The subsoil is somewhat lighter in color but grades quickly to heavy brownish-red or yellowish-red clay, which is the characteristic subsoil material of the Superior soils. The depth to the heavy red clay is somewhat variable, and in a few places the heavy subsoil comes within a few inches of the surface.

Superior silt loam is of very small extent. It is closely associated with other soils of this series and with the Poygan soils, all of which occur exclusively in the northeast quarter of the county, chiefly in the townships of Byron and Oakdale. Numerous small areas are scattered about this part of the county. Some areas were too small to be shown on the map.

Areas of this soil are level, or very nearly level, and the natural drainage is somewhat deficient, especially where the clay comes near the surface. In a few depressions the soil is always wet in the spring, and in these and over a considerable proportion of the soil, tile drains could be installed with profit.

The original forest growth consisted of oak, maple, elm, soft maple, some hickory, and, in places, white pine and Norway pine. Practically all of the valuable timber has been cut.

This is a good soil and is well suited to all of the general farm crops common to the region. The greater part of it is cleared and cultivated. In its higher areas, drainage is a question which must be given consideration. Although the topsoil is in places slightly acid, the subsoil is generally well supplied with lime. More legumes should be grown to add to the supply of organic matter. With thorough drainage insured, alfalfa would do well and the acreage of this crop could well be extended.

PEAT

The material classified as peat consists chiefly of vegetable matter in varying stages of disintegration and decomposition, with which there is mixed a small but varying quantity of mineral matter or fine earth. The depth of the material forming this soil is also extremely variable, and on the soil map has been divided into two classifications. Typical peat is more than 18 inches deep and may be as much as 15 feet deep, although the average depth is probably between 4 and 5 feet. The shallow phase of peat ranges from 6 to 18

inches in depth. Usually the material is more thoroughly decayed and because of this is darker in color. The mineral substratum under most of the peat consists of fine sand.

The color of the peat and the extent to which the vegetable matter has decayed are variable. These variations are of importance, although they have not been indicated on the soil map except as they are brought out by the differences in the depth of the peaty material. By far the greater proportion of the deep peat is brown in color, with a fibrous texture showing that it has not reached an advanced stage of decomposition. In many places the stems, leaves, and roots of grasses or moss from which it is formed can still be recognized. This raw material continues to a depth varying from 3 to 6 or more feet, but in most places the lower deposits are somewhat more thoroughly decayed and are of a darker color than the surface. As a whole, peat of the shallow phase is somewhat more decayed and darker in color than the deep peat, and, in a few places, because of the larger percentage of fine earth present, approaches muck in composition. Such dark-colored well-decomposed material, however, is of rather small extent.

As has been indicated above, the earthy subsoil under the peat consists for the most part of white or grayish fine sand. Two exceptions to this are worthy of note. The peat areas which are associated with and border the Poygan and Superior soils in the northeastern part of the county are in many places underlain by clay similar to that which forms the subsoil of the Superior soils. These peat areas form only a small proportion of the total area of peat in the county. The other exception is in the southern part of the county where small areas of peat land lie along the bottoms of some of the drainage ways in regions where the surrounding upland soils are heavy. In these places the substratum beneath the peat is heavy in texture.

From the viewpoint of area covered, peat is one of the important kinds of land in Monroe County. It occurs in all but two or three townships in the county but the largest and most numerous areas are in the northeastern quarter, in the townships of Oakdale, Byron, Scott, Lincoln, La Grange, and Tomah. Probably more than 75 per cent of this peat is deep. All the peat, taken together, covers 6 per cent of the county or a total of 35,840 acres. In the northeastern part of the county the peat marshes are largely surrounded by sand of the Sparta and Boone series and by marsh border soils of the Dunning series. In the southern part of the county peat occurs chiefly in stream bottoms where the surrounding upland soils are mostly heavy. The shallow peat is a gradational soil from the Dunning soils to deep peat and is all closely associated with deep peat, usually occurring between the latter and the soils of the Dunning series.

In a few places along the northern boundary of the county, areas mapped as peat in Monroe County join areas mapped as Boone fine sand and Plainfield fine sand in Jackson County. This discrepancy is probably due to the difficulty of following the county line and accurately locating the soil boundaries in this comparatively undeveloped region.

The material forming the peat has come from the decay or partial decay of large quantities of vegetable matter with which there have been mixed small quantities of mineral matter. The sand substratum has come largely from Potsdam sandstone. Where there is a heavy subsoil under the peat, as occurs in parts of Byron, Oakdale, and Scott Townships, this heavy material is largely water-laid and most of it contains considerable lime carbonate.

Acidity tests made on peat show that this material is all acid but varies somewhat in the degree of acidity.

The tracts of peat soil are all comparatively low and flat and are naturally very poorly drained. On many of the marshes water stands on the surface during the spring and early summer. In this soggy condition the land is often so soft that it will not support the weight of livestock. During the late summer, especially during dry seasons, the marshes dry out so that farm animals can safely go almost anywhere, and the peat frequently becomes so dry that danger from fires must be considered. When fire once gets started in the peat it is very difficult to extinguish and sometimes continues to burn until it is stopped by the fall rains. Practically all of the material mapped as peat is sufficiently rich in organic matter to burn when dry.

A number of large drainage ditches have been extended into and through the large peat tracts, but these supply only partial outlets and in order to drain the land sufficiently for the safe cultivation of crops numerous lateral ditches supplemented by tile drains are necessary. In the vicinity of cranberry marshes drainage is restricted by the dams which form reservoirs for storing water so that the cranberries may be flooded when necessary. Outside of the cranberry marshes very few lateral ditches have been installed, so that on but few, if any, tracts are the peat lands properly and sufficiently drained. From work already done there appears to be sufficient fall so that from an engineering point of view it would be possible to drain all of the peat land in this county.

The present growth on forested areas of peat consists of tamarack, alder, poplar, willow, and various other water-loving trees. (Pl. 49, E.) Only a comparatively small proportion of the peat marshes are forested, most of them being open and treeless or nearly so. The open marshes support a growth of coarse marsh grass, wire grass, or Sphagnum moss, through which are scattered small and stunted water-loving shrubs. Some of the marsh grasses are pastured or cut for hay.

Although peat is an extensive soil material in Monroe County, it is at present of little importance agriculturally. Some cultivation is being attempted in several places. In some of these attempts, work has been done on a rather large scale, in some places with tractors. In most places it has been found that because of insufficient laterals or tile ditches, the drainage is not adequate and crop failures have resulted from an excess of moisture, even on land which, during a series of dry seasons, produced fair or good crops of timothy hay.

The crops most commonly grown here on peat are buckwheat, rye, timothy, potatoes, root crops, and some cabbage and onions. Some attempts are made to grow corn but because of the danger of summer frosts this crop is very uncertain.

Tracts of peat lands of various size are utilized to a small extent for pasturage and hay, although the wild marsh grasses have a low food value. These marshes are frequently burned over to destroy the dead grass and trash on the surface, and a fair stand of clean grass usually follows. While this is young and tender, it makes fair pasturage. If the marshes are burned over during dry seasons there is danger of the peat itself being burned.

Without fertilization the yields of the crops mentioned, when grown on raw, brown, fibrous peat, are usually low and unsatisfactory. Where the peat is well decayed and of a black color fair crops may be grown for a few years without fertilization. Where the surface of the peat, to a depth of a few inches, is burned there is a concentration of the mineral elements sufficient in some places to insure two or three fair crops. The fire, if not controlled, however, may burn to the water table, and the surface of the ground is thus lowered to such an extent that the land will no longer be sufficiently drained.

In some places a minor industry has developed in the cutting of wire grass which is cured like hay, baled, and sold to the manufacturers of grass rugs.

It is well known that frosts frequently occur on marshland when there is no frost on higher land. This is partly because the cold air which forms on the surface of all the ground at night tends to flow down and collect in low places, but it also results from the fact that the loose, spongy material of peat marshes does not conduct downward the heat received from the sun during the day. In consequence of this, the lower layers of soil do not become warmed in peat marshes as they do in mineral soils, and the little heat left in the surface 1-inch or 2-inch layer is rapidly lost at night by radiation, so that the freezing point is frequently reached on such soil when it is not reached in surrounding mineral soils. This difficulty can be overcome to a certain extent by heavy rolling, which, by compacting the soil, allows the heat to be conducted downward more readily. The danger of frost will become less as the peat decomposes and takes on more of the character of muck. Nevertheless, it must always be expected that marshland will be more subject to late spring and early fall frosts than high land.

The main difference between peat soils and upland soils consisting largely of mineral matter is that the peat soils contain comparatively small quantities of the mineral elements, including phosphorus, potassium, calcium, and magnesium, and extremely high quantities of organic matter.

The fertilizer requirements of peat soils are extremely variable, but in general it may be said that their rational treatment requires the use of fertilizers containing especially phosphorus and potassium. On the deeper peats which are in a very raw and acid condition the use of lime will be found necessary for the production of many crops.

The best staple crops for this land are grasses for hay and pasture, hardy root crops, rye, and to a less extent oats. When the land is properly drained, fertilized, and limed, clover, alfalfa, and other legumes can also be grown, as well as such crops as cabbage, onions, buckwheat, sugar beets, and rape. On fairly well drained, well-decomposed marshland, good pasture can be developed. The

compacting of the soil resulting from the use of this land as pasture is also a great benefit to it. When peat land is placed under cultivation a heavy roller should be included with the implements necessary to its successful management.

Summarizing the situation for the future agricultural development of the peat lands such as are found in Monroe County, it may be suggested that before farming on these lands can be permanently successful there are several conditions with which it is necessary to comply. (1) It is absolutely necessary that the land should be sufficiently drained. Large outlet ditches, although necessary, are not in themselves sufficient and must be supplemented by open laterals and tile drains. (2) This type of land is poor in potash, phosphorus, and in many places in lime, and these materials must be supplied in proper form and proper quantities before permanent, profitable production can be expected. (3) It must be recognized that the danger from summer frosts makes such crops as corn and potatoes uncertain, and the crops to be grown must be those which are not only suited to the soil but also to the climatic conditions peculiar to these organic soils. (4) Those purchasing this type of land must not only see their way clear to pay for the land itself but they must also provide adequate drainage and fertilization, both of which call for an added investment.

Peat, shallow phase.—Peat, shallow phase, includes areas in which the deposit of organic soil is generally less than 18 inches deep. The soil so mapped is described in the general discussion of peat.

ROUGH STONY LAND

Rough stony land includes steep, rocky, gullied slopes and rocky sandy hills which are too steep or too rocky and shallow to cultivate. Areas having a slope of 29 per cent or more were arbitrarily included with this soil. A slope of 29 per cent was considered about the maximum slope on which it is practical to plow land in this county. Farm machinery can not be used successfully on steeper slopes, and the land washes too badly when it is plowed.

In the southern part of the county rough stony land is found mostly on the slopes of the deep, rocky valleys that have been eroded into and now ramify the table-land. Here it occurs on fringelike areas between the valley bottom soils and Dubuque silt loam or Clinton silt loam on the table-land, or Boone silt loam on the rounded hills. The degree of slope in most places becomes progressively steeper farther up the slopes, and in places the land is almost clifflike on the breaks bordering Dubuque silt loam. The soil is mostly fine sandy loam or coarse silt loam on the lower slopes where Potsdam sandstone crops out, and it becomes gradually heavier up to the slopes to where the lower magnesian limestone crops out. The surface soil consists very largely of colluvial material washed down from the higher elevations. On the higher elevations where the surface has been gullied, the soil between the rocks is red clay. Chert rock is thickly scattered over the surface. In this locality nearly all of this soil is forested, though small areas have been cleared to increase their value for pasturage. Rough stony

land is largely fenced in for pasture. In the forested areas the pasturage furnished is very sparse.

In the west-central part of the county, north of Sparta, much of this land was mapped on badly eroded, rounded shale hills where the limestone and rock have been almost entirely removed by erosion. Here the soil is very largely shallow, friable silt loam underlain by shale on the upper parts of the hills and by coarse loam, fine sandy loam, or fine sand on the lower parts where the coarser layer of Potsdam sandstone crops out.

Black oak, white oak, hickory, maple, and other hardwoods predominate, and much aspen, white birch, jack pine, and birch are found on the lower parts of the slopes. Many of the slopes have been cleared in order to increase their value for pasture.

In the southern part of the county rough stony land is more heavily wooded than any other land in the county. Nearly all of the trees common to the region grow here. They are mostly of medium size, averaging about 12 inches in diameter. Old settlers say they have grown up very largely since the region was settled about 60 years ago. Black oak, maple, white oak, hickory, wild cherry, and white pine are among the most common varieties. Considerable aspen and white birch and an occasional ash are found on the lower parts of the slopes, and cedar grows in a few scattered areas. Other trees and bushes occasionally found are red oak, jack pine, wild apple, thorn apple, Norway pine, elderberry, wild plum, hazel brush, raspberry, blackberry, highland cranberry, wild grapes, box elder, and butternut.

In the northern part of the county this soil occurs mostly on the slopes and extending over the tops of rounded, moundlike or mesalike hills or series of hills bordering level areas of sandy soils. These were formerly covered with a heavy growth of pine trees. The soil on these hills is composed mostly of fine sand and sandstone, with in places a small cap of soft shale. Areas are covered with thick, tangled oak brush 6 or 7 feet high and with a few small red oak, black oak, jack pine, and aspen trees. Blueberres abound on the north side of the hills. These areas are often burned over. Their value is low for grazing, as the growth of grass is very sparse. This represents the least valuable phase of rough stony land in the county and is valuable primarily for growing pine trees. Most of the rough stony land occurs in the south and southwest parts of the county.

Practically no rough stony land is cultivated. In a few places badly gullied parts of fields associated with rough stony land were mapped with this land in order to make the mapping consistent.

Rough stony land is considered nonagricultural and is suitable only for forestry and permanent pasture. In connection with tillable soil, it is of considerable value for use as a wood lot and for spring pasture.

Rough stony land is usually sold with other soil types. Areas surrounded by Dubuque silt loam or Boone silt loam are held at prices ranging from $25 to $50 or more an acre. Areas surrounded by Boone fine sand sell for $5 or $10 an acre. Areas on which there is considerable merchantable timber sell at a higher price, depending on the value of the timber.

SUGGESTIONS FOR THE IMPROVEMENT OF MONROE COUNTY SOILS

CULTURAL METHODS

In parts of Monroe County where heavy soils are prevalent, some land is plowed in the fall. Only land not subject to serious danger from erosion should be plowed at this time. The tendency throughout the county is toward better methods of cultivation, fertilization, and seed selection. It is customary to apply manure to fields before plowing for corn. When land is plowed in the fall, many farmers haul manure out during the winter and scatter it over the plowed field. This is a good practice, except in fields where the surface is so steep that fertility is lost by the manure being carried away by rains and melting snows.

In growing tobacco too many farmers fertilize the tobacco field so heavily that the remainder of the farm suffers. On most farms there is not sufficient manure available to give the tobacco patch all it should receive and still furnish the remainder of the farm its proper share.

In the northern part of the county, other methods are necessary since conditions are radically different. Here the land should be plowed in the spring rather than in the fall. Sandy soils should be covered during the fall and early spring with a good growth of vegetation. In this way, loss of plant food by leaching and loss of fine sand particles by severe winds are prevented.

DRAINAGE

Monroe County, according to the 1920 census, contains 3,519 farms. The report indicates that 533 need artificial drainage and that 181 have been drained. This report also states that 61,100 acres are included within operating drainage enterprises at present. Of this acreage, 27,641 acres are classed as improved land and 29,158 acres as swamp land subject to overflow. This report states that 18,765 acres of the land in drainage enterprises actually need drainage. Outside of the organized drainage enterprises there is considerable additional land which would be benefited by drainage. It is probably safe to estimate that there are in all at least 25,000 acres in the county where drainage would improve the agricultural value of the land.

A large part of the land needing drainage consists of muck and peat which ranges in depth from a few inches to 6 or more feet and which is underlain in some places by sand and in others by clay. Considerable marsh borderland also needs drainage. These are all low-lying soils which are naturally wet during part of each year. In addition to such areas level areas throughout the upland part of the county, on terraces, and in other locations where the surface is level and the soil is heavy, impose conditions which would in many places be improved by use of tile drains. With this level upland included, the area needing drainage would be increased still more.

The cranberry industry[1] has been developed almost entirely on peat soils. In the immediate vicinity of cranberry fields thorough drainage is not needed. With proper construction of reservoirs and ditches, however, the development of the cranberry industry and of farming cultivated lands need not interfere materially with one another, since drainage water from one tract may be used at a lower point on the cranberry bogs. Probably there is sufficient fall to successfully drain practically all marshlands in this county.

FERTILIZATION AND LIMING

Most of the nitrogen needed for plant food by Wisconsin crops can best be obtained through the growth of legumes and the use of stable manure. Since legumes require a good supply of available phosphorus, this element should be applied, when needed, by the broadcast application of phosphatic fertilizers when the land is seeded down to a legume. This phosphorus, together with the nitrogen of the legume, becomes partly available to the succeeding crop of corn, potatoes, sugar beets, tobacco, or other crops. All these crops, on upland soils at least, should be grown either in rotation with legumes or on manured land. Only such additional quantities of phosphorus and potash should be applied to these special crops as are needed.

Only such quantities of nitrogen should be purchased in commercial fertilizers as are needed to supplement that furnished by green-manure crops. Such supplementary nitrogen should ordinarily be in immediately available form and should be used to encourage early growth. Where it is desired to use a fertilizer carrying nitrogen, it is highly important that this fertilizer be applied with a fertilizer attachment on the planter or in such a manner as to come within the root-feeding radius of the plant. Fertilizer attachments are used for application of fertilizers to potatoes and corn. For sugar beets, fertilizer should be applied with a fertilizer beet drill at the time of planting. Fertilizers for tobacco and cabbage are usually broadcast previous to setting the plants, although experience has proved it desirable to apply a small quantity of fertilizer by means of an attachment on the tobacco or cabbage setter, and to broadcast the remainder after the root system has developed more extensively. For onions and other truck crops it is usually desirable to broadcast fertilizer previous to planting.

Three factors must be considered in relation to fertility and the yield of crops. These are the condition of the soil itself and the supplies of the various kinds of plant food which it offers in available form; the crops to be grown, including the kinds and quantities of plant food they require; and the use of fertilizers which will supplement the supply of plant food already in the soil in a way to meet the demand of the crops concerned.

Soils vary greatly in the total supply of plant food they contain in available form, and especially in the proportion of the various elements required by crops. Sandy and light soils are generally low in most elements. Light-colored clay soils are comparatively low in

[1] For a complete discussion of the cranberry industry see bulletins of the Wisconsin Agricultural Experiment Station.

nitrogen, are moderately well supplied with phosphorus, but contain potash in abundance. Peat soils are abundantly supplied with nitrogen which may be made available by proper treatment but are nearly always low in potash, are frequently low in phosphorus, and are sometimes low in lime as well.

Two important considerations must be taken into account with reference to crops. These are the comparative proportion of the different elements they require and the total quantity needed. Though there are undoubtedly slight variations in the requirements of individual crops, they can be grouped into classes fairly well. Such crops as small grains and grasses, including timothy, require an abundance of phosphorus and moderate quantities of potash and nitrogen. Such crops as corn, potatoes, tobacco, and sugar beets require large quantities of nitrogen and potash and moderate quantities of phosphorus. Peas, clover, and alfalfa require large quantities of phosphorus, potassium, and lime, but under proper conditions can obtain most of their nitrogen from the air.

The total quantity of plant food needed depends largely on the total weight of the crop produced. Such crops as small grain, timothy, and flax require only moderate amounts of plant food to the acre, whereas such crops as corn, sugar beets, cabbage, onions, and potatoes require much larger quantities.

The yields of crops are affected not only by the quantity of plant food available but by the moisture supply which the climate provides and the proportion of it which the soils on which crops are grown will retain until it is absorbed by growing plants.

In working out ideas of the proper fertilizers to use in Wisconsin, therefore, all these factors must be taken into consideration and commercial fertilizers should be used only to supplement the natural fertility of the soils. Roughly this means that on any particular kind of soil and for the growing of any one of the group of crops mentioned, the best fertilizer to use would depend on: (1) Whether stable manure had been used or not; (2) whether legumes, which would supply nitrogen but no other element, have been grown; or (3) whether the soil is unfertilized in either way.

Superphosphate (acid phosphate) should be used on the heavier soils, in the general system of farming, where a sufficient quantity of manure is produced to cover the cultivated land every fourth year. This phosphatic fertilizer should be used at rates ranging from 125 to 350 pounds to the acre (depending on the grade) and should be broadcast or applied with a fertilizer grain drill at the time of seeding to small grain and clover.

Mixed fertilizers rich in phosphorus, such as 2–12–2 [2] mixtures, may be used on lighter soils having a scant supply of organic matter. For small grains these fertilizers may be applied at rates ranging from 200 to 400 pounds to the acre, depending on conditions. This fertilizer may also be used on corn at the rate of 75 to 125 pounds to the acre and should be applied with fertilizer attachments on the corn planter. Fertilizer applied in this manner for corn should be used only as a supplement to the usual manurial treatment and in conjunction with the practice previously outlined.

[2] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

Mixed fertilizers rich in potash may be used for truck crops where it is impossible to obtain a sufficient quantity of barnyard manure. It is imperative that some legume, such as clover or soy beans, be grown under this system in order to supply the necessary amount of organic matter and partly supply the required nitrogen. For potatoes, fertilizer should be applied, in the furrows with fertilizer attachments, in quantities ranging from 400 to 1,000 pounds to the acre. For onions, cabbage, beets, tobacco, and some other crops fertilizer may be broadcast in quantities ranging from 400 to 1,500 pounds to the acre, depending on individual requirements.

Phosphorus and potash mixtures should be used on dark-colored soils having no need for nitrogen in the fertilizer. Soils ranging from black sandy loam to muck and peat fall under this class. The kind of fertilizer and the rate of application depend on the type of soil, the crop to be grown, and other conditions peculiar to the individual case, and no recommendations can be made unless all these factors are taken into consideration.[3]

Most of the topsoils in Monroe County show a more or less acid condition. Many subsoils also show some acidity to a depth of 2 or 3 feet. The heavy, light-colored upland soils are commonly acid at the surface, but the deep part of the subsoil may be free from acid or even slightly calcareous. The members of the Dubuque, Superior, and Poygan series of soils are usually well supplied with lime, especially in the lower part of the subsoil. The surface soils, however, are acid in many places and are in need of lime.

The degree of aciditiy is variable, and each farmer may find a wide variation in the need for lime on his farm. Failure of clover and alfalfa are often an indication of the need of lime. Two or 3 tons of ground limestone to the acre is the usual application on these soils when alfalfa is to be grown and 2 tons where clover is seeded. The quantity to be used, however, may vary with the degree of acidity, the character of the soil, and the crop to be grown.

Ground limestone is doubtless the most economical form of lime which can be extensively utilized in Monroe County. The limestone rock, which is found in numerous places in this county as the uppermost rock and which in many places crops out on the hillsides, is of a good quality for agricultural purposes and should be utilized to the fullest possible extent. Local portable limestone-grinding outfits have been bought and installed in several communities, and these are doing custom work in a satisfactory manner.

SOIL EROSION

The most important single problem in soil management in Monroe County is the management of the large acreage of steep or rolling land. The county is in the so-called unglaciated or residual part of the State, where the streams which drain the area have cut their beds down through the formerly level elevated plain into sandstone rock. These valleys have never been altered or filled by the action of glaciers which once covered most of the State. Their beds lie from 200 to more than 400 feet below the intervening ridges. The valleys

[3] For additional information on fertilizers and their use under Wisconsin conditions consult bulletins of the Wisconsin Agricultural Experiment Station.

and their tributaries radiate like the veins of a leaf, and the steep slopes which lead down from the ridge tops to the valley bottoms make up a considerable part of the area of the county.

Most of the soil on the sloping land is heavy and is included in the steep phase of Dubuque silt loam. These slopes, which originally were forested or brush covered, have been largely cleared and cultivated. Because of their unprotected condition and exposure to the run-off of surface water from higher land, many fields on these slopes are extensively washed and gullied by storm water and the water from melting snow in spring.

Other soils subject to erosion are those of the Boone series, which were derived from sandstone and shale and which occur on many of the lower slopes in the valleys. The members of the Bertrand series of soils, which lie on narrow benches along the sides of the valley bottoms, are also subject to severe gullying. The swift-flowing water from the ridges and slopes must cross these benches before reaching the valley stream, and deep ravines, gullies, and ditches are developed. Soil erosion is a farm problem not only because fields are cut by ditches and gullies which make cultivation difficult but because erosion removes the organic matter and the finest and most fertile soil particles first and reduces the fertility and yield of fields. The causes of removal of soil from the surface without formation of gullies generally lie in improper methods of cultivation or poor arrangement of fields. Many fields where this kind of erosion occurs are only gently rolling or undulating, and the rain water does not collect in large, swift-flowing rills or streams which have power to cut ditches but follows the cultivated rows, in fields of corn or potatoes, or the drill rows in grainfields. The soil is removed only from the knolls and is deposited in the hollows.

Contour cultivation and the arrangement of the crop rows across the slope instead of with or down the slopes retards the movement of soil in such fields. Keeping the most exposed places in sod as much as possible and cultivating the field in alternate strips of crop and sod across the slopes are inconvenient but often necessary methods.

Rotation of crops in such a way that two cultivated crops do not follow in succession gives the field opportunity to recover from its losses under cultivation. By avoiding a hard, bare condition of the eroded ground after harvest, surface wash in the fall is prevented. A cover or catch crop of rye or peas in the corn rows helps protect the soil after harvest and furnishes pasturage until winter.

Deep plowing and the plowing under of straw, manure, or a second crop of clover to increase the supply of organic matter in the soil give the surface of the field greater absorbing capacity and resistance to erosion.

Gullying occurs where greater volumes of water collect and form cutting streams. Steeper slopes cause the water to flow faster. In places the soil has an unstable foundation of sandy material, easily undermined when the water once cuts through the surface soil. Such cutting establishes a fall which cuts back in the sandy subsoil. In some places large gullies, one-half mile or more in length, are cut during a single season.

In their beginnings most small gullies are easily controlled. Small drainage ways or shallow ditches can be filled with straw or manure

and plowed shut. Such shallow drainage ways should be left in permanent sod. On the level terraces or where heavy soil lies on the light sand or sandy gravelly subsoil, small gullies must be immediately attended to, because all gullies on such soil are dangerous.

Where the subsoil is clay and where clay or silt material is being brought down by the flood water, large gullies may be filled by putting in a dam of stumps, brush, and logs. Where the subsoil is sandy, much greater care is required. If dams are built in the latter case, they need to be carefully constructed to prevent the water from cutting around them. Dams of concrete, stone, wire mesh, and brush have been successfully used. Flume devices also have been used to carry the water over the head of the ditch and down into it, preventing its continued growth.

Planting willows and bushes on the sides and bottom of ditches too deep to fill often arrests the growth of the ditch. Sorghum, sweet clover, or rye make good emergency crops on eroded patches or fields. Such fields should later be seeded to grasses and left in permanent sod.

ROTATION OF CROPS

In discussing crop rotation, farm crops may be divided into three classes—grain crops, hay crops, and cultivated crops. Grain crops are generally shallow feeders, add little organic matter to the soil, and tend to weediness. Of the hay crops, such as legumes and timothy, legumes have extensive root systems and taproots, add organic matter, and improve the physical condition of the soil. The third group includes cultivated crops, such as corn and potatoes.

A good rotation should include crops belonging to each of these three classes. The value of such a rotation is apparent in its effect on the physical condition of the soil, on weediness, on organic-matter supply, on plant diseases, and on the nitrogen content of the soil. Better yields are, therefore, obtained when crops are rotated than when a single-cropping system is followed.

The soil is a factor of great importance in considering crop rotation. As a general rule, small grain crops do better on heavy than on light soils, and the same is true of grasses grown for hay. On the other hand, the same variety of corn requires a shorter season for maturity on light than on heavy soil. Rather light soils and those of intermediate texture are better adapted to potato growing and root crops. Therefore, on light soils a greater acreage should be devoted to cultivated crops than on heavy soils.

There is no one best system of rotation. The rotation depends on the system of farming, and this depends partly on the personal choice of the farmer. Following are a few suggestions which will apply to the heavy soils of Monroe County and which may serve as outlines to be modified according to varying conditions.

As much of the land is very rolling, this factor should be considered in working out a rotation. One of the chief difficulties on long slopes is that of the tendency of little streamlets to collect into large streams which greatly increase their eroding power. This difficulty can be overcome to some extent by laying out the fields in long, comparatively narrow strips on the hillsides so that the land which is in tilled crops, such as corn or potatoes, will alternate

with land in grain or hay, thus greatly shortening the distance down the hill through which this accumulation of streams may take place. The sodded strips serve to check the flow of surface water, absorbing it and carrying it off beneath the surface.

A rotation which adapts itself to this system consists of corn, followed by small grain, followed by hay for two years. In some parts of the county grain is inclined to lodge. This tendency may be overcome somewhat by growing grain twice in succession on the same fields. Where the slope is not too great this may be safely done, and two crops of corn may also be grown in this way where the slope will allow. A 3-year rotation may be used on much of this land. Corn may be followed by a small grain and the grain by clover. Where the fertility is rather low, the second crop should be plowed under as a green-manure crop.

In the sandy parts of the county, somewhat different rotations should be followed. The following is probably the best for most farms of sandy soil: First year, clover, with perhaps a light seeding of rye or oats; second year, clover for hay, leaving the second crop to be turned under either in the fall or spring; third year, corn or potatoes; fourth year, soy beans which may be used for feed, for hay, and for green manure.

If any other crops are to be grown, they may be planted following clover, thus eliminating one of the crops named. Another rotation which is frequently followed on sandy soils consists of small grain, followed by clover, then by potatoes. The second crop of clover in this system should be plowed under as a green-manure crop.

It is better to use mammoth clover on the sandy soils than red clover, as it is more hardy and more vigorous in growth and is able to obtain its plant food more readily. It grows to about the same size on sandy soils as the medium red clover does on heavy soils. In some of the rotations suggested, it may be desirable to substitute rye for wheat or oats, especially on the sandy soils.

Tobacco can be grown on the same field for two or three years and can be followed by corn, two years, and small grain seeded to clover, one year. With the tobacco, a phosphatic fertilizer should be used to supplement the manure. A second crop of clover can be plowed under, thus saving some of the manure for other parts of the farm. Tobacco should not be grown on the same field for a long period of years as is the practice on many farms.

The growing of peas for canning could be made an important industry, and this crop could be readily introduced into a 4-year rotation. Such a rotation might consist of small grain, clover, a cultivated crop, then peas. This may be made a 5-year rotation by adding timothy and cutting hay for two years. This system would be best suited to the parts of the county where the soils are heavy.

On the marshlands, as they are reclaimed, the question of crop rotation should also be considered. Grain farming can not be recommended on peat soils. In growing corn and potatoes in this region one must take into account the danger from frost. In some localities outside of this county, in this and other States, a one-crop system is being followed where celery, peppermint, or some other crop is the entire source of income.

SUMMARY

Monroe County is slightly south of the west-central part of Wisconsin and comprises an area of about 924 square miles or approximately 591,360 acres. It may be divided roughly into two topographic and agricultural regions. The northeastern part of the county is, for the most part, level and consists of a series of sand flats and marshy areas. A large percentage of the central and northern parts is sandy, with extensive sand plains adjacent to La Crosse River. Throughout the sandy and marshy parts of the county the soils have a rather low agricultural value. The southern, the north-central, and part of the west-central parts of the county have a rolling or hilly surface and here heavy soils predominate and agriculture is highly developed. Elevations of more than 1,400 feet above sea level are common in the hilly region in the southern part of the county, whereas the general level in the flat, northeastern part is about 925 feet. In the rough areas, differences in elevation ranging from 200 to 400 feet in the same square mile are not uncommon.

The first settlement in this county was made in 1842, and the first railroad was built in 1859. The county was set off from La Crosse County in 1854. In 1920 the population of Monroe County was 28,666, of which only 3,076 were foreign born.

Transportation and shipping facilities are good.

In the southern part of the county and wherever the medium and heavy soils predominate, agriculture is well developed and the communities are in a prosperous condition. Throughout the sandy and marshy sections, agriculture is not so well developed and a less prosperous condition prevails. General farming and dairying are carried on in nearly all parts of the county. Corn, hay, and small grains are the principal crops, but much of the output of the farm reaches the market in the form of dairy products. There are a number of special crops, among which is tobacco, grown mostly around Sparta and in the southwestern part of the county. Potatoes are grown mainly on the sandy soils; strawberries and bush berries are grown extensively in the vicinity of Warrens and Sparta; cranberries are grown on some of the marshes in the northeastern part of the county; onions and cabbage are raised to a small extent on some of the drained marshes; and apples thrive on the sandy loams and silt loams in the hilly areas.

Monroe County lies entirely within the unglaciated part of Wisconsin, and the soils were derived mainly from the weathering of the lower magnesian limestone and the Potsdam sandstone which form the two important geologic formations in the county. In addition to these, there is a remnant of a loessial blanket from which some soil has been derived. In large tracts which have been influenced by the action of water there are deposits in the form of valley fill and stream terraces. Peat has developed in extensive deposits of decaying vegetable matter.

Exclusive of rough stony land and peat, 13 soil series are mapped in the survey of Monroe County.

The various soils are described in detail and their agricultural values are discussed. Some suggestions are offered for the improvement of these soils.

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[PUBLIC RESOLUTION—No. 9]

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

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

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

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils, and on July 1, 1927, the Bureau of Soils became a unit of the Bureau of Chemistry and Soils.]

Areas surveyed in Wisconsin, shown by shading

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