

SOIL SURVEY OF FULTON COUNTY, OHIO

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COUNTY SURVEYED

Fulton County, Ohio, is in the northwestern part of the State, and has an area of 405 square miles, or 259,200 acres.

Most of the land forms a level or gently undulating plain with some ridgy areas. In the extreme northwest is an undulating tract, which forms part of the Later Wisconsin ground moraine. This tract has an elevation ranging from 800 to 830 feet above sea level, and every part is reached by natural drainage ways. Its eastern boundary is well marked by a series of low gravelly and sandy ridges, which enter the county near Ritters on the Michigan line, extend southwest through Fayette, and cross into Williams County 4 miles west of Zone. These ridges are about 800 feet above sea level, and range in width from 100 to 300 yards, and in length from one-quarter to 1 mile. They are beach remnants of the glacial lake described by Frank Leverett and F. B. Taylor in Monograph 53 of the United States Geological Survey as "First Lake Maumee."



FIG. 55.—Sketch map showing location of Fulton County, Ohio

A belt of knolls and short choppy ridges ("land-laid" part of the Defiance moraine) which ranges from 1 to 7 miles wide and from 760 to 810 feet high, begins 2 miles southwest of Pettisville. Its western boundary extends north and slightly east through Pettisville and Tedrow, and across the Michigan line 2 miles northwest of Denson; and the eastern boundary extends northeast through Wauseon, Winameg, and then north to the Michigan line 1 mile north of Lyons. The knolls and ridges have abrupt slopes, are separated by numerous undrained basins, are usually smaller than 1 acre in extent, and range from 5 to 20 feet high.

Flanking this belt on the east and west sides, at an altitude varying from 760 to 780 feet, are sand and gravel ridges which range from one-quarter mile to 3 miles in length, from 100 to 200 yards in width, and from 5 to 20 feet above the adjacent land. These ridges are beach remnants of the old glacial lake known as "Second Lake Maumee."

A very conspicuous and almost unbroken sand and gravel ridge varying in elevation from 730 to 740 feet, in width from 100 to 300 yards, and in height, from 4 to 10 feet above the general region, enters the county 2 miles west of Naomi. It extends northeast through Delta to a point $3\frac{1}{2}$ miles west of Swanton, where it turns

north, crossing the Michigan line about one-half mile west of Champion. Another sand and gravel ridge at approximately the same elevation extends several miles north and south through Charaghar. A third sand and gravel ridge at the same elevation, ranging in width from 50 to 100 yards and in height from 2 to 12 feet, extends several miles northeast from Archbold. These three ridges are beach remnants of the old glacial lake known as Lake Whittlesey.

Crossing the southeastern corner of Fulton County and extending northeast and southwest are successions of sand ridges and knolls with poorly drained depressions intervening, but in places the land is almost flat and more or less dotted with poorly drained basins. These ridges and knolls represent beach remnants of glacial Lake Warren. Between these old beach lines are level or undulating plains somewhat broken by shallow valleys and small isolated sand knolls or ridges.

The area lying at an altitude between 760 and 780 feet, west of Bean Creek in the northwest part of the county, consists of a series of very low, roughly parallel, undulating ridges. These ridges extend northeast and southwest and are separated by small streams which have been the principal factors in the development of the present topography. Between altitudes of 730 and 760 feet in both the eastern and western parts of the county, are level or gently undulating plains modified by shallow valleys and especially by sand ridges and hillocks which vary from 5 to 20 feet high. Those areas in the western part of the county lying below 730 feet are level.

East of the sand and gravel ridge that crosses the county extending northeast and southwest through Delta, a very striking relation exists between the topography and the texture of the soil. The soil extending 3 miles southeast of this ridge is clay, and the surface is almost level except for slight interruptions of shallow stream valleys. Beyond this limit the soils become more sandy as they extend to the southeast, there being within the next half mile clay loam, loam, fine sandy loam, loamy fine sand, and loose, incoherent fine sand. Within this half mile is a level plain with sand ridges and low sand hills, ranging in height from 2 to 20 feet, which increase in number as the texture of the sandy material becomes lighter.

Fulton County lies in the drainage basin of Maumee River, with the exception of a strip of country lying east of the Detroit, Toledo & Ironton Railroad and along the Michigan line, the western part of which drains through Bear Creek into Raisin River and the eastern part through Tenmile Creek into Ottawa River. The principal affluents of Maumee River within the county are Tiffin River and Bean Creek, the tributaries of which furnish drainage for that part of the county lying west of the main watershed which extends from a point 1 mile south of Pettisville, northeast of School No. 5 of Dover Township, and then north to the Michigan line. East of this divide the drainage is carried southeastward through Turkeyfoot, Bad, and Swan Creeks to Maumee River; through Tenmile Creek to Ottawa River; and through Bear Creek to Raisin River.

Comparatively small areas of Fulton County are well drained. The principal well-drained areas occur on the old beach ridges, the belt of knolls and short choppy ridges between Lyons and Pettisville, the undulating tract in the northwest corner of the county, and the sand ridges and knolls which are more or less numerous in almost all

parts of the county. The streams are small and sluggish, and the valleys are very narrow and rarely exceed 20 feet in depth. Bean Creek and Tiffin River have not developed valleys, and at many places along these streams it is difficult to determine the extent of overflow land, owing to the gradual merging of the first bottom into the upland. Many extensive interstream tracts, especially where the surface is level or gently undulating, have no well-developed natural drainage ways and in many such situations ditches must be dug and tile drains installed before cultivation is possible.

Fulton County was organized in 1850, but permanent settlement began about 20 years earlier. The early settlers were from eastern Ohio, Pennsylvania, New York, and the New England States.

According to the 1920 census the population of Fulton County was 23,445, of which 3,035 were urban and the remainder rural, the latter including all towns under 2,500. The density of the rural population was reported as 50.4 to the square mile. The distribution of the rural population is fairly uniform throughout the county, except along the sand ridges of the southeastern corner which are sparsely settled.

Wauseon, the county seat and largest town, is a little south of the geographical center of the county, on the New York Central Railroad, the Detroit, Toledo & Irontown Railroad, the Wabash Railway, the Toledo & Indiana Interurban Railway (electric), and the Toledo and Chicago Pike. A large and well-equipped milk condensery is one of the most important industrial plants. Delta, the town second in size and importance, has a large milk condensery and transportation facilities similar to those of Wauseon. Other shipping points are Swanton, Pettisville, and Archbold on the New York Central Railroad and the Toledo & Indiana Interurban; Naomi, Oakshade, and Denson on the Detroit, Toledo & Ironton Railroad; Fayette on Lake Shore & Michigan Southern Railroad and the Toledo & Western Interurban; Brailey, Delta Station, Eckley, and Elmira on the Wabash Railway; Treadway, Metamora, Seward, Lyons, and Denson, on the Toledo & Western Interurban.

Transportation facilities are good. Two railroads cross the county east and west; one extends north and south, through the central portion; another cuts the northwest corner; and a branch railroad extends northeast into Michigan from its southern terminus, Fayette. In addition to the railroads, two electric interurban railways cross the county east and west. Concrete and water-bound macadam pikes connect all leading towns with Toledo. Gravel or macadam roads pass more than 95 per cent of the farms in the county. Dirt roads are kept in repair and are suitable for automobile traffic except when muddy. All parts of the county are supplied with rural delivery of mail, and telephones are in common use.

CLIMATE

Fulton County has a temperate climate with rather short periods of extreme heat and cold. The mean annual temperature as recorded at Wauseon is 48.4° F., which is similar to that of other counties in northern Ohio but considerably lower than that in the southern part of the State, as at Cincinnati where the mean annual temperature is 55.2°. The mean for the summer months (June, July, and August)

is 70.5°, and for the winter months 25.3°. The summer mean is very close to that suggested as most favorable for sugar-beet production, 70°.

The average annual precipitation at Wauseon is 36.81 inches. This is 3 or 4 inches lower than for counties in the extreme north-eastern part of the State, and also for the southeastern counties. The rainfall is fairly well distributed throughout the year. The early summer months have the greatest rainfall. The snowfall averages approximately 44 inches yearly, being about equally distributed between December, January, and February. The total is from 10 to 15 inches less than for counties in northeastern Ohio where a maximum slightly in excess of 60 inches has been reported.

The central and southwestern parts of Fulton County have a frost-free season from 5 to 10 days shorter than the remainder of the county. The average date of the last killing frost in spring at Wauseon is May 10 and of the first in fall, October 2, giving an average frost-free season of 144 days. This is about 20 days less than in central Ohio, from 40 to 50 days less than in a narrow belt adjacent to Lake Erie, and also a minimum for the State except for an area in northeastern Ohio where the average date of the last killing frost in spring is from a week to 10 days later than at Wauseon. The latest recorded killing frost in the spring occurred on June 1, and the earliest in the fall on September 2.

The following table, giving the more important climatic data, was compiled from the records of the Weather Bureau station at Wauseon:

Normal monthly, seasonal, and annual temperature and precipitation at Wauseon

(Elevation, 780 feet)

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1888)	Total amount for the wettest year (1892)	Snow, average depth
	° F.	° F.	° F.	Inches	Inches	Inches	Inches
December.....	27.6	70	-32	2.55	1.88	2.10	10.1
January.....	23.7	70	-32	2.48	2.40	1.40	12.0
February.....	24.7	64	-24	2.61	1.96	3.56	10.2
Winter.....	25.3	70	-32	7.64	6.24	7.08	32.3
March.....	34.7	84	-17	3.32	3.64	5.54	7.1
April.....	46.9	91	15	3.16	2.27	5.17	1.4
May.....	58.7	103	21	4.02	3.36	11.40	.1
Spring.....	46.8	103	-17	10.50	9.27	22.11	8.6
June.....	68.3	100	34	3.91	3.52	8.65	.0
July.....	72.8	104	41	3.73	.86	2.95	.0
August.....	70.4	109	36	2.92	1.95	2.38	.0
Summer.....	70.5	109	34	10.56	6.33	13.98	.0
September.....	63.6	100	25	2.65	.84	4.61	Trace.
October.....	51.2	94	12	2.54	1.93	.39	.3
November.....	37.8	76	-8	2.92	3.88	4.38	2.9
Fall.....	50.9	100	-8	8.11	6.65	9.38	3.2
Year.....	48.4	109	-32	36.81	28.49	52.55	44.1

AGRICULTURE

Agriculture in Fulton County dates from the eighteenth century when the Indians hunted and their squaws cleared a little land in the forests and grew corn, beans, peas, squashes, cucumbers, pumpkins, melons, and tobacco. When the productiveness of the soil decreased they moved their wigwams to another location and cleared new fields. It was about 90 years ago when the first white settlers began to clear and improve their homesteads. Development was slow owing to lack of capital and labor-saving implements, remoteness of markets, poor roads which were impassable for long periods in many places, swamps, and forests which spread over the entire county.

Most of the county was in a poorly drained condition throughout the greater part of each year. The lack of drainage outlets and the cost of installing artificial drainage in wet areas prohibited their use for cultivation, and for several decades only land having good natural drainage was tilled. Consequently the gravelly and sandy ridges were first homesteaded. General farming was practiced, and wheat, corn, hay, oats, flax, and potatoes were important crops. Many farmers planted wheat on the same field year after year. At first the hay crop consisted only of wild grasses, but later timothy and clover became important crops.

During the seventies and eighties the demand for ship timbers, staves, railroad ties, hoop poles, and lumber of various kinds caused many of the farmers to devote a large part of their time to lumbering. The removal of the forests was followed by the draining of the land. By cooperative efforts in the construction of the larger ditches and the straightening of many of the streams, improvement of drainage was more rapid and effectual and a large proportion of the former poorly drained lands are now tillable.

The virgin tree growth on light-colored and well-drained sand consisted mainly of black oak, yellow oak, and pin oak; aspen, willow, elm, and soft maple grew on dark-colored and poorly drained sand; white oak, red oak, hickory, hard maple, and red birch were the principal trees growing on light-colored sandy loam and loam; hard maple, basswood, and beech on dark-colored sandy loam and loam; white oak, red oak, hickory, and beech grew mainly on light-colored clay and clay loam; and elm on those soils having a dark color. The present tree growth consists largely of second growth in small wood-lot pastures.

According to Ohio crop statistics the leading cereal crops of the county from 1850 to 1879 and from 1890 to 1899, named in the order of acreage, were corn, wheat, and oats; from 1880 to 1889 they were wheat, corn, and oats; from 1900 to 1910 they were corn, oats, and wheat; from 1918 to 1922 wheat again ranked next to corn; but at present, the wheat acreage is very materially decreased. From 1850 to 1879 hay led all crops in acreage, but since that time it has held second place.

Corn is the most important crop in Fulton County. According to Ohio statistics from 1850 to 1859 there was an average yearly yield of 29.4 bushels an acre from 7,214 acres. The 1920 census reports an average of 40.9 bushels an acre from 40,498 acres in 1919. Corn is

raised in all parts of the county and upon all of the soils. The greater part is fed to livestock on the farm and the corn produced from about 1,000 acres is used for silage. Reid Yellow Dent and Leaming are the predominating varieties.

Wheat is the second crop in importance. According to the 1920 census, there were in 1919, 35,558 acres with an average production of 21.2 bushels an acre. From 1850 to 1900 the acreages of wheat and corn were nearly equal, but during the next decade a marked decrease in wheat was shown, oats being the crop second in importance. This condition continued until the increasing demand and high prices during the World War rejuvenated the wheat-growing industry and caused a decided increase in acreage. During the last 50 years there has been practically no change in the average yield. However, it is generally conceded that wheat yields have gradually declined, except where commercial fertilizers have been used. Wheat growing in Fulton County is generally rated by farmers as commercially unprofitable, because of the injury caused by the Hessian fly, chinch bug, rust, scab, smut, and frequent freezing and thawing during winter, which causes heaving and breaking of the root systems. The value of wheat as a nurse crop for clover and as a winter cover crop would seem to warrant its retention in the usual rotation of corn, oats, wheat, and clover. The bulk of the crop is consumed outside of the county, but is sold to local milling companies or is shipped through local dealers.

Oats rank next to wheat in importance. There was a steady increase in the acreage of oats from 1850 to 1910, but since that time the acreage has decreased. In 1919 oats were grown on 26,566 acres with a yield of 32.3 bushels an acre. About 80 per cent of the oats is used for feeding purposes on the farms and the remainder is sold. The leading variety sown is New Victory.

Hay is grown on every farm and is next to corn in acreage. The 1920 census reports for 1919 a total of 35,073 acres in all cultivated grasses, with a production of 49,368 tons. Mixed red clover and timothy is the principal hay crop. On poorly drained soils alsike clover is used instead of red clover. Alfalfa is growing in favor, and is planted throughout the county in small areas ranging in extent from 5 to 12 acres. In some communities it is grown on every farm. Three cuttings a year are generally made with an average yield of about three-fourths ton an acre at each cutting. Without the use of lime this legume does well on all soils of the county that are heavier than fine sandy loam, except gently rolling tracts in the extreme northwestern corner of the county. Sweet clover is grown to a small extent for hay and as pasturage for hogs and cattle. Probably its most important use is the opening up of impervious subsoils by deep rooting.

The culture of soy beans has been taken up by many farmers during the last three years. In 1922, 2,000 acres were planted to soy beans including those that were planted with corn for silage and for hog pasturage. Although some fields ranged in size from 15 to 25 acres, most of them were small. Yields vary from 15 to 28 bushels an acre. Soy beans do not deposit so much nitrogen in the soil as red clover or alfalfa, but the hay is high in nitrogen, and soy beans contain as much protein as oil meal. Because of the nutritious feeding and soil-building qualities of soy beans, some of the more progressive farmers

have introduced this crop into their rotation instead of oats, the succession of crops being corn, soy beans, wheat, and clover. Where clover fails, soy beans are sometimes sown at corn planting time and harvested for hay or seed in the fall.

Sugar beets are grown on some of the heavier soils, chiefly Toledo silty clay loam, Brookston clay, and Brookston clay loam. In 1919 a production of 14,144 tons was reported from 1,329 acres. Beets are grown under contract with a sugar-manufacturing company. The farmer puts in the crop, cultivates it, and delivers it to the shipping point on the railroad or interurban line; and the beet company furnishes seed and laborers who do the weeding, thinning, and topping, for which a charge of \$23 an acre is made (1922). Yields range from 8 to 15 tons an acre, with an average of about 10 tons. Sugar beets yield best on heavy soils of the Brookston, Toledo, and Clyde series.

In 1919, 132,509 bushels of barley were grown on 6,699 acres, the yield averaging about 20.4 bushels an acre. Barley is used as hay and in grain mixtures as cow feed. It is used, to a small degree, as an early feed for hogs as it matures before corn. It usually takes the place of oats in the rotation.

Rye was grown on 1,395 acres in 1919, and the yield was about 13.2 bushels an acre. Rye is grown principally on sandy soils, and about one-half of it is threshed for grain. It takes the place of oats in the rotation and is sometimes plowed under as a green-manure crop preceding corn. It is a valuable winter cover for light-textured soils. It is used as a nurse crop when seeding some of the lighter soils to grass and clover, as it makes less demand on the supply of soil moisture than either wheat or oats. It is also used as fall and early spring pasture.

Buckwheat is usually sown on low, sandy soils where, on account of poor drainage, other crops can not be put in until too late. It is occasionally plowed under as green manure. The census of 1920 reports 385 acres in buckwheat, with a yield of about 18 bushels an acre.

Very little attention is given to truck growing. Tomatoes are produced in the vicinity of Swanton and Metamora under contract with canning companies outside the county. Potatoes are grown for the local markets.

There are only two or three very small commercial orchards in the county, although nearly every farm has a small home orchard which, as a rule, is very poorly cared for. The orchards consist mainly of apple trees, with some peach, pear, plum, and cherry trees. The census of 1920 reports 60,062 apple trees, yielding 7,733 bushels in 1919; 14,447 peach trees, yielding 3,328 bushels; 43,016 pear trees, yielding 1,831 bushels; 5,686 plum and prune trees, yielding 766 bushels; 11,694 cherry trees, yielding 1,567 bushels; 15,052 grapevines, yielding 211,658 pounds of grapes; 28 acres of strawberries, yielding 36,936 quarts; and 17 acres of raspberries, yielding 15,791 quarts.

Dairying is the most important industry in the county. Holstein cattle are more numerous than those of other breeds. There are a number of purebred dairy herds in the county, but by far the greater proportion of dairy cattle are grade stock, principally Holstein. Purebred sires are commonly used, and the stock is being improved.

A large proportion of the dairy products are handled by the Dairy Farmers Cooperative Marketing Association through cream stations distributed over the county; about one-fourth by the condenseries at Wauseon, Fayette, and Whitehouse in Lucas County, Bryan in Williams County, and Morenci in Lenawee County, Mich.; and the remainder, with the exception of a small proportion that goes to the cheese factories at Oakshade and Fayette, is shipped by railroads, interurban lines, and automobile trucks to Toledo. The census of 1920 reported 15,372 dairy cows in the county and the total value of dairy products produced in 1919 was \$2,055,299.

Practically all farmers have some hogs to sell. Duroc-Jersey is the favorite breed, although Poland-China and Chester White are also raised. On January 1, 1920, there were 38,141 hogs in Fulton County valued at \$621,160.

Principally in the northeastern part of the county, to some extent in the western part, and in a small way in the remainder, beef cattle are fed for market. They are shipped in from western points in the fall and fed during the winter for marketing in April, May, and June. Hereford and Shorthorn are the leading beef breeds.

About 12 per cent of the farmers keep small flocks of sheep. Shropshire is the leading breed.

The value of poultry and eggs produced was given as \$1,118,848 for 1919. This industry is a very important source of income. Most farms have from 150 to 300 chickens, and an increasing number of farmers are specializing in poultry on farms varying in size from 10 to 20 acres. White Leghorn is the favorite breed.

Horses are raised to a very small extent, though many farmers breed their working mares and raise enough work animals for their own farms.

Most farmers understand something of the adaptation of soils to crops, and many of them apply this principle so far as economic conditions will allow. General farming is engaged in on practically all the soils, and corn, hay, wheat, and oats are the leading crops. It is generally recognized that the heavier soils of the Brookston, Toledo, and Clyde series, having moderately friable topsoils and subsoils, are the best soils for the production of corn, sugar beets, alfalfa, and sweet clover. The very heavy members of these series are also recognized as good soils for these crops, but special care should be exercised in their treatment. Light sandy soils are well suited to melons, cucumbers, small fruits, berries, and rye. Well-drained muck and peat soils are considered good for onions, cabbage, carrots, head lettuce, beets, and celery. Red clover and alfalfa succeed best on well-drained soils that are not acid, and where the lime is within 36 inches of the surface. Small grains are apt to lodge on Clyde and Maumee soils, and the quality is not so good as on Miami, Fulton, and Lucas soils. It is well known that potatoes do best on fine sandy loams and loamy fine sands, and that the quality is better on light-colored soils than on dark.

Modern methods are followed by the farmers of Fulton County. Seed selection is practiced, especially in the case of corn, and germination tests are made by some before planting. Considerable attention has been given to testing out improved varieties of wheat. Inoculation against hog cholera has proved popular, and the loss from this disease has been very materially reduced. In an effort to learn the

crops best suited to the different soils and the treatment through which the largest yields may be obtained, demonstration fields have been established in different parts of the county through the cooperation of farmers and the Ohio State University extension service. Poultry culling is practiced extensively. Very effective drainage systems have been installed on naturally poorly drained soils. Tractors are used extensively, particularly in breaking heavy soils, as the period when the moisture content is suitable for pulverization is usually brief, and rapid work is imperative. Fall plowing is commonly practiced on heavier soils, as it is realized that they disintegrate and fall to pieces under the action of freezing and thawing, so that a good seed bed can be produced readily in the spring.

Farm buildings are generally substantially built, are of modern construction, and are kept painted and in good repair. The prevailing type of barn has a covered barnyard in which the manure is very carefully conserved until it is spread on the fields. The fences are very good, a large proportion being woven wire. Nearly all tillage operations are performed with riding implements and hand labor is reduced to a minimum. Most farms are equipped with gasoline engines which are used in pumping water, cutting wood, shredding corn, and filling silos. The 1920 census reports the average current value of all property as \$15,148 to the farm.

Heavy mixed clover and timothy sod, well covered with manure, is usually plowed 6 or 8 inches deep for corn. It is disked, harrowed, or gone over with the cultipacker once or twice, and the corn planted in checks so as to admit of cross cultivation. As a rule, three or four shallow cultivations are given the corn before it is "laid by."

In growing wheat the usual practice is to plow the oats stubble in early August or September and drill in the wheat after the period of emergence of the Hessian fly has passed, which is usually between September 6 and 20. Considerable care is exercised in obtaining a thoroughly pulverized seed bed, and in lighter soils, a compacted seed bed as well. Usually 16 per cent acid phosphate is drilled in with the wheat at the rate of 200 pounds an acre. Winter wheat does best if the moisture is right to germinate the seed and to allow a strong root growth. Too much moisture causes heaving, surface rooting, and inability to withstand cold and drought.

The land is usually plowed and worked into a fairly good seed bed for oats. In a comparatively small number of cases corn-stubble ground is disked and harrowed, the seed being drilled among the stalks.

The crop rotation generally practiced in Fulton County consists of corn, oats, wheat, and mixed clover and timothy hay. Timothy is usually seeded with the wheat in the fall and clover sowed in the spring, although on some farms both are sowed in the fall. Timothy is sowed mainly as an assurance of a hay crop in event of a clover failure. Clover is cut for both hay and seed, after which the sod is manured and plowed for corn. Barley, soy beans, or rye sometimes take the place of oats in the rotation, and rye is occasionally substituted for wheat, particularly on lighter soils. In light sandy areas potatoes have taken the place of corn.

For a period of 10 years the Ohio Agricultural Experiment Station maintained an experiment farm in the southeast corner of Fulton

County on incoherent fine sand of the Plainfield series, where potatoes, wheat, and clover were grown in rotation. It was noted that the organic matter in the soil was inadequate to prevent the soil from blowing in the wind; but where this succession of crops was made preliminary to seeding to grass, which was allowed to stand several years and was pastured with sheep, a rapid increase in productiveness took place, the sheep assisting materially by compacting the sand.

In 1919 fertilizers to the value of \$152,600 were used in the county. The fertilizer in general use consists of 16 per cent acid phosphate, but 20 per cent acid phosphate is preferred by some. Other commercial fertilizers used, particularly on lighter-textured soils, consist of 2-12-6¹ and 0-14-4. Wheatland usually receives about 200 pounds of commercial fertilizer per acre in the course of a three-year or four-year rotation; but on some farms corn receives from 70 to 100 pounds to the acre. Where soils are acid, ground limestone is used, an application of 1,000 pounds an acre being applied to light phases of fine sandy loam and loamy fine sand; and on loose, incoherent fine sand about 2 tons are used. In acid soils lime is essential for best results with clover, alfalfa, and soy beans, and the yields of grain and other crops are decidedly increased through its use. The nitrogen supply is maintained principally by growing legumes.

Farm labor in Fulton County is white and for the most part American born, but the supply is usually insufficient. Members of the family do most of the farm work. The exchange of help among neighbors is commonly practiced when extra labor is needed. Hired help is paid from \$30 to \$40 a month with board. During harvest day laborers are paid from \$2 to \$3. The census of 1920 reports a total expenditure in 1919 of \$319,958 for labor, or \$233.04 for each of the 1,373 farms reporting.

The farms range in size from 40 acres, which is about the minimum, to 400 acres, most of them being between 60 and 100 acres. The average size in 1920 was 78.6 acres.

Farm land is rented almost entirely on a share basis. Usually the renter furnishes half the seed, cattle, hogs, and sheep, and all the work animals, pays half the threshing bill, and receives half the income. Where land is rented for cash, from \$5 to \$10 an acre is paid.

Land values in Fulton County depend upon the nature of the soil, the improvements, and location with respect to improved roads, shipping points, towns, markets, schools, and churches. The current value of dark-colored, friable clay, clay loam, silty clay loam, silt loam, and loam, ranges from \$125 to \$250 an acre, but where these soils are light colored, from \$100 to \$200; heavy plastic clay and clay loam, from \$100 to \$150; fine sandy loam, from \$100 to \$200; loamy fine sand, from \$75 to \$125; and loose, incoherent fine sand, from \$50 to \$75. The average assessed value of farm land in 1920 was given as \$126.69 an acre.

SOILS

The soils of Fulton County have developed in a forested region under the influence of a humid, temperate climate, with but short

¹ Percentages, respectively, of ammonia, phosphoric acid, and potash.

periods of extreme heat and cold. The greater portion of the land under natural conditions, was poorly to imperfectly drained and the development of soils normal to well-drained situations in this region was thus prevented. However, such well-developed soils do occur, and are important in establishing the broader relationships or correlation of all the soils of the region.

Mature, virgin upland soils of this county have the general distinguishing characteristics common to the soils of this region. These may be described as follows, according to the successive soil layers: (1) A surface layer of leaf litter and leaf mold, the latter very thin; (2) a 2-inch or 3-inch layer of dark grayish-brown, loose, friable material containing considerable finely divided organic matter, silt, and fine sand; (3) a layer of light-colored, grayish-brown or gray material, varying in thickness from 3 to 8 inches, and having characteristics similar to layer No. 2, but containing less organic matter (these three layers together constitute the A or eluvial horizon); and (4) horizon B, a layer of material much heavier in texture, somewhat plastic when wet and breaking into hard angular fragments when dry, and entirely leached of lime carbonates. The substratum, or horizon C, consists of partially weathered glacial drift, in places ice-laid and unassorted, elsewhere water-laid or wind-laid and assorted.

The imperfectly drained soils on the uplands of the county have developed under conditions which have limited the normal activity of the soil-forming forces. A typical profile of such a soil may be described as follows, from the surface downward: Beneath the thin covering of leaf mold is a surface layer of dark-gray soil which varies in thickness from 1 to 3 inches, the dark color being caused by the incorporated organic matter. The subsurface layer of light-gray or gray soil varies in thickness from one-half inch to 3 inches, is lower in organic matter than is the surface soil, but is similar in texture. The subsoil ranges in thickness from 12 to 30 inches and consists of heavier material, granular in structure, and ranging in color from yellowish gray to brownish yellow, with mottlings of gray, yellow, and brown. Underlying this the material is olive-gray, plastic, heavy, calcareous clay, with mottlings of gray, yellow, and brown. In some places the texture of this material is lighter than typical, being lighter than that of the subsoil. Heavier soils of the Nappanee and Fulton series have these distinguishing characteristics. In the sandy soils of these series, as well as those of the Plainfield and Lucas series, these characteristics are imperfectly developed because of the loose consistence, light texture, and siliceous composition of the parent material.

The very poorly drained, dark-colored soils of the uplands are the most extensive in Fulton County, and a typical profile of these soils shows three distinct layers. To depths varying from 5 to 10 inches, the topsoil consists of a thin covering of partly decayed leaves, twigs, roots, and grasses underlain by friable, dark-gray or almost black material. The subsoil is olive-gray material with distinct mottlings of gray, yellow, and brown. This layer usually ranges in thickness from 20 to 30 inches, the material has a nut structure, and is distinctly heavier in texture than the topsoil. There is usually very little difference in the texture of the lower part of the subsoil and that of the parent material, but they differ in that the calcium car-

bonate is leached from the subsoil. The material underlying the subsoil consists of either unweathered till or lacustrine deposits. These characteristics are typically developed in the clay, clay loam, and loam members of the Clyde and Toledo series.

In the deposits constituting the stream flood plains definite soil characteristics have not yet developed, so that these may be called young soils. Of these the dark-colored soils are grouped with the Wabash series and the light-colored soils with the Genesee series.

About 56 per cent of the soil material of Fulton County belongs to the Later Wisconsin glacial drift, 42 per cent to the glacial lake deposits which overlie the glacial drift, $1\frac{3}{4}$ per cent to alluvial deposits along streams, and 0.25 per cent to peat and muck beds. Glacial drift ranges from 50 to 225 feet in thickness. At depths where oxidation has not affected it, it consists of heterogeneous clay, silt, sand, pebbles, and boulders. The rocks consist of limestone, shale, chert, sandstone, quartzite, granite gneiss, and other meta-igneous crystallines, limestone and shale predominating. The glacial-lake deposits consist of sand, silt, and clay.

By the process of weathering, the surface soil of the drift and glacial-lake deposits has been reduced to a more uniform composition in respect to texture and structure. The most striking characteristics are the result of the accumulation of organic matter, oxidation, leaching near the surface, and the development of soil horizons by the readjustment of materials rather than of variations in the original parent material. Peat and muck have developed from the partial disintegration and decomposition of organic material in the presence of water.

The soils of Fulton County are grouped into soil series, each series including types of soil which are similar in all respects except texture and productiveness. Minor variations in the soil are indicated as soil phases.

Grouped in the Nappanee series are soils having in common the following characteristics: Topsoil, or horizon A, consisting of two layers—a surface layer varying from 1 to 3 inches in thickness, which has a thin covering of leaf mold underlain by dark-gray material high in organic matter, and a subsurface layer of gray or light-gray material varying in thickness from one-half to 6 inches and of about the same texture as the surface layer; subsoil, or horizon B, of plastic, olive-gray or dark olive-gray clay with distinct mottlings of various shades of gray and yellow, the texture becoming heavier with increasing depth, and underlain by a substratum of unweathered glacial till of olive-gray, heavy, plastic, calcareous clay, with mottlings of gray and yellow. Areas on which these soils occur vary from level to gently rolling, surface drainage is poor or fair, and subsurface drainage is poor because of the texture of the subsoil. Soils of the Nappanee series differ from those of the Miami and Lucas series in having distinct mottlings throughout the subsoil, and from those of the Fulton series in being more heterogeneous.

Soils of the Miami series in Fulton County have the following characteristics: A surface layer of dark-gray, friable material from 1 to 3 inches deep with a thin covering of decayed leaves, twigs, and roots; a subsurface layer, ranging from 4 to 7 inches in thickness, consisting of grayish-brown or light grayish-yellow material of the same texture as the surface layer; subsoil which is light grayish-

yellow or light grayish-brown in color, of heavier material than the subsurface layer; and, at depths ranging from 28 to 32 inches, a substratum of grayish-brown, calcareous clay, with yellow mottlings. Areas on which these soils develop are undulating, and drainage is fair or good.

There are three distinct layers in typical soils of the Brookston series. Under a thin covering of leaf mold is the topsoil which consists of dark or very dark grayish-brown material from 5 to 10 inches deep. The subsoil consists of heavier, granular, gray or olive-gray material with mottlings of gray and yellow. At depths ranging from 24 to 40 inches is the substratum of heavier, calcareous, olive-gray clay which also has gray and yellow mottlings. Soils of this series differ from Fulton soils in that the topsoil is darker in color and the calcareous substratum is nearer the surface, and from those of the Clyde and Maumee series in that the topsoil is lighter in color. Areas on which soils of the Brookston series occur are level or gently sloping, and drainage is poor.

Soils of the Wauseon series have developed from fine sandy material deposited over heavy calcareous clays, either till or lacustrine deposits. Weathering and eluviation have since developed three distinct horizons. The topsoil, or horizon A, consists of a surface layer of dark-gray, friable material from 4 to 8 inches deep, and a 10-inch subsurface layer of grayish-brown or brownish-yellow material of the same texture. The subsoil, or horizon B, at depths ranging from 14 to 18 inches, consists of brownish-yellow or grayish-yellow, heavier material with yellow and gray mottlings. Underneath this is a substratum of heavy, calcareous, olive-gray clay.

Soils of the Fox series have a surface layer of grayish-brown friable material, underlain at a depth of 2 or 3 inches by brown material, the color of which changes to grayish-yellow at a depth of about 10 inches. Between depths of 26 inches and 36 inches is calcareous, brown gravel. This soil in Fulton County occurs on long, narrow ridges, and drainage varies from good to excessive. Only the beach-ridge phases of Wauseon fine sandy loam and fine sand occur in Fulton County.

Soils of the Toledo series have dark grayish-brown topsoils to depths ranging from 7 to 10 inches, where they are underlain by mottled yellowish-gray or olive-gray subsoils, varying in thickness from 30 to 40 inches, and heavier in texture than the topsoils. Underlying this is a substratum of water-laid, calcareous, heavy-textured, gray or olive-gray material, with gray and yellow mottlings. The surface of areas on which these soils occur are level and drainage is poor.

Clyde soils are characterized by friable, very dark gray topsoils the color of which at about 10 inches becomes slightly lighter; subsoils, which consist of an olive-gray, friable, granular clay layer varying in thickness from 10 to 14 inches, and having mottlings of shades of gray and yellow. Underlying this is heavy calcareous, olive-gray clay. This land is level and the drainage is very poor.

Soils of the Maumee series have black or very dark gray topsoils from 8 to 11 inches deep, underlain by an olive-gray or dark olive-gray layer varying in thickness from 28 to 40 inches and having mottlings of yellow and gray. This rests on olive-gray or grayish-

yellow, calcareous parent material. Areas on which these soils occur are level and drainage is very poor.

The topsoils of the Wabash series are dark grayish-brown, and the subsoils are gray material mottled with yellow. These soils are of alluvial origin and subject to frequent overflow. The land is flat and drainage is poor.

Grouped with the Genesee series are soils having brownish-gray or dark grayish-brown topsoils, and yellowish-brown or grayish-yellow subsoils, which in places are mottled with shades of gray and yellow. These soils occur on first bottoms of streams and are subject to overflow.

Soils of the Coloma, Dunkirk, and Plainfield series have yellowish-brown topsoils and brownish-yellow or yellow subsoils. The parent material consists of sand or fine sand. They occur on undulating or rolling land and drainage varies from good to excessive.

Grouped with the Fulton series are soils having the following characteristics: Topsoils consisting of a 3-inch surface layer of dark grayish-brown material underlain by a subsurface layer of dark olive-gray material, somewhat mottled with yellow and heavier in texture than the surface layer; subsoils which are heavier than the topsoils and gray or grayish yellow with distinct mottlings of gray and yellow; and at depths ranging from 36 to 44 inches the material is grayish-yellow calcareous clay with similar mottlings. Land including these soils is level and drainage is poor. These soils differ from those of the Lucas series in that the subsoils are distinctly mottled.

The topsoils of the Lucas series vary from gray to yellowish brown in color; the subsoils are yellow, with mottlings of various shades of gray and yellow. The surface is level and drainage is poor.

The following table gives the name and extent of the different soil types and phases mapped in Fulton County:

Acreage and proportionate extent of Fulton County soils

Soil	Acres	Per cent	Soil	Acres	Per cent
Brookston clay	23,680	9.1	Miami loam	8,320	3.2
Brookston clay loam	28,864	11.1	Miami fine sandy loam	704	.3
Brookston silty clay loam	2,112	.8	Lucas fine sandy loam	5,312	2.1
Brookston loam	9,920	3.8	Lucas loamy fine sand	768	.3
Brookston fine sandy loam	5,952	2.3	Dunkirk loamy very fine sand	960	.4
Wauseon fine sandy loam	27,904	10.8	Fox gravelly fine sandy loam, beach-ridge phase	1,472	.6
Wauseon loamy fine sand	11,776	4.5	Fox loamy fine sand, beach-ridge phase	384	.1
Toledo silty clay	12,736	4.9	Plainfield fine sand	12,480	5.3
Toledo silty clay loam	11,456	4.4	Mixed phase	1,344	2.5
Toledo silt loam	6,144	2.4	Plainfield loamy fine sand	6,464	2.7
Newton fine sand	11,968	4.6	Coloma fine sand	6,976	.1
Newton loamy fine sand	4,352	1.7	Coloma loamy fine sand	320	.2
Newton very fine sandy loam	4,672	1.8	Coloma very fine sand	448	.8
Newton loam	3,136	1.2	Genesee silt loam	1,984	.6
Maumee fine sandy loam	1,792	.7	Heavy phase	1,536	.4
Muamee fine sand	1,024	.4	Genesee fine sandy loam	1,024	.4
Clyde clay loam	1,408	.9	Genesee clay loam	960	.4
Heavy phase	1,024	.3	Genesee clay loam	896	.4
Clyde loam	832	.3	Wabash silt loam	896	.9
Nappanee silty clay loam	9,280	3.9	Heavy phase	1,408	.7
Heavy phase	832	1.4	Wabash loam	1,728	.5
Nappanee clay loam	2,688	.7	Wabash clay loam	640	.3
Heavy phase	1,024	2.2	Heavy phase	704	.3
Nappanee loam	1,856	1.7	Wabash fine sandy loam	704	.3
Nappanee fine sandy loam	5,632	.4	Peat and muck	832	.8
Fulton silty clay loam	4,032	.4			
Heavy phase	320	.5			
Fulton silt loam	960	.8			
Fulton loam	1,344		Total	250,200	
Fulton very fine sandy loam	1,984				

BROOKSTON CLAY

The profile of virgin Brookston clay when dry may be described as follows, according to layers from the surface downward: A layer of very dark grayish-brown, friable, mellow, crumbly clay from 5 to 8 inches deep; a dark-gray crumbly clay layer to a depth of about 9 inches; a 15-inch layer of olive-gray, friable, granular clay with yellow, yellowish-gray, gray, and brownish-yellow mottlings; a layer of olive-gray rather plastic clay, with mottlings of yellow and yellowish gray; and at a depth of about 40 inches a layer of stiff, compact, calcareous olive-gray clay, with mottlings of gray, yellow, yellowish gray, and brownish yellow.

In some places the dark grayish-brown color of the surface layer continues to a depth of 12 inches. Extending east from Naomi for several miles the soil contains more fine sand than the typical soil, making it very friable. Practically all this soil lying southeast of the gravel ridge extending from near Naomi through Delta consists of friable, crumbly clay. Northwest of this ridge are many spots where very stiff, plastic, impervious clay occurs at depths ranging from 8 to 18 inches.

About 85 per cent of this soil in Fulton County is cultivated. Tilled soil differs from virgin soil in that the surface and subsurface layers have been mixed together, and other variations occur owing to the treatment it has received under cultivation. Under average moisture conditions, to a depth of 8 inches, the tilled soil is dark-gray, friable, crumbly clay. When wet, the color is very dark gray or grayish black. Owing to the heavy texture of this soil, cultivation is more difficult than upon the loamy-textured soils with which it is generally associated; but because of its mellowness and friability, cultivation is much easier than on stiff, heavy clay soils of the area. It is sticky when wet and clods when dry, and consequently must be worked when it is fairly moist.

This is one of the most extensive soils in the county, occurring principally in the townships of Amboy, York, Fulton, and Royalton, the northeastern part of Chesterfield, the southern part of Clinton, and the northwestern part of Swan Creek. One continuous belt ranging in width from one-half mile to 4 miles and averaging about 2 miles wide extends across the county in a northeasterly and southwesterly direction from Naomi on the south to Metamora on the north.

This land is level or gently undulating and lies a little below the general level of the surrounding country. Although surface and subsurface drainage are very poor, the friable, crumbly subsoil greatly facilitates tile drainage.

Wood lots on soil of this kind support a tree growth consisting of elm, black ash, bur oak, cottonwood, soft maple, basswood, sycamore, quaking aspen, white ash, and water beech.

General farming in conjunction with dairying is the chief type of agriculture, except in the northeastern corner of the county where considerable attention is devoted to feeding beef cattle. The most important crops produced on this soil are corn, mixed clover and timothy hay, wheat, oats, alfalfa, barley, sugar beets, and soy beans. Almost all the grain and hay, except wheat, is fed to livestock on the farms. According to estimates of farmers in the dairy section,

there is 1 dairy cow to each 10 acres of this soil, 2 chickens for each acre, 1 hog turned off annually for each 4 acres, and 1 sheep for each 25 acres.

On Brookston clay corn yields about 45 bushels an acre, but where the best methods of farming are followed, yields of 60 or 70 bushels an acre are not uncommon. Wheat yields average about 20 bushels an acre and oats 40 bushels, with considerably higher yields under good management. Yields of mixed clover and timothy hay average about 1½ tons, alfalfa 2½ tons, barley 35 bushels, and soy beans 20 bushels to the acre. Sugar beet yields range from 8 to 15 tons an acre, with an average of 12 tons.

Brookston clay is naturally fertile, and under good farming methods the fertility is easily maintained. Crop rotation is generally practiced. Corn is grown one year or possibly two, oats one year, followed by wheat seeded to mixed red clover and timothy. The clover sod is either plowed in the fall for corn the following spring or is left the second year for pasture. Some farmers have successfully used soy beans in the rotation instead of oats, and the acreage of soy beans is being increased rapidly. The crop makes very nutritious hay. On many farms it is grown with corn for hog pasturage: Where clover fails, soy beans are sown at corn-planting time and harvested for hay or seed in the fall.

All the farmers use commercial fertilizer for wheat generally at the rate of 200 pounds an acre and sometimes for corn. The fertilizer most commonly used contains 16 per cent phosphoric acid. Large quantities of stable manure are applied for corn.

The current value of areas of Brookston clay varies from \$150 to \$250 an acre, depending on improvements and location with respect to good roads, transportation facilities, towns, and schools.

More thorough drainage is needed on many farms on Brookston clay. The main drainage outlets are usually good, but many fields would be benefited by tiling so that crops might be seeded early and cultivated during wet seasons. With good drainage alfalfa does particularly well without the use of lime. Where the subsoil is so tough and compact as to cause much difficulty in obtaining adequate drainage through tile drains, sweet clover should enter the rotation, so that its heavy roots may penetrate and open up the more or less impervious lower layers. Many farmers advise fall plowing, in order that the upturned soil will disintegrate and fall to pieces under the action of freezing and thawing, thus making possible more thorough pulverization of the seed bed in spring.

BROOKSTON CLAY LOAM

From the surface downward Brookston clay loam, when dry, may be described by layers as follows: A 3-inch layer of very dark grayish-brown, rather mellow, friable clay loam, high in organic matter; a 7-inch layer of friable, dark grayish-brown clay loam which becomes lighter in color with increasing depth; a 7-inch layer of brownish-yellow or dark grayish-brown crumbly clay with brown and yellow mottlings; a layer of friable, crumbly clay, with mottlings of olive-gray and brownish-yellow color; and at depths ranging from 27 to 40 inches, the underlying material is olive-gray, calcareous clay

with brownish-yellow mottling, and containing some white lime concretions.

Included with mapped areas of this soil are numerous areas of loam, clay, and fine sandy loam members of the Brookston series, and Nappanee clay loam, too small to be mapped separately. In many places the surface soil is loam to depths of 6 or 8 inches, and then very friable clay loam occurs, and this, in turn, grades downward into heavier-textured material. There are places, particularly between Lyons and Pettisville, where very heavy, tough, impervious clay occurs at depths ranging from 12 to 18 inches.

About 80 per cent of this type of soil in Fulton County is tilled. Under normal moisture conditions the cultivated soil to a depth of 8 inches consists of dark grayish-brown clay loam which when wet becomes very dark grayish brown. The soil is high in organic matter, is very fertile and fairly friable, and can be worked into a good seed bed; but great care should be exercised to cultivate it when at the optimum moisture content.

Brookston clay loam is the most extensive soil in Fulton County, and occurs in every township, principally in large continuous areas in Clinton, York, Pike, Amboy, and Royalton Townships. In other parts of the county, and particularly in the northwestern corner, it occurs as long narrow belts contiguous to the courses of intermittent streams and as small, irregularly outlined patches on areas of lighter-textured or lighter-colored soils.

Areas on which Brookston clay loam has developed are nearly level or gently sloping and occur at slightly lower elevations than areas of lighter-textured or lighter-colored soils which they usually border. In general the drainage of Brookston clay loam is very poor, but in many places the friable soil admits of good aeration and circulation of moisture when artificial drainage has been established. In other places where the subsoil is very heavy, tough, and impervious, it is extremely difficult and expensive to install adequate artificial drainage, and in such places it is necessary to lay the lines of tile at intervals of 2 rods or less. Where the soil is typically developed tile drains are laid from 3 to 4 rods apart, and from 30 to 36 inches deep.

This is a very important soil agriculturally, and at least 80 per cent of it is cultivated, the remainder being mostly in wood lots. Elm is the predominating tree, but black ash, cottonwood, bur oak, soft maple, basswood, sycamore, quaking aspen, white ash, and water beech also grow.

General farming, dairying, and raising hogs and chickens are the prevailing practices, so that farming operations center for the most part around the production of feed crops for use on the farm. Corn, the most important crop, is followed in acreage by mixed clover and timothy hay; wheat and oats are grown less extensively; and barley, alfalfa, sweet clover, and soy beans are minor crops. Corn is grown for silage and grain, the silage being used as feed for the dairy cattle and the grain mostly for fattening hogs. As a corn soil, Brookston clay loam is the most important in the county.

The current value of Brookston clay loam ranges from \$125 to \$250 an acre, depending on improvements and location.

Yields of the various crops and the methods of cultivation and fertilization are about the same as for Brookston clay. Methods of improving Brookston clay are equally applicable to Brookston clay loam. On some farms, and especially some of those operated by tenants, the maintenance of organic matter in the soil has not been adequately provided for and productiveness is gradually decreasing. The soil when well drained is adapted to red clover, alfalfa, sweet clover, and soy beans, and these crops should be grown much more extensively, as they will add needed organic matter and nitrogen and will improve the soil. The turning under of a leguminous crop in connection with deeper plowing in the late fall is reported by some of the better farmers as a very effective method of improving it and increasing its productiveness.

BROOKSTON SILTY CLAY LOAM

A profile of Brookston silty clay loam may be described by layers as follows: A 5-inch layer of very dark-gray, rather friable, granular silty clay loam; a 5-inch layer of dark-gray, friable clay loam; a 4-inch layer of gray or dark-gray crumbly, granular silty clay loam containing mottlings of yellowish brown and brownish yellow; a layer of compact, heavy, gray silty clay containing mottlings of yellow, yellowish brown, and brownish yellow; and between depths of 26 and 40 inches, a layer of heavy, compact, plastic, calcareous clay, olive-gray with yellow mottlings.

Approximately 60 per cent of Brookston silty clay loam is tilled. When cultivated, the surface soil differs from that of virgin soil because of the mixing of the upper layers and the depletion of virgin humus and also because of modifications of chemical composition, texture, and consistence brought about through the application of stable manure, and commercial fertilizers, and the turning under of green-manure crops. Under average moisture conditions the soil to a depth of 8 inches is a dark-gray, friable clay loam, but when wet it is very dark gray. This soil is high in organic matter and is fertile, but it must be worked within a narrow range of moisture conditions.

Brookston silty clay loam is developed in scattered areas near Fayette, and in the northwestern part of Clinton Township. It occurs as depressed patches in areas of lighter-textured and lighter-colored soils. Both surface and subsurface drainage are extremely poor, and because of the compactness of the subsoil material below 14 inches, artificial drainage is more difficult than in Brookston clay loam, but not so difficult as in Toledo silty clay.

About the same trees grow on this soil as on Brookston clay loam. Corn, mixed alsike clover and timothy hay, wheat, and oats are the principal crops. Yields and methods of treatment are practically the same as for Brookston clay loam.

This soil is sold in conjunction with soils of other kinds, but is estimated by farmers to have a current value ranging from \$100 to \$125 an acre.

Many fields are in need of tile drainage. Sweet clover will greatly improve the internal circulation of water and air, if it is introduced in the crop rotation so that it can be left one year or a sufficient period

of time to allow the development of a root system that will penetrate downward into the heavy, plastic layers of the subsoil. Most suggestions offered for the improvement of Brookston clay and Brookston clay loam apply also to this soil.

BROOKSTON LOAM

The profile of virgin Brookston loam, when dry may be described as follows: A 5-inch layer of very dark gray friable loam or heavy fine sandy loam; a 4-inch layer of grayish-brown loam; a 12-inch layer of gray or dark grayish-brown, friable clay loam material mottled with yellow, brownish yellow and yellowish brown; a layer of dark yellowish-brown clay loam or light friable clay with mottlings of gray and yellow; and at depths ranging from 24 to 30 inches the underlying material is heavy, calcareous, light gray with mottlings of yellow, brown, brownish yellow, and yellowish brown, and containing appreciable quantities of small angular gravel. As mapped, areas of this soil include smaller bodies of Brookston fine sandy loam, Brookston clay loam, Miami loam, Miami fine sandy loam, and Nappanee clay loam.

Probably 90 per cent of Brookston loam in Fulton County is tilled. Under normal moisture conditions, the cultivated surface soil consists of dark grayish-brown loam about 8 inches deep, but, when the soil is wet the color becomes very dark grayish brown. This is probably the most desirable soil in the county. When properly drained it is a warm, early, fertile soil. It has a good supply of organic matter and the moisture-holding capacity is such that crops rarely suffer seriously from lack or excess of moisture.

Brookston loam is widely distributed in Fulton County, occurring in practically all the townships but chiefly in Royalton, Amboy, Pike, Fulton, Clinton, York, and Swan Creek Townships. Here the largest bodies lie between tracts of Brookston clay loam and Wauseon fine sandy loam, whereas smaller bodies occur as long narrow strips bordering stream flood plains and as isolated patches in larger developments of Brookston clay loam and Wauseon fine sandy loam. In the remainder of the county Brookston loam usually occurs on lower positions such as along stream courses or as shallow basins in association with areas of lighter-textured or lighter-colored soils.

Areas of Brookston loam are prevailingly level, but where the land slopes upward from an intermittent stream course or borders a stream flood plain, it is gently sloping. The drainage is poor, but artificial drainage can be readily established because of the friable, open topsoil and subsoil.

The predominating tree growth is elm, with black ash and bur oak second in importance. Soft maple, basswood, sycamore, quaking aspen, white ash, water beech, tulip poplar, white oak, dogwood, shellbark hickory, pignut hickory, and ironwood also grow on this soil.

In the production of crops Brookston loam is treated about the same as Brookston clay loam. Current values of farms on Brookston loam range from \$150 to \$250 an acre, depending on improvements and location.

The productiveness of Brookston loam has been fairly well maintained, but on some farms continued cultivation has greatly reduced the organic matter.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of Brookston loam.

Mechanical analyses of Brookston loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>						
2725290	Surface soil, 0 to 7 inches	1.0	3.2	4.2	30.9	18.5	29.4	12.8
2725291	Subsurface, 7 to 10 inches	.7	2.3	3.4	20.5	15.7	39.2	18.3
2725292	Subsoil, 10 to 24 inches	1.2	3.4	3.5	15.7	11.1	34.8	30.3
2725293	Subsoil, 24 to 27 inches	.4	2.8	2.4	12.9	12.2	39.3	29.9
2725294	Subsoil, 27 to 36 inches	1.4	3.1	2.6	12.7	11.3	40.5	28.5

BROOKSTON FINE SANDY LOAM

The profile of dry, virgin Brookston fine sandy loam may be described as follows from the surface downward: A layer of very dark gray fine sandy loam or loamy fine sand, from 2 to 4 inches deep; a layer of material which gradually grades into dark-gray or dark grayish-brown loamy fine sand or light fine sandy loam to a depth of 6 inches; a layer of grayish-brown, dark grayish-brown, very dark gray, or brownish-yellow loamy fine sand with some gravel to depths varying from 13 to 17 inches; a 9-inch layer of grayish-yellow fine sandy loam; and underlying this is olive-gray, calcareous, heavy clay or silty clay with mottlings of gray, yellow, and brown, and containing gravel ranging in size from a flaxseed to a pea.

Between Lyons and Pettisville the lower portion of the subsoil is stiff, friable, light grayish-yellow clay, containing fine gravel and numerous pockets of fine sand. In many places, especially where this soil borders heavier soils, at depths ranging from 6 to 12 inches the texture is fine sandy loam which becomes heavier with depth until at about 16 inches it is heavy clay. Where drainage is very poor and the ground water level is near the surface for long periods in spring there is usually more humus in the topsoil and the color of the subsoil is gray. Mapped areas of Brookston fine sandy loam include many patches of loam, clay loam, and clay, too small to indicate on the map.

In Fulton County about 85 per cent of Brookston fine sandy loam is cultivated. To a depth of 8 inches cultivated soil under average moisture conditions consists of dark grayish-brown loamy fine sand or light fine sandy loam, but when wet the color is darker than typical. When adequately drained Brookston fine sandy loam is warm, early, fertile soil which can be easily worked into a good seed bed. It has a good supply of organic matter, and the moisture-holding capacity is such that crops rarely suffer seriously for lack of or from excess moisture.

Brookston fine sandy loam occurs in Chesterfield, Dover, western Royalton, western Pike, and western Clinton Townships, and there is also a small area in the northwestern corner of Gorham Township.

The land ranges from level to sloping. The surface run-off is slow and subsurface drainage is poor but easily supplemented by artificial means because of the open topsoil.

The predominating tree growth on this soil is hard maple, basswood, and beech. Trees less numerous are hickory, bur oak, white oak, white ash, sycamore, and cottonwood.

About the same type of agriculture is followed on Brookston fine sandy loam as on Brookston clay. The most important crop, corn, gives an average yield of about 40 bushels an acre; oats, 40 bushels; mixed clover and timothy hay, 1½ tons; wheat, 20 bushels; barley, 30 bushels; soy beans, 18 bushels; and alfalfa, 2½ tons.

Brookston fine sandy loam is naturally well supplied with organic matter, is warm and early, and easily tilled under a wide range of moisture conditions.

About 200 pounds of 16 per cent acid phosphate is generally used for wheat, and sometimes 100 pounds is used for corn. Most farmers practice a rotation of corn, oats, wheat, and mixed clover and timothy.

The current value of farm land on Brookston fine sandy loam ranges from \$125 to \$175 an acre, depending on improvements and location.

WAUSEON FINE SANDY LOAM

From the surface downward the profile of Wauseon fine sandy loam, may be described according to layers as follows: A 2-inch layer of grayish-black fine sandy loam or loamy fine sand; a 4-inch layer of very dark gray or dark brownish-gray loamy fine sand or fine sandy loam; an 11-inch layer of grayish-brown or yellowish-brown loamy fine sand containing some gravel; a layer, varying in thickness from 8 to 18 inches, of grayish-yellow or brownish-yellow fine sandy loam; and the underlying material is olive-gray, calcareous, heavy clay, or silty clay, with gray, yellow, and brown mottlings, and containing considerable gravel.

Where this soil borders heavier soils the material throughout is heavier than typical, being fine sandy loam to depths ranging from 6 to 12 inches, where a loam to clay loam occurs, and below this is clay or silty clay at a depth of 16 inches. This soil, as mapped, differs from Brookston fine sandy loam in having fewer included patches of heavier soil and in having the heavy clay layer occurring at a somewhat greater depth.

About 90 per cent of this soil is cultivated. Under average moisture conditions the cultivated soil to a depth of 8 inches is dark grayish-brown loamy fine sand or fine sandy loam, but when wet the color is darker.

Wauseon fine sandy loam is extensively developed throughout the eastern half of the county except for the southeastern corner. Small areas occur in the western part of the county in Franklin, Gorham, western Chesterfield, and southeastern Clinton Townships. The surface is level and drainage is poor, but owing to the porous soil and subsoil layers, artificial drainage can be easily established.

The tree growth consists principally of hard maple, basswood, and beech, with some hickory, white oak, bur oak, white ash, sycamore, and cottonwood. On this soil corn yields an average of about 40

bushels an acre; oats, 40 bushels; mixed clover and timothy hay, 1½ tons; wheat, 20 bushels; barley, 30 bushels; soy beans, 18 bushels; and alfalfa, 2½ tons.

The treatment of this soil and recommendations for its improvement are about the same as for Brookston fine sandy loam.

The current value of soil of this type ranges from \$125 to \$200 an acre, depending upon improvements and location.

WAUSEON LOAMY FINE SAND

The profile of dry, virgin Wauseon loamy fine sand may be described by layers as follows: A layer of very dark gray loamy fine sand 2 to 4 inches deep; a layer of very dark grayish-brown loamy fine sand to a depth of 8 inches; a 6-inch layer of dark grayish-brown loamy fine sand with mottlings of various shades of gray, yellow, and brown; a 6-inch layer of mottled gray or grayish-yellow loamy fine sand, mottled with gray; and at depths ranging from 28 to 48 inches the underlying material is light-gray or gray, compact, calcareous silt loam or heavy, compact, calcareous clay, with mottlings of yellow and brown.

In some places in Chesterfield and Dover Townships the material is fine sandy loam underlain at depths of 8 or 12 inches by loamy very fine sand, which continues until the substratum of friable, calcareous silty clay is reached at depths ranging from 36 to 48 inches. In Swan Creek and York Townships, where this soil is associated with Newton fine sand, the material is usually sticky loamy fine sand to depths ranging from 40 to 50 inches, where it is underlain by a substratum of heavy, calcareous, till clay.

About 75 per cent of this soil is cultivated. To a depth of 8 inches and under normal moisture conditions the cultivated soil is dark grayish-brown loamy fine sand, but when wet it is very dark grayish brown. This is warm, early soil, well supplied with organic matter and retentive of moisture.

Scattered areas of Wauseon loamy fine sand occur in all townships of Fulton County, with the exception of German and Franklin Townships. This land is level or gently undulating and drainage is insufficient, but because of the porous soil material this can be easily supplemented with tile.

The trees and crops grown on this type of soil are about the same as those on Wauseon fine sandy loam, but yields are somewhat lower.

The current value of farm land of this soil ranges from \$100 to \$150 an acre.

TOLEDO SILTY CLAY

From the surface downward the profile of dry, virgin Toledo silty clay shows the following layers: A 3-inch layer of very dark gray silty clay loam; a 2-inch layer of very dark gray silty clay with yellowish-gray mottlings; a 3-inch layer of compact, dark-gray silty clay with mottlings of yellowish gray and brownish gray; a 6-inch layer of heavy, plastic, dark-gray silty clay with mottlings of yellow, yellowish brown, and brownish yellow, and containing some iron concretions; a layer of heavy, compact, gray, or dark-gray silty clay, with yellow, yellowish-brown, and brownish-yellow mottlings;

and at depths ranging from 34 to 80 inches the underlying material is heavy, plastic, calcareous, olive-gray silty clay, with gray mottlings.

South and southeast of Archbold the soil is unusually heavy, stiff, plastic, and impervious. In the northwestern part of section 6, T. 6 N., R. 5 E., the surface layers are much lighter in color than typical. In Franklin Township, the northwestern part of German Township, and the southeastern part of Gorham Township some small areas of heavy Toledo silty clay are mapped with this type of soil. About 70 per cent of Toledo silty clay in Fulton County is tilled. Under normal moisture conditions the cultivated soil to a depth of 8 inches consists of dark-gray silty clay, but when wet it is very dark gray. Toledo silty clay is well supplied with humus, but is a cold soil and can be cultivated only within a narrow range of moisture content. It tends to puddle and clod when wet, and when dry becomes extremely hard and cracks, breaking into large lumps when plowed.

The largest areas of Toledo silty clay are in German Township, and other areas occur in Franklin Township. This land is level or gently undulating and sloping where it borders the bottom land along Brush Creek and some of its larger tributaries. Run-off is very slow, and the compact, plastic, and impervious subsoil greatly impedes the movement of the underground water, and makes successful artificial drainage difficult. Farmers east and northeast of Archbold report that where they set the 4-inch tile at intervals of 2 rods and at a depth of about 24 inches the underdrainage is fair; but south and southeast of Archbold the subsoil is extremely impervious, and it is necessary to set the laterals 1 rod apart. A conspicuous characteristic of the surface soil is that when thoroughly wet it retains water for a long time, but when dry it is so dense that rain water enters it slowly and absorption is hardly noticeable except during continued rains.

This is locally known as "elm land" as elm is the principal tree; but other trees are black ash, cottonwood, bur oak, soft maple, basswood, sycamore, and quaking aspen.

Corn, mixed alsike clover and timothy, oats, and wheat are the principal crops, corn having the largest acreage. General farming is practiced in conjunction with hog raising and dairying, the dairies usually being small. Sugar beets are grown successfully, yields ranging from poor to good, depending largely on the method of cultivation employed and the seasonal distribution of rainfall. Yields of corn range from 25 to 65 bushels an acre, with an average of about 40 bushels; wheat, from 10 to 25 bushels, averaging 18 bushels; oats, from 10 to 50 bushels, averaging 40 bushels; hay averages about 1 ton an acre, and sugar beets about 11 tons.

Most farmers follow a rotation consisting of corn, small grain one or two years, then mixed alsike clover and timothy hay.

The current value of farms on this soil ranges from \$100 to \$150 an acre.

The plowing under of green leguminous crops late in the fall when the moisture content is right, so that the upturned soil will crumble and disintegrate under the action of freezing and thawing, will improve the condition of this soil, will make possible a more thorough pulverization of the seed bed, and will increase the supply of avail-

able plant food. A good rotation for this soil would be corn, soy beans, wheat, and sweet clover, allowing the sweet clover to remain one year, thus giving time for its heavy rooting system to penetrate downward and open up the heavy, tenacious, subsoil layers.

TOLEDO SILTY CLAY LOAM

The profile of dry virgin Toledo silty clay loam may be described as follows: A 3-inch layer of friable, mellow very dark gray silt loam; a layer of mellow very dark gray or dark grayish-brown silt loam to a depth of 6 or 7 inches; a layer of mellow, dark grayish-brown silt loam material which has slight mottlings of gray and yellow and which, with increasing depth becomes lighter in color and heavier in texture until at depths of 10 or 11 inches it is olive-gray silty clay loam with distinct mottlings of yellow and brown to a depth of 24 inches; a layer of heavy, olive-gray silty clay loam with yellow mottlings; at depths ranging from 26 to 28 inches, a layer of compact silty clay loam; and at depths ranging from 30 to 80 inches the underlying material is stiff, calcareous olive-gray silty clay loam with yellow mottlings.

In the northern part of German Township and the southern part of Franklin Township this soil is heavier than typical. In the vicinity of Archbold the silt loam texture in many places extends to depths ranging from 12 to 18 inches, where it rests on light silty clay loam. In the western part of Franklin Township and in Gorham Township there is, in places, a considerable amount of very fine sand and fine sand in the upper layers, and numerous patches of loam, fine sandy loam, and very fine sandy loam too small to map separately are included with Toledo silty clay loam as mapped. Just north and northwest of Thelma a part of the Bean Creek flood plain which is no longer subject to inundation has a very dry layer resembling hardpan which undoubtedly has an important influence on the movement of moisture and air through the subsoil. The thickness of this compact layer ranges from a few inches to 24 inches, and it is in some places underlain by brownish-gray silty clay, which grades into gravelly sandy loam at depths ranging from 36 to 48 inches.

Toledo silty clay loam is a very important soil, and about 90 per cent of it is cultivated. In cultivated fields under average moisture conditions the soil to a depth of 8 inches consists of dark grayish-brown silt loam or light silty clay loam, but when wet it is very dark gray. This type of soil is high in organic matter, retentive of moisture, comparatively easy to till, but warms up rather slowly in the spring.

Toledo silty clay loam is the predominating soil in German and Franklin Townships. Small areas occur in the eastern part of Gorham Township, the extreme western parts of Chesterfield and Dover Townships, and the northwestern corner of Clinton Township. This land is level and both surface and internal drainage are slow and poorly developed owing to the absence of slope and the imperviousness of the subsoil. Artificial drainage is rather difficult to establish.

Elm is the predominating tree on this soil, with some black ash, cottonwood, bur oak, soft maple, basswood, sycamore, quaking aspen, white ash, water beech, and willow. Corn, mixed clover and tim-

othy, wheat, and oats, ranking in acreage in the order named, are the leading crops. Dairying and hog raising are carried on. Practically all the hay and grain except wheat is fed on the farms. According to estimates of farmers, there is one dairy cow to every 15 acres of this soil and one hog fattened and turned off annually for every 2 acres. Many farmers raise from 200 to 500 chickens annually, White Leghorns predominating. Sugar beets have become a very important special crop in the vicinity of Burlington. Soy beans are grown with the corn on many farms, and on a few farms are grown alone. Alfalfa and sweet clover are grown successfully by a number of farmers.

On this soil corn yields between 30 and 70 bushels an acre, averaging 45 bushels; mixed alsike clover and timothy, or mixed red clover and timothy, about 1½ tons; oats, 40 bushels; wheat, 20 bushels; barley, 30 bushels; soy beans, 20 bushels; alfalfa, 2½ tons; and sugar beets, about 10½ tons.

A rotation commonly followed is corn, oats, wheat, and mixed clover and timothy. In some cases soy beans have proved very satisfactory as a substitute for oats in the rotation. On many farms corn is planted two years in succession. Deep plowing and thorough preparation of the seed bed have resulted in a very noticeable increase in crop yields. About 200 pounds an acre of 16 per cent acid phosphate fertilizer is commonly used with wheat, but on some farms mixed fertilizer analyzing 12 per cent phosphoric acid and 5 per cent potash is used instead.

The current value of this land ranges from \$125 to \$250 an acre, depending on farm improvements, location with respect to transportation facilities, towns, schools, and the character of the roads.

The productivity of Toledo silty clay loam could be increased by the application of 600 pounds an acre of 16 per cent acid phosphate within a period of four years. From 300 to 400 pounds an acre should be used for wheat and the remainder for corn. An increased acreage of alfalfa would prove highly beneficial in improving the quality of hay and the fertility of the land. When seeded to alfalfa for the first time, the field should be inoculated. A rotation in which sweet clover could be left for one year, so that the roots would have time to penetrate downward through the subsoil, would improve the internal water and air drainage.

TOLEDO SILT LOAM

The profile of Toledo silt loam, when dry and in the virgin state, may be described by layers from the surface downward as follows: A layer of friable, smooth, very dark grayish-brown silt loam, grading at a depth of about 5 inches into dark grayish-brown mellow silt loam; a layer of olive-gray mottled with yellow and gray, mellow silt loam material, between depths of 7 and 16 inches; a 6-inch layer of yellowish-gray silt loam material mottled with yellow and brownish yellow; a layer of light, friable, grayish-yellow silty clay loam material mottled with gray, brown, and yellow, and containing an appreciable quantity of very fine sand; and at depths ranging from 40 to 44 inches, the material is calcareous, mottled gray, yellow, yellowish-brown, and brownish-yellow silty clay loam or silty clay.

Included with this soil as mapped are numerous small spots of Toledo silty clay loam and Fulton silt loam. Where it grades into Fulton silt loam, the surface soil becomes lighter in color, and the depth to the silty clay loam layer is decidedly variable, ranging from 15 to 36 inches. On part of what was the flood plain of Bean Creek about 30 years ago before the channel was straightened and dredged, the soil is similar to Genesee silt loam, the material being friable silt loam to depths ranging from 10 to 50 inches, where it grades into lighter-textured material ranging from loam to fine sand or very fine sand.

It is estimated that 95 per cent of Toledo silt loam in Fulton County is tilled. Under average moisture conditions the cultivated soil to a depth of 8 inches consists of dark grayish-brown, mellow silt loam, but is very dark grayish brown when wet. This soil is well supplied with organic matter and if properly drained is easily cultivated.

Most of Toledo silt loam is in German Township, but small bodies occur in Franklin, the southeastern part of Gorham, and the extreme western part of Chesterfield Townships. The land is almost level and drainage is inadequate, but because of the pervious subsoil, artificial drainage can be easily installed. Elm is the predominating tree on this soil with some black ash, bur oak, cottonwood, sycamore, soft maple, basswood, quaking aspen, white ash, and water beech.

General farming is practiced in conjunction with dairying and hog raising. Farming operations are confined chiefly to growing corn, small grains, and hay. Corn yields average about 45 bushels an acre; oats, 40 bushels; wheat, 20 bushels; barley, 25 bushels; and mixed clover and timothy hay, 1½ tons. Around Burlington and Elmira sugar beets are grown as a special crop, yields averaging about 11 tons an acre.

Most farmers on this soil are systematically adopting such practices as deep plowing, rotating crops, and growing legumes. About 200 pounds of 16 per cent acid phosphate is used for wheat. The current value of Toledo silt loam ranges from \$125 to \$250 an acre, depending upon improvements and location with respect to shipping facilities, improved roads, towns, and schools.

More thorough drainage is needed on some farms. Although outlets are provided, many fields need tiling to hasten the removal of water so that crops may be seeded early and cultivated regularly. A rotation suggested for this soil consists of corn, followed by soy beans, then wheat seeded to sweet clover.

NEWTON FINE SAND

The dry topsoil of Newton fine sand consists of a 2-inch layer of very dark grayish-brown or grayish-black fine sand with a high percentage of organic material, underlain by a 4-inch layer of dark grayish-brown fine sand containing large quantities of organic matter. In this topsoil the sand particles are gray and are intermingled with the dark organic remains. Below a 2-inch transition zone, consisting of dark-brown fine sand, there is an 8-inch layer of dark yellowish-brown or dark grayish-brown fine sand, with mottlings of brown, grayish brown, and yellow. At depths ranging from 16

to 24 inches the color is pale yellow mottled with gray and in places with bright yellow. This is underlain at about 36 inches by compact fine sand with yellow, gray, and brown mottlings, yellow becoming more prominent with depth. The proportion of yellow and gray in the subsoil is variable. At places where the yellow color is very pronounced, the iron coatings of the soil particles give a slight coherence or loaminess to the sand.

About 40 per cent of this soil is cultivated. Under average moisture conditions the cultivated soil consists of dark grayish-brown fine sand, moderately high in organic matter. Adjacent to areas of Plainfield fine sand a narrow gradation zone occurs where the surface soil is decidedly gray.

The largest area of Newton fine sand is south of Swanton in the region known locally as the "oak openings," where it is low-lying and adjoins areas of Plainfield fine sand. This soil occurs as irregular areas varying in size from a few acres to 40 acres.

The surface is level and drainage is poor. Where a satisfactory outlet can be secured, this soil can be drained fairly easily because the subsoil is open and porous.

The forest growth is principally aspen, cottonwood, elm, soft maple, and willow. Where the land has been cleared and allowed to remain uncultivated for a number of years, the principal growth is aspen.

Although areas of this soil are fairly extensive, Newton fine sand is of only moderate agricultural importance. The leading crops are corn, rye, oats, wheat, and mixed timothy and clover hay. Where adequate drainage has been established yields are fair. Buckwheat, cabbage, and cucumbers are grown to a small extent. When proper methods of cultivation are used, some of the special crops should prove to be especially profitable.

Much of this land is inadequately drained and crops suffer in wet years. The soil is slightly acid, and this condition together with poor drainage makes it very unfavorable for clover. The improvement of this soil will require, first of all, adequate artificial drainage.

NEWTON LOAMY FINE SAND

When dry, virgin Newton loamy fine sand consists of loamy fine sand to depths ranging from 40 to 50 inches. The surface soil, to about 4 inches deep, is high in organic matter and contains large quantities of grass roots. The color gradually becomes lighter with depth, grading from very dark grayish brown or nearly black in the surface layer, to light gray, with mottlings of gray, yellow, and brownish yellow at depths varying from 16 to 22 inches; and light grayish yellow with gray and pale-yellow mottlings at depths ranging from 26 to 34 inches. Below this, at depths ranging from 40 to 50 inches, the material is dark yellowish-brown or yellowish-brown calcareous, fine sandy loam with gray and yellow mottlings.

In some places the loamy fine sand gradually becomes heavier until stiff, heavy, calcareous, light-gray or light grayish-yellow clay is reached at depths ranging from 38 to 48 inches. The surface soil to depths of 2 to 4 inches varies in some places from heavy loamy fine sand to light fine sandy loam. Newton loamy very fine sand on

long, narrow strips bordering the flood plains of Brush Creek in the southwestern part of Dover Township, are mapped with Newton loamy fine sand. In the northwestern part of Pike Township and in the vicinity of Oakshade, this soil is in places decidedly lighter in texture, it being slightly loamy fine sand. Numerous patches of Newton fine sandy loam too small to show on the map are also included with this soil as mapped.

Probably 70 per cent of Newton loamy fine sand in Fulton County is cultivated. The cultivated soil under normal moisture conditions consists of very dark grayish-brown loamy fine sand, but when wet the color is darker.

Newton loamy fine sand is developed in practically all the townships of Fulton County, except those bordering Williams County line. The land is level or gently sloping and drainage is naturally poor, but owing to the sandy texture of the soil and subsoil artificial drainage can be easily established.

Uncleared areas support a tree growth consisting mainly of bur oak, aspen, elm, and soft maple. Cottonwood, willow, sycamore, white oak, yellow oak, ash, and basswood are other trees that grow on this soil. On lighter, poorer variations of this soil the tree growth is mainly aspen, cottonwood, elm, and soft maple.

The leading crops are corn, oats, wheat, rye, and mixed timothy and clover. On dry areas red clover is grown and on poorly drained fields alsike clover is substituted. Buckwheat and potatoes are minor crops. Watermelons and cantaloupes do well where drainage is good. According to the estimates of farmers, yields of corn vary from 25 to 40 bushels an acre, with an average of 32 bushels; hay, from 1 to 1½ tons; oats, from 20 to 40 bushels, with an average of 30 bushels; wheat, from 12 to 20 bushels, with an average of 15 bushels; and rye, from 10 to 25 bushels, with an average of 15 bushels. Where the soil is considerably loamy the least acidity exists and better yields of crops are secured.

No systematic rotation is followed, although as a rule sod is broken for corn which is either grown the second year or followed by oats then wheat which is seeded to mixed clover and timothy. About 200 pounds to the acre of 16 per cent acid phosphate is applied for wheat and 80 pounds an acre for corn.

Current land values range from \$50 to \$125 an acre, depending on the loaminess of soil, the improvements, the condition of the roads, and the location with respect to transportation facilities, towns, and schools.

With drainage and the application of lime, clover and other legumes will do well. By growing legumes, plowing under green-manure crops, and applying barnyard manure supplemented with phosphate the productivity of this soil is greatly improved. A very good rotation for increasing and maintaining the productiveness of this soil is corn followed by oats seeded with red clover, the clover being left for a hay crop, after which it is turned under for fall wheat. About 200 pounds of fertilizer analyzing 12 per cent phosphoric acid and 5 per cent potash, and a light dressing of stable manure are applied to wheat land. If the soil has not been previously limed, 1 or 2 tons of finely pulverized limestone may also be applied with a lime drill. Sweet clover is seeded in the wheat in the spring, and a year later it is plowed under for corn.

NEWTON VERY FINE SANDY LOAM

The profile of Newton very fine sandy loam, when dry and in the virgin state may be described as follows: A 3-inch surface layer of grayish-black very fine sandy loam high in organic matter, below which to a depth of 7 inches the color becomes lighter; a layer of grayish-brown or dark grayish-brown very fine sandy loam mottled with gray, yellow, and brown; at a depth of about 15 inches a layer of brownish-gray very fine loam material with yellow, yellowish-brown, and brownish-yellow mottlings; at depths ranging from 20 to 30 inches a layer of heavy, mottled gray, yellow, and brown loam or friable silty clay loam; and at depths varying from 38 to 42 inches the underlying material is light grayish-yellow, calcareous silty clay mottled with yellow.

As mapped, areas of this soil contain many patches of Newton loam and some areas of Newton very fine sand, Toledo silty clay loam, and Lucas fine sandy loam. In some places the upper layers to depths varying from 8 to 12 inches consist of loamy very fine sand, the texture of which grades downward into very fine sandy loam. Adjacent to old glacial lake beaches and flood plains of Tiffin River, Bean and Brush Creeks, in the western part of the county, are areas of a light phase of Newton very fine sandy loam, which have been included in mapped areas of the typical soil.

About 80 per cent of Newton very fine sandy loam in Fulton County is under cultivation. Under normal moisture conditions the cultivated soil, to a depth of 8 inches, is dark grayish-brown very fine sandy loam, but when wet the color is very dark grayish brown. This soil with proper drainage is early, easy to handle, and is high in organic matter. The subsoil is open, allowing free movement of air and water.

Areas of Newton very fine sandy loam occur in German, Franklin, Dover, Chesterfield, and Clinton Townships. This land varies from level to gently sloping or gently rolling. The surface run-off and internal drainage are poor but easily corrected by artificial means, owing to the favorable consistence and texture.

Uncleared areas of this soil support a forest growth consisting mainly of hard maple, basswood, and beech. The other trees are about the same as those grown on Brookston fine sandy loam. The principal crops are corn, mixed red clover and timothy hay, wheat, and oats. Corn yields average about 40 bushels an acre, hay 1 to 1½ tons, wheat 17 bushels, and oats 37 bushels.

A rotation including corn, oats, wheat, and hay is generally followed. Grasslands are given a dressing of stable manure previous to breaking, and an acreage application of about 200 pounds of 16 per cent acid phosphate is usually made for wheat at the time of planting.

The current value of land of this type ranges from \$100 to \$150 an acre, depending on improvements and nearness to towns, transportation facilities, and schools.

Newton very fine sandy loam could be improved by the more frequent plowing under of leguminous crops. Barnyard manure should be supplemented with phosphoric acid. Moderate applications of lime will in many places prove beneficial in connection with such

crops as clover and alfalfa. Where fertility is seriously depleted, the rotation of crops recommended for Newton loamy fine sand would be very effective in increasing the productiveness.

NEWTON LOAM

The profile of dry virgin Newton loam may be described by layers from the surface downward as follows: A 4-inch layer of very dark grayish-brown friable, mellow very fine loam or heavy very fine sandy loam which with increase in depth gradually becomes heavier in texture and lighter in color, until between 6 and 12 inches deep is friable, dark grayish-brown loam or very fine loam; a 3-inch layer of brownish-gray or grayish-yellow friable silt loam material with gray and yellow mottlings; below 15 inches deep a layer of mottled light-gray or grayish-yellow friable silty clay loam material which becomes heavier with depth; at depths ranging from 24 to 28 inches a layer of heavy, yellowish-olive silty clay loam material mottled with gray and yellow; and at depths ranging from 36 to 50 inches the underlying material is stiff, calcareous, olive-gray silty clay loam with mottlings of yellow and gray.

As mapped, many small areas of Toledo silt loam, Toledo silty clay loam, Fulton fine sandy loam, and Fulton very fine sandy loam are included with this soil. Where associated with Newton very fine sandy loam or Wauseon fine sandy loam, the layers below 8 or 12 inches are in places very fine sandy loam or fine sandy loam, and in some places the material below 26 inches is loamy very fine sand or loamy fine sand. Wherever the soils with which Newton loam is associated are heavier than loam in texture the surface layers are usually heavy loam grading into silty clay loam at depths between 8 and 14 inches.

About 85 per cent of Newton loam in Fulton County is tilled. Under normal moisture conditions the tilled soil to a depth of 8 inches consists of dark grayish-brown loam or very fine loam, which becomes decidedly darker in color when wet. This is warm, early, and fertile soil, which can be easily worked into an excellent seed bed.

Newton loam occurs as small scattered areas in the townships of Gorham, Franklin, the northwestern corner of German, and the extreme western parts of Chesterfield and Dover. The surface is level or gently sloping and drainage is poor, but the subsoil admits of excellent artificial drainage.

The native forest consists mainly of elm, black ash, cottonwood, bur oak, soft maple, and some basswood, sycamore, quaking aspen, white ash, water beech, yellow poplar, white oak, pin oak, dogwood, shellbark hickory, pignut hickory, ironwood, and willow. Corn, hay, wheat, and oats are the principal crops, with corn predominating in acreage. Corn yields about 40 bushels an acre, hay 1½ tons, wheat 18 bushels, and oats 40 bushels.

The current value of this soil ranges from \$125 to \$200 an acre, depending upon location and improvements.

Newton very fine sandy loam can be readily improved by applying stable manure and plowing under leguminous crops. Acid phosphate aids materially in growing cereals. Thorough drainage is imperative for satisfactory results. The treatment recommended for Toledo silty clay loam and Brookston loam are suitable for this soil.

MAUMEE FINE SANDY LOAM

The profile of virgin Maumee fine sandy loam may be described by layers from the surface downward as follows: A 6-inch layer of black loamy fine sand or light fine sandy loam; a 5-inch layer of grayish-black loamy fine sand or fine sandy loam; a 3-inch layer of very dark grayish-brown fine sandy loam mottled with yellow; a 6-inch layer of dark grayish-brown fine sandy loam material mottled with grayish yellow and yellowish brown; a layer of light, friable, dark-gray loam material mottled gray, brownish gray, and yellowish brown; and at depths ranging from 28 to 36 inches the underlying material is gray or olive-gray, calcareous, heavy silty clay mottled with yellow and containing considerable gravel.

In some areas of this soil friable clay loam occurs at depths ranging from 14 to 24 inches. In many places at depths ranging from 34 to 40 inches loam or light clay loam occurs, which at depths ranging from 44 to 50 inches grades into friable, calcareous clay. This soil is closely associated with Clyde loam and Brookston fine sandy loam, and mapped areas of this type of soil include areas of these soils too small to separate on the soil map.

Probably 60 per cent of Maumee fine sandy loam is under cultivation, and in this condition it differs in some particulars from the virgin soil. The cultivated soil under normal moisture conditions to a depth of 8 inches consists of black loamy fine sand or light fine sandy loam. When drained this is a warm, early soil with a good supply of organic matter.

Maumee fine sandy loam occurs on low, depressed areas along intermittent streams and in the sites of old ponds and sloughs in the townships of Pike, Royalton, Chesterfield, Dover, and Clinton. The surface is flat, level, or gently sloping and drainage is very poor, but the porous soil makes artificial drainage a comparatively easy matter.

The principal tree growth consists of elm, aspen, cottonwood, and soft maple, with some bur oak, black ash, sycamore, and willow. Corn, hay, wheat, and oats are important crops grown on this soil. Yields of corn average about 40 bushels an acre, mixed clover and timothy hay 1½ tons, oats 40 bushels, and wheat 18 bushels. As this soil has been under cultivation a comparatively short period of time and is naturally fertile, farmers have given little attention to crop rotation, fertilization, or to maintaining its productiveness.

The current value of most of this land ranges from \$100 to \$150 an acre.

More thorough drainage is the principal need of this soil. Many fields should have more tile so that crops might be seeded earlier and be cultivated during wet seasons. The rotation of crops, including legumes, and the use of some phosphate would tend to maintain its productiveness.

MAUMEE FINE SAND

The topsoil of dry virgin Maumee fine sand consists of black fine sand or loamy fine sand which grades into grayish-black fine sand, at a depth of about 8 inches. Both these upper layers are very high in organic matter and in places mucky. The upper portion of

the subsoil at a depth of about 12 inches, is dark olive-gray fine sand, slightly tinged with yellow; and the lower portion of the subsoil at a depth of about 15 inches is yellowish-brown fine sand, mottled with yellow and gray. Underlying this at a depth of about 25 inches the material is light-yellow fine sand.

A loamy variation of this soil type is very common and consists of an 8-inch layer of black fine sand high in organic matter; a 2-inch layer of grayish-black loamy fine sand; a 4-inch layer of dark olive-gray, sticky fine sand or light fine sandy loam; a layer of grayish-yellow sticky fine sand with mottlings of yellow and brownish yellow; underlain at a depth of about 24 inches by grayish-yellow fine sand, which continues downward to a depth of 60 inches or more.

About 40 per cent of Maumee fine sand is under cultivation. Under average moisture conditions the cultivated soil to a depth of 8 inches consists of black fine sand or loamy fine sand. This soil is well supplied with organic matter, and when well drained is warm and early.

This soil is inextensive and occurs on low, poorly drained areas in the southern part of Chesterfield, the western part of Pike, and the eastern part of Dover Townships. The surface is flat or gently sloping and drainage is very poor. Before profitable yields can be obtained it is necessary to construct tile drains or open ditches.

Maumee fine sand supports a tree growth consisting mainly of aspen, cottonwood, elm, and soft maple with some pin oak, bur oak, black ash, sycamore, and willow. Corn and hay are the main crops. Where the surface drainage is poor, alsike clover is preferable to red clover. Wheat, oats, buckwheat, rye, and potatoes are other crops grown.

The current value of this land ranges from \$60 to \$120 an acre.

CLYDE CLAY LOAM

The profile of dry virgin Clyde clay loam may be described as follows: A 7-inch layer of black, mellow, friable clay loam; a 3-inch layer of grayish-black, friable, granular clay loam; a 4-inch layer of very dark gray, granular, friable clay; a 3-inch layer of gray or dark-gray, friable, granular clay mottled with yellow, yellowish brown, and brownish yellow; a layer of friable, gray, or olive-gray clay mottled with yellow, yellowish brown, and brownish yellow; underlain at depths ranging from 24 to 36 inches by stiff, calcareous, olive-gray clay mottled with gray and yellow.

In Fulton County approximately 65 per cent of this soil is cultivated. The tilled soil to a depth of 8 inches under normal moisture conditions is grayish-black friable clay loam, but it is black when wet. This soil is well supplied with organic matter and is one of the most fertile and best corn soils of the county.

The total area of Clyde clay loam is inextensive, occurring in the extreme northwestern corner of the county and in small scattered bodies in Chesterfield, Royalton, Pike, Dover, and Clinton Townships. It occurs in basinlike depressions and long, narrow, low-lying belts along intermittent stream courses, which at one time were a series of ponds and swamps.

This land is flat or gently sloping. Drainage is naturally very poor, but the fairly friable subsoil makes artificial drainage feasible.

Elm is the predominating tree growth on Clyde clay loam. Black ash, cottonwood, sycamore, bur oak, soft maple, willow, and quaking aspen are other trees growing on this soil. Corn, mixed clover and timothy, wheat, and oats are the leading crops. Alfalfa and soy beans are also grown. Corn yields range from 40 to 70 bushels an acre, with an average of 48 bushels, and hay about 1½ tons an acre.

This soil receives about the same treatment as Brookston clay loam, and the methods suggested for improvement are also the same.

The current value of this land ranges from \$125 to \$200 an acre.

Clyde clay loam, heavy phase.—The top layer of dry, virgin Clyde clay loam, heavy phase, is black friable clay or heavy clay loam. At a depth of 7 inches this is underlain by a 7-inch layer of grayish-black or very dark gray, rather heavy, plastic, granular clay. Below 14 inches the material is dark-gray, compact, sticky clay mottled with yellow, yellowish brown, and brownish yellow, and at a depth of about 20 inches is olive-gray heavy tenacious clay mottled with yellow. This at depths ranging from 24 to 32 inches is underlain by olive-gray, calcareous, compact, stiff, plastic clay with yellow and yellowish-brown mottlings. The moist condition of this soil in the virgin state has favored a rank growth of grasses and water-loving plants, the decay of which accounts for the dark color of the surface soil and its large supply of organic matter.

About 80 per cent of this soil in Fulton County is under cultivation. Where cultivated the surface soil to a depth of 8 inches under normal moisture conditions is grayish-black, friable clay loam, but when wet the color is black. This heavy Clyde clay loam is rather difficult to handle and must be cultivated within a narrow range of moisture conditions as it tends to puddle and clod when wet, and when dry it becomes hard and cracks, breaking into large lumps when plowed.

The occurrence of Clyde clay loam, heavy phase, is inextensive, the largest body occurring in the southeastern part of Gorham Township, and others in Clinton and Chesterfield Townships, and the western part of Royalton Township.

The tree growth, crops, yields, and methods of treatment of this soil are about the same as those prevailing on Brookston clay.

The current value for farm land on Clyde clay loam, heavy phase, ranges from \$150 to \$200 an acre.

With adequate drainage, Clyde clay loam, heavy phase, is especially adapted to growing corn, clover, alfalfa, sweet clover, sugar beets, soy beans, and peas. Small grains have a tendency to grow too rank. Sweet clover and alfalfa, if grown, would penetrate and open up the compact, plastic subsoil with their heavy rooting systems, thus improving internal air and water drainage.

CLYDE LOAM

The profile of Clyde loam in its dry, virgin condition may be described by layers from the surface downward as follows: An 8-inch layer of very dark gray or black mellow loam; a 3-inch layer of very dark gray, friable, granular clay loam; a 4-inch layer of dark-gray or very dark gray, granular clay loam; a 7-inch layer of heavy, plastic, dark olive-gray or dark-gray clay with mottlings of yellow

and yellowish brown, and containing considerable small gravel; a layer of gray or yellowish-gray, heavy, tenacious clay with mottlings of various shades of yellow and gray; and at depths ranging from 26 to 36 inches the underlying material is gray or olive-gray, calcareous, plastic clay with mottlings of yellow and yellowish brown and containing much small gravel. The upper layers are high in organic matter, and this gives them their dark color.

All variations between Clyde clay loam and Clyde fine sandy loam were included with this soil as mapped. In places the upper layers are fine sand, which grades at a depth of about 6 inches into loam or sandy clay loam. In the eastern part of Pike Township are places where layers of fine sand occur at depths ranging from 24 to 40 inches. In the eastern parts of Gorham and Pike Townships and the western part of Chesterfield Township the subsoil is more friable than in the typical soil; at a depth of 16 inches is friable clay loam, and at depths ranging from 24 to 36 inches there may be a moderately friable or slightly plastic clay.

About 70 per cent of this soil in Fulton County is under cultivation. The surface soil under normal moisture conditions consists of grayish-black loam, but when wet the color is usually black. This soil is very high in organic matter and is one of the most productive in the county. The moisture-holding capacity is such that, where adequate drainage has been installed, crops rarely suffer seriously from lack or excess of moisture.

This soil is inextensive. It occurs as very small scattered areas in Gorham, Chesterfield, Pike, and Clinton Townships. It is low-lying and occurs along intermittent stream courses and in shallow depressions. The surface ranges from level to gently sloping and drainage is very poor. However, by placing lines of 4-inch tile about 26 inches deep and from 2½ to 3 rods apart artificial drainage can be accomplished.

The tree growth consists mainly of elm and black ash, with some soft maple, bur oak, cottonwood, sycamore, and willow. Corn, mixed alsike clover and timothy, oats, and wheat are the leading crops. Corn and oats yield fully as well as on Clyde clay loam. Oats yield about 45 bushels an acre, and wheat about 20 bushels. In the production of crops Clyde loam is treated in about the same manner as Brookston clay loam.

The current value of this land ranges from \$100 to \$200 an acre.

The following table gives the results of mechanical analyses of samples of the surface soil, subsurface, and subsoil of Clyde loam:

Mechanical analyses of Clyde loam

Number	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		<i>Per cent</i>						
2725186	Surface soil, 0 to 3 inches....	1.0	9.0	4.8	32.4	12.8	27.1	13.0
2725187	Subsurface, 3 to 6 inches....	1.4	7.0	5.6	32.4	13.5	25.7	14.5
2725188	Subsoil, 6 to 10 inches.....	.4	3.9	6.2	38.4	15.6	21.9	13.5
2725189	Subsoil, 10 to 13 inches.....	.8	3.0	4.4	33.7	16.0	24.6	17.5
2725190	Subsoil, 13 to 26 inches.....	.5	2.7	3.2	36.5	16.8	20.9	19.5
2725191	Subsoil, 26 to 42 inches.....	1.9	4.1	2.4	12.5	14.6	36.7	27.9

NAPPANEE SILTY CLAY LOAM

The profile of Nappanee silty clay loam in the dry virgin state may be described by layers as follows: A 2-inch layer of dark-gray silt loam; 2-inch layer of gray silt loam somewhat darkened by organic matter; a layer of light-gray silt loam with mottlings of yellow, to a depth of about $7\frac{1}{2}$ inches; a layer of mottled gray, yellowish-brown, and brownish-yellow silty clay loam, to a depth of about 10 inches; a 7-inch layer of dark olive-gray silty clay loam material mottled with gray, yellow, and brown; a layer of dark olive-gray, plastic clay with similar mottlings and a small amount of gravel; at depths ranging from 20 to 36 inches a layer of plastic, calcareous light-gray clay, having mottlings of brown, yellowish brown and brownish yellow; and at depths ranging from 21 to 40 inches the underlying material is very hard, stiff, highly calcareous light-gray clay, mottled with brownish yellow and yellowish brown.

In many places, at depths varying from 10 to 18 inches, is very heavy, plastic, impervious, grayish-brown or brownish-gray silty clay, commonly termed "hardpan," with gray, yellowish-brown, and brownish-yellow mottling. In other places both the surface and subsurface layers contain considerable fine sand or very fine sand which makes the material friable. In some places a layer of loam or fine sandy loam material occurs at depths ranging from 24 to 36 inches, underlain by heavy, calcareous clay.

In the northern part of Chesterfield Township, mapped areas of this soil include some small areas of Nappanee silt loam, which consists of silt loam to a depth of about 16 inches, the color of which becomes lighter with depth ranging from dark gray to pale yellow and yellowish gray, with mottlings of yellow and gray. Below 16 inches is gray, friable silty clay or silty clay loam material which contains numerous small pockets of very fine sand. Below 28 inches the material is grayish-yellow silty clay underlain by calcareous, compact clay mottled with yellow, yellowish brown, and brownish yellow, with splotches of white, and having a tendency to break up into pea-sized, irregularly shaped blocks.

Between 1 and 2 miles west of Fayette and at several other places in Gorham Township near Williams County line, are small areas of Crosby silt loam, which have been mapped with this soil.

Probably 75 per cent of Nappanee silty clay loam is under cultivation. In cultivated fields under normal moisture conditions, Nappanee silty clay loam to a depth of 8 inches is light-gray silt loam or silty clay loam but during wet periods the color is gray. This soil is rather low in organic matter, warms up rather slowly in the spring, and should be worked within a narrow range of moisture conditions.

This is a rather extensively developed soil, and, with the exception of Dover Township, it is well distributed throughout the western half of Fulton County.

The land is gently rolling or rolling. The surface run-off ranges from fair to good, but because of the compact subsoil drainage is usually retarded. On most farms artificial drainage is necessary for growing the crops common to the region.

The principal trees are white oak, hickory, red oak, and beech; and there are also some hard maple, bur oak, and black walnut. Corn is the chief crop grown, its acreage being about 20 per cent

greater than that of mixed red clover and timothy hay, the next largest crop. Wheat and oats are also important. Barley, alfalfa, soy beans, and sweet clover are grown to a small extent. General farming in connection with dairying is practiced. About one hog to every 4 acres is turned off annually. About one farmer out of 10 raises sheep. Corn yields about 35 bushels an acre; hay, about 1½ tons; oats, 40 bushels; barley, 25 bushels; soy beans, between 15 and 25 bushels; wheat, 20 bushels; and alfalfa, about 2 tons.

Fall plowing is generally practiced on Nappanee silty clay loam. In the fall most farmers apply barnyard manure to the sod land, after which they plow it so that the freezing and thawing action will disintegrate and slake the soil, making it pulverulent and well suited to develop a good seed bed in the spring. The rotation is usually corn, oats, and wheat, seeded to mixed clover and timothy. Acid phosphate (16 per cent) is the main commercial fertilizer used on this soil, and it is applied for wheat at the rate of about 200 pounds an acre.

Current values of this land range from \$100 to \$150 an acre, depending on improvements and location.

A very satisfactory rotation for this soil is corn, oats, clover, wheat, and sweet clover, the sweet clover being left for one year so that the roots will have time to penetrate downward and open up the heavy, plastic subsoil. Deep plowing in conjunction with the turning under of green legumes greatly improves the surface soil, deepens the root zone, and makes available elements of plant food.

Nappanee silty clay loam, heavy phase.—The profile of Nappanee silty clay loam, heavy phase, in the dry virgin state may be described by layers from the surface downward as follows: A 1-inch layer of very dark brown loam or friable silt loam containing a considerable supply of grass roots and partially decomposed organic matter; a 1-inch layer of dark-gray, friable silt loam; a 1-inch layer of gray friable silty clay loam mottled with yellow; a 3-inch layer of heavy, plastic, stiff, light-gray silty clay; a 12-inch layer of heavy, compact, crumbly, olive-gray clay, mottled with yellow; a layer of stiff, heavy, dark olive-gray clay with mottlings of yellow and brownish yellow; and at depths ranging from 24 to 30 inches the material is heavy, impervious, tenacious, calcareous, dark olive-gray clay, having mottlings of gray and yellow and containing some pebbles.

About 80 per cent of Nappanee silty clay loam, heavy phase, is cultivated. Under average moisture conditions the tilled soil to a depth of 8 inches consists of light-gray silty clay, which is gray in color when wet. Under favorable moisture conditions this soil granulates and works up into a good seed bed, but when worked too wet it clods.

Soil of this phase is inextensive, occurring in German Township as slightly raised elevations in areas of Toledo silty clay. The surface is level or gently sloping, and drainage is poor. Because of the compactness and plasticity of the subsoil, the movement of the ground water is extremely slow, making artificial drainage difficult.

Corn, hay, wheat, and oats are the principal crops on Nappanee silty clay loam, heavy phase. Corn averages about 35 bushels an acre, hay 1½ tons, oats 40 bushels, and wheat 18 bushels.

This land is sold only in connection with larger areas of Toledo silty clay or other adjoining soil.

NAPPANEE CLAY LOAM

The profile of Nappanee clay loam, in the dry virgin state, may be described by layers as follows: A 2-inch top layer of dark-gray loam or clay loam which grades into dark-gray loam, silt loam, silty clay loam, or clay loam; a 1-inch layer of gray silty clay loam or clay loam with faint mottlings of yellow and brownish yellow; a 5-inch layer of light yellowish-gray, heavy, plastic clay loam mottled with yellow and brownish yellow; a 6-inch layer of compact, plastic, light grayish-brown clay with mottlings of yellow and gray; a layer of olive-gray, very heavy, plastic clay mottled with gray, brown, brownish yellow, yellowish brown and yellow; and at depths ranging from 20 to 28 inches the underlying material is olive-gray, plastic, calcareous clay mottled with brown, yellow, yellowish brown, and brownish yellow.

Intermingled with this soil and in places predominating, is heavy, plastic, sticky clay loam, which grades at about 7 inches deep into extremely hard, plastic, impervious grayish-brown clay mottled with brownish yellow, yellowish brown, and grayish brown. This clay is locally known as hardpan. Underlying this at depths ranging from 21 to 24 inches is calcareous, compact, heavy, plastic, grayish-brown or brownish-gray clay with mottlings of gray, yellowish brown, and brownish yellow. Small patches of gravelly clay loam dot some bodies of this soil, and in such places considerable gravel is present throughout the soil. Mapped areas of Nappanee clay loam include numerous small patches of Nappanee loam, Nappanee fine sandy loam, Nappanee clay, Brookston clay loam, Brookston loam, and Brookston clay. In most of the bodies there are patches which contain considerable fine sand in the upper layers and which have distinctly friable lower layers.

Approximately 70 per cent of this soil in the county is under cultivation. In cultivated fields under normal moisture conditions this soil to a depth of 8 inches is light yellowish-gray clay loam or heavy clay loam, which becomes distinctly darker in color when wet. This soil is low in organic matter. It must be worked when it is fairly moist, as it is sticky when wet and clods when dry.

The total area of Nappanee clay loam is not extensive, small tracts occurring in Royalton, Amboy, Fulton, York, Gorham, and the southern part of Clinton Townships. The surface is predominantly level, but in many places it is gently undulating or rolling. The surface drainage ranges from poor to fair, but because of the compact, plastic subsoil the subsurface drainage is poor and artificial drainage is difficult.

The predominating tree growth is hickory, red oak, and beech. Other trees growing on this soil are white oak, hard maple, bur oak, black oak, and basswood. Corn, hay, wheat, and oats are the leading crops, and barley, sweet clover, soy beans, and alfalfa are also grown. Corn yields average about 35 bushels an acre; hay, 1½ tons; oats, 40 bushels; wheat, 20 bushels; barley, 25 bushels; soy beans, 20 bushels; and alfalfa, 2 tons. The soil is cultivated and fertilized in about the same way as Nappanee silty clay loam.

Nappanee clay loam is usually sold in connection with other types of soil, but where it is sold separately it has a current value ranging from \$90 to \$125 an acre.

Profitable farming on this soil depends largely on adequate drainage, plowing, and cultivating the soil at the optimum moisture content, proper fertilization, and the use of methods to increase and maintain the supply of organic matter in the soil. The rotation of crops suggested for Fulton silty clay loam is equally suitable for this soil.

Nappanee clay loam, heavy phase.—The profile of dry, virgin soil of Nappanee clay loam, heavy phase, may be described as follows: To a depth of 1½ inches, a layer of very dark gray, friable silty clay loam with considerable organic matter; a transition zone about 2 inches thick, composed of a mixture of dark-gray and very dark gray silty clay loam, grading into heavy, gray silty clay or light silty clay to a depth of 5 inches; a 2-inch layer of light-gray friable clay; a layer of stiff, heavy, sticky, olive-gray clay, mottled with gray, yellow, and brownish yellow, a layer of very compact, plastic olive-gray clay; and at depths ranging from about 18 to 24 inches, the material is mottled gray and pale-yellow, calcareous, heavy, stiff, compact, plastic clay. In many places the stiff, plastic clay is within a few inches of the surface.

About half of Nappanee clay loam, heavy phase, is cultivated. The tilled soil to a depth of 8 inches and under average moisture conditions is gray clay loam, which becomes darker in color when wet. This soil is rather low in organic matter. It can be worked only within a narrow range of moisture conditions.

Areas of Nappanee clay loam, heavy phase, are not extensive, ranging in size from 2 to 60 acres. They occur east, south, and southwest of Delta. The surface is level or gently sloping, and is slightly higher than adjacent Brookston clay. The run-off is very slow and the impervious subsoil makes the movement of the ground water extremely slow, and tile drains are comparatively ineffective.

The tree growth is principally white oak, hickory, red oak, and beech. About the same crops are grown and about the same yields obtained as on Nappanee silty clay loam, heavy phase.

NAPPANEE LOAM

The profile of Nappanee loam when dry and in virgin condition, may be described by layers from the surface downward as follows: A one-half-inch layer of leaf mold; a 2-inch layer of very dark gray mellow loam; a layer of gray or dark-gray, light-textured, friable loam to a depth of about 7 inches; a 3-inch layer of light grayish-yellow loam; a 6-inch layer of light grayish-yellow, friable clay loam material granular in structure; a 4-inch layer of light grayish-brown, friable, granular clay loam or clay containing considerable fine gravel; a layer of light grayish-brown, heavy, stiff, compact clay, with mottlings of yellow; and at depths ranging from 20 to 24 inches, the underlying material is heavy, plastic, calcareous, grayish-brown clay with yellow mottlings. Included in mapped areas of this soil are many small areas of Nappanee silt loam and Nappanee fine sandy loam.

Approximately 70 per cent of this soil is cultivated. Under average moisture conditions the cultivated soil consists of gray friable loam, but it is almost dark gray when wet. The cultivation of this soil is more difficult than that of lighter-textured soils; but because of its friability it is much easier to work than stiff, heavy clay and clay loam. Because of a tendency to be sticky when wet and to clod when dry, it should be worked when it is in fairly moist condition.

Comparatively small areas of Nappanee loam occur through the county except in those townships which border Williams County line. The land is undulating as a rule, but is gently rolling or sloping where it is contiguous to stream courses. The surface run-off is usually fair, but subsurface drainage is poor although it is much better than that of Nappanee clay loam. Owing to the rather porous subsoil, artificial drainage can be easily established. In places where the subsoil is very heavy and plastic clay subsurface drainage is similar to that of Nappanee clay loam.

The principal tree growth is white oak, red oak, hickory, and beech. The crops grown, yields, and methods of treatment are similar to those on Miami loam.

NAPPANEE FINE SANDY LOAM

From the surface downward the profile of dry virgin Nappanee fine sandy loam may be described by layers as follows: A 2-inch layer of mellow, very dark gray loamy fine sand or very fine sand, a layer of olive-gray loamy fine sand or very fine sand, the texture of which grades with depth into fine sandy loam or very fine sandy loam; at depths varying from 13 to 18 inches a layer of yellowish olive-gray, friable, crumbly loam or clay loam material; at a depth of about 20 inches a layer of grayish-brown or olive-gray friable clay loam material which becomes heavier with depth; at a depth of about 23 inches a layer of slightly calcareous, grayish-brown clay; and at depths of 26 or 28 inches the material is light grayish-yellow, plastic, calcareous clay mottled with various shades of gray, yellow, and brown.

Mapped areas of this soil include many patches of Nappanee loam, Nappanee clay loam, and Coloma loamy fine sand. A common variation, especially where this soil adjoins bodies of Coloma loamy fine sand, consists of loamy fine sand to depths of 20 to 26 inches, underlain by clay or clay loam. Some small tracts of Nappanee very fine sandy loam in Clinton Township were mapped with this soil because they are too small to map separately.

Perhaps 75 per cent of this soil is cultivated. Under normal moisture conditions the cultivated soil to a depth of 8 inches is light-gray or olive-gray fine sandy loam, but when wet the color becomes darker. The soil is easily tilled and warms up early in the spring. It is low in organic matter.

Although bodies of Nappanee fine sandy loam are small and scattered, the total area in the county is fairly large. This soil occurs in Chesterfield, Dover, and Clinton Townships and in the western parts of Pike and Royalton Townships. The land is sloping or gently rolling. Drainage is usually good, as the open material allows the free movement of air and water; but where the land is

gently sloping or where there is clay loam in the upper portion of the subsoil artificial drainage is necessary.

The principal trees are white oak, red oak, hickory, hard maple, and beech; and other trees growing on this soil are basswood, tulip poplar, white ash, bur oak, black walnut, butternut, ironwood, dogwood, wild cherry, crab apple, June berry, and coffee tree. The principal crops are corn, mixed clover and timothy hay, wheat, and oats. Less extensively grown crops are barley, rye, buckwheat, potatoes, alfalfa, and soy beans. Corn yields average about 35 bushels an acre; hay, 1½ tons; oats, 38 bushels; wheat, 17 bushels; barley, 25 bushels; and rye, 20 bushels.

A rotation, including corn, oats, wheat, and hay is generally followed, but is varied somewhat to meet individual needs. Sometimes potatoes take the place of corn in the rotation and in other cases soy beans take the place of oats. An acreage application of 200 pounds of 16 per cent acid phosphate is usually made for wheat at the time of planting.

The current value of Nappanee fine sandy loam ranges from \$80 to \$125 an acre.

FULTON SILTY CLAY LOAM

The profile of virgin Fulton silty clay loam, when dry, may be described as follows: A layer of dark grayish-brown, rather smooth silt loam, containing considerable humus and a mat of fine grass roots, which with increasing depth becomes lighter in color and heavier in texture, to about 4 or 5 inches deep; a 4-inch layer of dark olive-gray heavy silt loam, faintly mottled with yellow; at a depth of 8 or 9 inches a layer of heavy silt loam or light silty clay loam material, grayish yellow in color with brown and yellow mottlings; at a depth of about 19 inches a layer of rather heavy, compact, grayish-yellow silty clay loam material, with gray and brownish-yellow mottlings; at a depth of about 31 inches a layer of gray or grayish-yellow, heavy, compact silty clay or silt loam material, mottled with yellow and brownish yellow, slightly calcareous and containing some iron concretions; and at depths ranging from 38 to 44 inches the material is very calcareous grayish-yellow silty clay loam, mottled with gray, yellow, and brownish yellow.

Mapped areas of Fulton silty clay loam include soils with a considerable range in texture in the topsoil and subsoil, grading on the one hand toward Fulton silty clay loam, heavy phase, and on the other toward loam or silt loam. In many places along Bean and Brush Creeks and Tiffin River there are noticeable quantities of very fine sand in the upper layers, and in some places a layer of very fine sand at depths ranging from 20 to 36 inches is present. West of Elmira near the Williams County line the material to a depth of 10 inches is very heavy silty clay loam which grades downward into silty clay. In many places in German, Franklin, and Chesterfield Townships, where bodies of this soil border areas of Lucas fine sandy loam and Wauseon fine sandy loam, there is considerable fine sand or very fine sand throughout the soil. In other places very fine sandy loam or very fine loam material occurs at depths ranging from 20 to 30 inches and may continue to depths ranging between 36 and 50 inches, below which is calcareous silty clay loam.

North and west of Thelma in a part of the Bean Creek flood plain which is no longer subject to inundation the surface soil consists of friable, gray or brown silt loam or silty clay loam to a depth of about 7 inches, where it is underlain by heavy, brownish-gray silty clay loam; at depths ranging from 18 to 24 inches the material is yellowish-brown silty clay with yellow mottlings; and at depths varying from 30 to 54 inches it is friable, slightly calcareous, grayish-yellow gravelly sandy loam.

In this county about 70 per cent of this soil is cultivated. In cultivated fields under normal moisture conditions, Fulton silty clay loam to a depth of 8 inches is gray, or brown, or grayish-yellow, rather heavy silt loam but during wet periods the color is darker. This soil is rather low in organic matter, is fairly retentive of moisture, and is comparatively easily tilled, but warms up rather slowly in the spring.

This soil is developed mainly as narrow strips along Tiffin River, Bean Creek, and the many small tributaries of these streams. It also occurs as small, slightly elevated patches dotting the rather extensive developments of Newton silty clay loam in German and Franklin Townships. The land is level or undulating and surface drainage is only fair. The compactness of the lower layers makes artificial drainage rather difficult but in those places where considerable very fine sand or fine sand is present in the subsoil, artificial drainage is readily established.

Fulton silty clay loam is an important agricultural soil in the western part of the county. Its tree growth consists mainly of white oak and hickory, with some basswood, elm, bur oak, pin oak, hard maple, soft maple, cottonwood, sycamore, and ash. Corn, hay, wheat, and oats are the principal crops, corn having the largest acreage. Yields of corn average about 37 bushels an acre; oats, about 40 bushels; wheat, 18 bushels; and hay, 1½ tons. The methods of treating and fertilizing this soil are practically the same as on Toledo silty clay loam.

The current value of this land ranges from \$100 to \$150 an acre.

This soil is in need of organic matter. To supply this and increase the productiveness, a rotation is recommended by the county agricultural agent consisting of corn, followed by oats seeded with clover. The clover is left for a hay crop, after which it is plowed for fall wheat. Sweet clover is seeded in the wheat in spring, and the following spring it is plowed down for corn. An application of 200 pounds of fertilizer consisting of 12 per cent phosphoric acid and 5 per cent potash is applied to the wheat ground.

Fulton silty clay loam, heavy phase.—The dry virgin Fulton silty clay loam, heavy phase, consists of dark-gray silt loam which below 2 inches deep, grades downward into dark-gray or medium-gray silty clay loam, underlain at about 5 inches by gray, plastic silty clay mottled with yellow and brownish yellow. At a depth of about 8 inches the material is gray, heavy, plastic silty clay with yellow mottlings; at about 12 inches it is mottled gray and yellow, heavy silty clay; and at depths ranging from 38 to 50 inches it is mottled gray and yellow, heavy, calcareous silty clay.

About 30 per cent of this soil is cultivated. Under average moisture conditions the cultivated soil to a depth of 8 inches consists of

gray, plastic silty clay loam or silty clay, which when wet is almost dark gray. The heavy texture of this soil and poor drainage make it naturally cold and wet, causing it to warm up slowly in the spring and retarding the planting of crops. The heavy texture also necessitates working this soil within a narrow range of moisture conditions.

Fulton silty clay loam, heavy phase, occurs as comparatively small bodies along the Williams County line west of Elmira and also north of Elmira. This land is level and drainage is very poor.

The tree growth is principally white oak, with some hickory, ash, elm, bur oak, and soft maple. Corn, hay, oats, and wheat are the principal crops. Corn yields average about 35 bushels an acre; oats, 40 bushels; wheat, 18 bushels; and mixed alsike clover and timothy hay, 1 ton. The methods of cultivation, rotation, and fertilization of crops are similar to those practiced on Newton silty clay loam.

No farms are composed entirely of this soil type, the current value of which ranges from \$80 to \$125 an acre, depending upon location and improvements.

The greatest needs for the improvement of this soil are tiling, and the growing of more leguminous crops, particularly sweet clover or alfalfa, which will open up the tight subsoil and thus improve the subsurface drainage and aeration. A good rotation for this soil is corn, soy beans, wheat, and sweet clover.

FULTON SILT LOAM

From the surface downward the profile of dry virgin Fulton silt loam may be described by layers as follows: A 2-inch layer of friable, dark grayish-brown silt loam containing considerable organic matter, which becomes lighter in color to a depth of about 5 inches; a 3-inch layer of dark olive-gray or brownish-gray silt loam, faintly mottled with yellow; a layer of grayish-yellow silt loam mottled with yellow; a layer of gray or grayish-yellow silt loam, to a depth of about 18 inches; a layer of mottled grayish-yellow and gray silty clay loam; and at depths ranging from 36 to 44 inches the material is grayish-yellow, calcareous silty clay loam with yellow mottlings.

It is estimated that 80 per cent of Fulton silt loam in Fulton County is under cultivation. Under average moisture conditions the cultivated soil to a depth of 8 inches consists of gray or dark olive-gray silt loam, which is decidedly darker in color when wet. With adequate drainage the soil is easily handled and is productive. It is fairly well supplied with organic matter, and only rarely suffers from excessive moisture or drought.

This soil is not extensive and occurs in the northeastern quarter of German Township and the eastern part of Franklin Township as small, slightly elevated tracts in larger bodies of Toledo silt loam and Toledo silty clay loam. The largest area occurs near the northern border of the county in Gorham and Chesterfield Townships. The surface is level or very gently sloping and drainage is poor. The tree growth is principally white oak and hickory, with some beech, maple, basswood, elm, and white ash. This soil is cropped and farmed in about the same way as Toledo silt loam and Toledo silty clay loam.

FULTON LOAM

The profile of Fulton loam in the dry virgin state may be described by layers as follows: A 2-inch layer of friable, mellow, very dark gray loam; a 2-inch layer of dark-gray or medium gray, friable loam, the color of which between 4 and 7 inches deep becomes gray or brownish gray; a 3-inch layer of light yellowish-gray loam or friable silty clay loam with gray and yellowish-gray mottlings; a layer of grayish-yellow, yellowish-gray, and grayish-brown silty clay with mottlings of yellowish-gray and grayish-brown; and at depths ranging from 30 to 36 inches the material is tough, plastic, calcareous gray silty clay loam or silty clay, mottled with yellow and brownish-yellow.

Mapped areas of this soil include very small bodies of very fine sandy loam, fine sandy loam, silt loam, and silty clay loam members of the Fulton series, and Newton loam. In many places, especially where this soil is associated with lighter textured soils, very fine sandy loam or fine sandy loam may occur at any depth between 10 and 30 inches.

About 80 per cent of Fulton loam is under cultivation. Under normal moisture conditions the cultivated soil to a depth of 8 inches consists of gray, friable loam, which becomes decidedly darker in color when wet. This soil when properly drained is warm, early, and easily handled. It is somewhat low in organic matter.

The total extent of Fulton loam in Fulton County is very small. The bodies occur as long narrow strips adjacent to the flood plains of Bean, Brush, and Bates Creeks, and as small irregular tracts in the eastern part of Gorham and Franklin Townships, the extreme western parts of Chesterfield and Dover Townships, and the northern part of German Township. The land varies from level to gently sloping or gently undulating, and drainage is poor.

The tree growth and crops on Fulton loam are similar to those on Lucas fine sandy loam, but yields are a little better.

FULTON VERY FINE SANDY LOAM

The topsoil of Fulton very fine sandy loam, in the dry virgin condition to a depth of about 3 inches, consists of very dark gray, very fine sandy loam which becomes lighter in color with depth, underlain at a depth of about 4 inches by gray or yellowish-gray very fine sandy loam. At a depth of 10 inches the material is light-gray very fine sandy clay loam, and at a depth of about 22 inches is light-gray, sticky, plastic, heavy clay, with gray and yellow mottlings. At depths ranging from 26 to 50 inches, but usually from 36 to 40 inches, the underlying material is light-gray, tough, plastic, calcareous clay, mottled with various shades of gray and yellow.

Included in mapped areas of this soil are bodies where the surface layers are loam or silty clay loam to a depth of 6 inches, below which the texture becomes gradually lighter, merging into fine sand at depths varying from 16 to 20 inches.

About 70 per cent of this soil is cultivated. Under normal moisture conditions the cultivated soil to a depth of 8 inches consists of gray very fine sandy loam, but when wet the color becomes almost dark

gray. This soil has a rather low or fair supply of humus, is warm, early, easy to handle, and retentive of moisture.

Although this soil is not extensively developed, it is widely distributed in small, isolated areas throughout German, the eastern part of Franklin, the western part of Dover, and the northwestern corner of Clinton Townships. Its usual occurrence is as level or undulating areas, slightly elevated above Toledo soils, and as gently rolling or sloping areas on hillsides and ridges along streams. The drainage is poor on level areas, but is good on slopes and ridges.

The native tree growth consists mainly of white oak, red oak, hickory, hard maple, and beech, with some pin oak, white ash, ironwood, yellow poplar, coffee tree, sycamore, and cottonwood. This type of soil is utilized for the production of corn, wheat, oats, and hay. Corn yields about 38 bushels an acre; oats, 35 bushels; wheat, 17 bushels; and hay 1½ tons. Methods of treating this soil are about the same as those practiced on Toledo silty clay loam.

On most cultivated areas of this soil deeper and more thorough tillage should prove beneficial. The growing of leguminous crops is advantageous in supplementing the supply of organic matter in the soil. Where the soil is sour, clover and alfalfa would be benefited by the application of 1 ton of ground limestone to the acre. This soil is well adapted to the growing of potatoes. The rotation suggested for Fulton silty clay loam is suitable also for this soil type.

MIAMI LOAM

The profile of dry, virgin Miami loam may be described as follows: A 2-inch layer of very dark gray, mellow silty loam; a 5-inch layer of gray or dark-gray silty loam; a 3-inch layer of the same material, the color of which is light grayish yellow; a layer of light grayish-yellow loam or friable silt loam material to depths varying from 14 to 18 inches; a layer of light grayish-brown, friable, silty clay loam material with mottlings of yellow, to a depth of 20 or 22 inches; a layer of friable, granular silty clay loam material to depths ranging from 28 to 32 inches; and below this the material is heavy, stiff, compact, calcareous, grayish-brown clay, mottled with yellow.

In Fulton County, Miami loam is an important agricultural soil, and about 90 per cent of it is under cultivation. The cultivated soil under normal moisture conditions to a depth of 8 inches consists of gray, friable silty loam, but when wet the color is somewhat darker. Although rather low in organic matter, Miami loam is warm, early, and fairly productive soil which can be easily worked into a good seed bed. Crops rarely, if ever, suffer seriously from either lack or excess of moisture.

Miami loam is rather extensively developed in Gorham Township and the northwestern part of Franklin Township. Areas of this soil are undulating or gently rolling. The surface drainage varies from fair to good and the subsurface drainage is slow, but much better than that of Nappanee clay loam. Artificial drainage can be easily established, owing to the permeable subsoil.

The tree growth is principally white oak, red oak, hickory, and beech, with some hard maple, bur oak, black oak, black walnut, tulip

poplar, basswood, butternut, and dogwood. The leading crops are corn, mixed red clover and timothy hay, wheat, and oats, with some barely, rye, buckwheat, alfalfa, soy beans, and sweet clover.

General farming is practiced, and it is supplemented by dairying and the raising of hogs, sheep, and poultry. Almost all the hay and grain produced, except wheat, is fed to stock on the farm. Some farmers make a practice of buying western steers and feeding them. According to estimates of farmers in Gorham Township, there is, on Miami loam, about 1 dairy cow to 15 acres of land, 3 chickens for each acre, 1 lamb turned off annually for each 6 acres, and 1 hog for each 3 acres. The leading breed of dairy cow is Holstein; of hogs, Duroc-Jersey and Chester White; of sheep, Shropshire; and of chickens, White Leghorn. Corn yields average about 40 bushels an acre; oats, 40 bushels; wheat, 20 bushels; barley, 25 bushels; soy beans, 18 bushels; hay, about 11½ tons; and alfalfa, 2½ tons.

Most farmers practice a rotation consisting of corn, oats, wheat, and mixed clover and timothy hay. Wheat land receives about 200 pounds of 16 per cent acid phosphate fertilizer to the acre; and some farmers use about 150 pounds of the same fertilizer on corn ground. With the preparation of a good seed bed, inoculation, and the application of about 1,000 to 2,000 pounds of pulverized limestone to the acre, farmers are succeeding with alfalfa. Many farmers practice fall plowing and report that the disintegrating and breaking down of the soil brought about by freezing and thawing, greatly improves it, making it much easier to prepare a good seed bed in the spring.

Current land values range from \$75 to \$150 an acre, depending upon improvements and location.

A rotation recommended to increase and maintain the productivity of this soil consists of corn followed by oats seeded with red clover, the red clover being left for a hay crop, after which it is turned under for fall wheat. An acreage application of 200 pounds of fertilizer, analyzing 12 per cent phosphoric acid and 5 per cent potash should be made to the wheat land. If the soil has not been previously limed, from one-half to 1 ton of finely pulverized limestone should be applied with a lime drill. Sweet clover should be seeded in the wheat in the spring, and the following spring plowed down for corn. More alfalfa and soy beans could be grown to advantage, both crops being soil builders and most excellent feed for livestock.

MIAMI FINE SANDY LOAM

From the surface downward, the profile of dry, virgin Miami fine sandy loam may be described as follows: A 3-inch layer of very dark gray loamy fine sand; a 3-inch layer of olive-gray loamy fine sand or fine sandy loam; an 8-inch layer of the same material which is tinged with yellow; a 6-inch layer of grayish-yellow fine sandy loam material; a 4-inch layer of grayish-yellow, silty fine sandy loam material; a layer of friable loam material to a depth of 28 to 32 inches; a layer of grayish-yellow clay loam material; and at depths varying from 36 to 42 inches the material is light grayish-yellow stiff, compact, calcareous clay, with mottlings of various shades of gray and yellow.

In this county about 75 per cent of Miami fine sandy loam is under cultivation. Under average moisture conditions the cultivated soil, to a depth of 8 inches, is olive-gray fine sandy loam which is darker in color when wet. It is warm, early, and easily cultivated soil, somewhat low in organic matter. The water-holding capacity is such that this soil rarely suffers seriously from either excess or a lack of rainfall.

Miami fine sandy loam is inextensive and occurs in a few small bodies in Gorham and in the northwestern part of Franklin Township. This land is gently rolling and the natural drainage is good.

The crops grown, yields, and methods practiced on Miami fine sandy loam are like those on Miami loam.

LUCAS FINE SANDY LOAM

The profile of dry, virgin Lucas fine sandy loam may be described by layers from the surface downward as follows: A 2-inch layer of very dark gray loamy fine sand; a layer of gray or yellowish-brown loamy fine sand to a depth of about 12 inches below which the color is yellowish olive to a depth of about 17 inches; a 5-inch layer of light grayish-yellow loamy fine sand; an 8-inch layer of light grayish-yellow silty very fine loam material mottled with yellow and gray; and at depths ranging from 30 to 40 inches the material is light grayish-yellow, calcareous silt loam with mottlings of yellow, and high in very fine sand.

Where this soil is associated with heavier soil, heavy, plastic gray, yellowish-gray, grayish-yellow, or yellow clay mottled with yellowish brown, brownish yellow, and brown occurs at depths ranging from 12 to 29 inches. In such places the surface soil is usually gray fine sandy loam.

Approximately 85 per cent of Lucas fine sandy loam is under cultivation. In cultivated fields under normal moisture conditions, Lucas fine sandy loam to a depth of 8 inches is gray loamy fine sand, which during wet periods is distinctly darker in color. This soil is rather low in organic matter, but is warm, early, and easy to cultivate.

Lucas fine sandy loam has developed principally in Gorham, Franklin, and the western parts of Chesterfield and Dover Townships, occurring as long narrow strips bordering the flood plains of Bean Creek and its tributaries, and as slightly elevated, irregularly outlined areas dotting more extensive bodies of other soils. In the eastern half of the county are some very small and scattered tracts. This land is level or gently sloping. The surface drainage is usually poor, but is fair or good on the slopes. The subsurface drainage is naturally poor, but, owing to the friable nature of the subsoil, artificial drainage can be readily established.

The tree growth consists principally of white oak, red oak, hickory, hard maple, and beech. Corn, mixed clover and timothy hay, wheat, and oats, ranking in acreage in the order named, are the leading crops. Other crops grown are rye, barley, buckwheat, potatoes, alfalfa, sweet clover, and soy beans. The yields and the agricultural practices are similar to those prevailing on Miami fine sandy loam.

The current value of this soil ranges from \$80 to \$125 an acre.

When drained, Lucas fine sandy loam is warm, friable soil somewhat low in organic matter. Tests for soil acidity indicate that considerable of this soil needs about 1 ton of finely pulverized limestone to the acre. By green manuring, the supply of organic matter can be maintained, and together with the growing of legumes and the liberal use of barnyard manure will furnish sufficient nitrogen, make the soil more retentive of moisture during dry periods, and greatly improve the condition of the soil and allow the preparation of a good seed bed. A rotation consisting of corn, soy beans, wheat, and clover; or corn, oats seeded to clover, and wheat seeded to sweet clover, will be beneficial to this soil.

LUCAS LOAMY FINE SAND

The profile of Lucas loamy fine sand, when in the dry virgin state, may be described as follows: A 2-inch layer of very dark grayish-brown loamy fine sand or very fine sand, with a fair supply of organic matter; a 5-inch layer of light yellowish-brown fine sand; a layer of light grayish-yellow loamy fine sand or very fine sand to a depth of about 20 inches, where gray mottlings appear and become more numerous with increasing depth; at a depth of 30 inches a layer of light grayish-yellow sticky fine sand with gray and yellow mottlings; and at a depth of 38 or 40 inches the material is fine sandy loam or very fine sandy loam with gray and yellow mottlings.

About 75 per cent of this soil is cultivated. In cultivated fields under average moisture conditions, Lucas loamy fine sand to a depth of 8 inches is light-gray or light grayish-yellow loamy fine sand, which is gray when wet.

This soil is not extensively developed in Fulton County. Small areas occur in the southeastern corner of York Township, in the western parts of Chesterfield and Dover Townships, in the eastern part of Franklin Township, and the northeastern corner of German Township. This land is gently undulating or slightly rolling and drainage is usually fair.

The tree growth and crops are the same as on Lucas fine sandy loam, but yields are somewhat lower.

Where cultivated the organic matter in the soil is soon depleted, and in many places the incorporation of organic matter in the form of green manure is much needed. With adequate drainage the same treatment should be given this soil as Plainfield fine sand.

DUNKIRK LOAMY VERY FINE SAND

From the surface downward the profile of Dunkirk loamy very fine sand may be described by layers as follows: A 1-inch layer of very dark gray loamy very fine sand, somewhat darkened by organic matter; a 3-inch layer of dark grayish-brown loamy very fine sand; a layer of grayish-yellow or yellowish-brown loamy very fine sand to a depth of about 24 inches; a layer of grayish-yellow loamy very fine sand to depths ranging from 42 to 48 inches; a layer of yellowish-brown or brownish-yellow very fine sandy loam or very fine loam material, mottled with yellow and gray, to depths ranging from 52 to 60 inches; and the underlying material is friable, calcareous silty clay loam.

About 95 per cent of Dunkirk loamy very fine sand is cultivated, and where cultivated, the surface soil to a depth of 8 inches and under normal moisture conditions is grayish-brown loamy very fine sand, but when wet the color is darker. This soil is low in organic matter, but is warm, early, and easy to handle under cultivation.

The largest areas of Dunkirk loamy very fine sand are in and north of Pettisville, and small scattered bodies are in the extreme southeastern part of Franklin Township, the northeastern corner of German Township and the northwestern corner of Clinton Township. This land is gently undulating or gently rolling, and drainage is good.

The practice of growing corn, mixed clover and timothy hay, wheat, and oats is followed on this soil. Yields are somewhat lower than those on Lucas loamy fine sand but much better than those on Plainfield fine sand.

Dunkirk loamy very fine sand is sold in conjunction with other soil types for a somewhat lower price than the surrounding heavier soils.

The soil is improved by liming and the addition of organic matter by plowing under green legumes. This soil would be especially well adapted to the growing of potatoes, garden vegetables, and berries. The rotation suggested for Plainfield fine sand will also succeed on this soil.

FOX GRAVELLY FINE SANDY LOAM, BEACH-RIDGE PHASE

The profile of dry, virgin Fox gravelly fine sandy loam, beach-ridge phase, may be described by layers from the surface downward: A 10-inch layer of gravelly loamy fine sand, which ranges in color from very dark gray at the surface to brown below 3 inches deep; a layer of grayish-yellow gravelly loamy fine sand, to depths ranging from 14 to 24 inches; a layer of brownish gravelly fine sandy loam to depths ranging from 26 to 36 inches; and the underlying material is dark grayish-brown fine gravel which is usually calcareous. There is considerable variation in the depth at which the gravel layer appears, as in places it crops out at the surface, and in other places it lies at depths ranging from 40 to 55 inches.

About 75 per cent of this soil in Fulton County is cultivated. Under average moisture conditions the cultivated soil to a depth of 8 inches consists of grayish-brown or brown gravelly loamy fine sand. The texture of the topsoil together with the open subsoil makes it one of the warmest soils of the county and the best adapted to early vegetables. Usually in the spring and at other times when the quantity of moisture in the soil is above the average, the color is brown or dark brown.

Fox gravelly fine sandy loam, beach-ridge phase, occurs on long, narrow ridges, which are remnants of old lake beaches, principally in the townships of Royalton, Amboy, Pike, Fulton, York, Clinton, and the southeastern corner of German. This land is ridgelike and rolling. The drainage is ample and in some places excessive.

The tree growth consists mainly of white oak, hard maple, hickory, and birch, with some red oak, black oak, pin oak, yellow oak, basswood, black walnut, and butternut. Corn, mixed red clover and timothy hay, wheat, and oats are the main crops. Rye, buckwheat,

potatoes, and soy beans are crops of minor importance. With an application of about 1 ton of ground limestone to the acre, alfalfa does splendidly on this type of soil. Potatoes are grown in the vicinity of Winameg and yields average about 150 bushels an acre. Yields of most crops are somewhat better than those on Fox loamy fine sand, beach-ridge phase.

Fox gravelly fine sandy loam, beach-ridge phase, is easily improved. One of its greatest needs is the addition of organic matter in the form of green manure. Clover and sweet clover are excellent green-manure crops. As this soil is naturally very early and warm, it is particularly adapted to trucking, orcharding, and the growing of melons.

FOX LOAMY FINE SAND, BEACH-RIDGE PHASE

The profile of Fox loamy fine sand, beach-ridge phase, in the dry, virgin state may be described by layers as follows: A 1-inch layer of very dark gray loamy fine sand with considerable loose organic matter; a 2-inch layer of dark grayish-brown loamy fine sand; a 9-inch layer of brown loamy fine sand; a 10-inch layer of grayish-yellow loamy fine sand; a 2-inch layer of dark-brown sticky fine sand or sandy clay loam material; a layer of dark grayish-brown coarse sand to a depth of about 32 inches; all underlain by a bed of fine gravel.

In some places, especially a few miles north of Winameg, the material is loose, incoherent fine sand to a depth varying from 2 to 5 inches. In other localities considerable gravel is present throughout the soil. On the gravel ridge extending northeast from Archbold, the soil material is typical Fox loamy very fine sand, beach-ridge phase, but because it is not extensive and is similar to Fox loamy fine sand, beach-ridge phase, in all respects except texture, it has been included in mapped areas of Fox loamy fine sand, beach-ridge phase.

In Fulton County about 65 per cent of Fox loamy fine sand, beach-ridge phase, is under cultivation. Under average moisture conditions where cultivated the surface soil to a depth of 8 inches is brown loamy fine sand, but when wet the color is almost dark brown. This is a warm, early soil low in organic matter, and this deficiency, together with its open structure, allows a ready leaching of the more soluble mineral elements.

The total area of Fox loamy fine sand, beach-ridge phase, in Fulton County is not extensive, but bodies occur on long, narrow ridges in practically all parts of the county. These ridges extend in a general northeasterly and southwesterly direction.

This land is rolling or ridgelike. Drainage is good or excessive.

Because of its small extent, Fox loamy fine sand, beach-ridge phase, is unimportant in the agriculture of the county. Corn, mixed clover and timothy hay, wheat, and oats are the chief crops. Yields of corn average about 35 bushels an acre; hay, 1 ton; oats, 30 bushels; and wheat, 14 bushels. Potatoes and most garden vegetables do especially well.

Steps to improve this soil should include increasing the supply of organic matter, deepening the surface soil, and correcting the acidity by the application of ground limestone. The supply of organic matter can be increased by plowing under green-manure crops and

by growing more legumes. The rotation suggested for the improvement of Dunkirk loamy very fine sand is equally applicable to Fox loamy fine sand, beach-ridge phase.

PLAINFIELD FINE SAND

The profile of dry, virgin Plainfield fine sand may be described by layers from the surface downward: A 2-inch layer of very dark brown fine sand containing considerable organic matter; a 1-inch layer of dark grayish-brown fine sand; a layer of yellow or yellowish-brown loose incoherent fine sand between depths of 3 and 14 inches; a layer of slightly paler yellowish fine sand to a depth of 30 inches; and the underlying material is grayish-yellow fine sand, which in places is slightly mottled with brown. This sand continues to depths of 20 or 30 feet in the southeastern part of the county. Adjacent to bodies of Newton fine sand the color of the subsoil is gray or dark gray. Little variation in texture occurs throughout the soil, but the lower layers are slightly more compact than those above.

About 40 per cent of Plainfield fine sand is cultivated. Under average moisture conditions the cultivated soil to a depth of 8 inches consists of brown or yellowish-brown, loose, fine sand, low in organic matter. Because of its open, porous soil and low water-holding capacity it warms up early in the spring and can be easily cultivated.

The most extensive development of Plainfield fine sand in Fulton County is in the southeastern part, in the sandy tract known as the "oak openings" where it occurs, in association with Newton fine sand, as irregular bodies ranging from 1 to 80 acres in extent. Other areas are mapped in Fulton Township, the western part of Chesterfield Township, the western part of Royalton Township, and the western part of Pike Township.

This land varies from nearly level or gently undulating to gently rolling in the southeastern part of the county, and in places between Winameg and Oakshade it is ridgy or dunelike.

The surface drainage is good and the subsurface drainage varies from fair to excessive where this soil is adjacent to streams. Where the soil is only slightly elevated in position above Newton fine sand, the water table may be fairly close to the surface and until the lower-lying soils are drained, Plainfield fine sand may be imperfectly underdrained.

Although Plainfield fine sand is fairly extensive, it is of minor importance in agricultural value because it ranks as one of the poorer soils of the county. The forest growth, which is rather light, consists of black oak, white oak, yellow oak, and pin oak.

Most of the general farm crops common to the region are grown on this soil, but are not so well adapted to it as to heavier soils in other parts of the county. Corn is the most important crop and yields are fairly good in years of average or heavy rainfall; wheat and oats are grown with only fair success; rye is more certain as a grain crop; and timothy and clover hay gives fair yields. This soil is best adapted to special crops such as potatoes, melons, buckwheat, and strawberries. Fair crops can be obtained in years of average or excessive rainfall, but crops suffer seriously in years of subnormal precipitation.

The uncultivated parts of Plainfield fine sand adjoining associated Newton fine sand, furnish fair pasture. Dairying, which is carried on to a small extent, is increasing in importance.

Current values of this land range from \$30 to \$100 an acre, depending on improvements and location with respect to improved roads.

The hindering factors in crop production on this soil are low water supply, low fertility, and low organic matter. To improve this soil the supply of organic matter must be increased and this not only increases the water-holding capacity and fertility, but also tends to prevent blowing. The organic matter can be increased by growing legumes and plowing under green-manure crops. A good rotation for this soil as recommended by the county agricultural agent is corn, followed by oats seeded with medium red or mammoth clover. The clover is cut for hay and then turned under for fall wheat. Sweet clover is seeded in the wheat in the spring and a year later plowed under for corn. An application of 200 pounds of 3-12-4 fertilizer should be applied for wheat. If the land has not been previously limed, about 2 tons of ground limestone to the acre will aid in obtaining a good stand of clover. Manure can be used to best advantage on the cornland. Where the soil is very light a winter cover crop of rye and vetch will prevent blowing.

Plainfield fine sand, mixed phase.—This classification includes areas of Plainfield fine sand and Newton fine sand which are too small to be separately indicated on the soil map. These soils have been described elsewhere in this report. Bodies of the mixed phase occur throughout the "oak openings" in the southeastern part of the county, the largest one being several miles south of Swanton.

The areas of light-colored soil, Plainfield fine sand, occur as tracts of 1 or 2 acres or less on slight elevations above surrounding bodies of Newton fine sand. Areas of the mixed phase are gently undulating and drainage is poor. Probably not more than 30 per cent of this soil is under cultivation, the remainder supporting a vegetation characteristic of the various types of soil included.

Soils of this mixed phase are of rather low agricultural value. Because of its variability it is less desirable than Plainfield fine sand or Newton fine sand where either soil occurs in uniform areas. Much of this land which has been cleared is used for pasture. Where cultivated the crops grown are similar to those grown on the soils which make up the mixed phase and yields are about the same or slightly less. Because of its undesirability as a farming soil, bodies of this soil have usually been cleared **only** after the more uniform areas of sand have been cultivated.

PLAINFIELD LOAMY FINE SAND

The dry surface layer of Plainfield loamy fine sand consists of dark grayish-brown loamy fine sand to a depth of about 2 inches and contains a considerable amount of decayed leaves, roots, and twigs. This is underlain by yellowish-brown loamy fine sand, the color of which becomes brownish yellow. At depths ranging from 30 to 40 inches, the material is light grayish yellow loamy fine sand.

In Fulton County about 75 per cent of Plainfield loamy fine sand is cultivated. Under normal moisture conditions the cultivated soil

to a depth of 8 inches is yellowish-brown loamy fine sand, but during wet periods the color is darker. This soil is rather low in organic matter, is fairly retentive of moisture, warms up early in the spring, and is comparatively easy to till.

Plainfield loamy fine sand occurs as rather scattered areas in all parts of the county. This land is undulating or rolling, the drainage is thorough, and sometimes the soil is rather droughty for crops which do not mature early.

The tree growth is principally black oak, yellow oak, and red oak, and there is also some pin oak, shellbark hickory, and pignut hickory. Corn, hay, wheat, and oats are the main crops, and less important crops are barley, rye, buckwheat, potatoes, alfalfa, sweet clover, soy beans, and melons. Yields of corn range from 25 to 40 bushels an acre, with an average of about 32 bushels where the land has been limed. Yields of mixed clover and timothy average about 1 ton an acre; alfalfa, about 2 tons; and wheat, about 17 bushels. Yields of wheat depend largely on the time of sowing and the freedom from attack by the Hessian fly. Yields of oats range from 10 to 50 bushels an acre, with an average of about 35 bushels, the fluctuation being largely the result of failure to fill because of unfavorable weather conditions.

In the treatment of this soil sod is usually manured and broken for corn, which is followed by oats and then wheat seeded to clover and timothy. About 200 pounds an acre of 16 per cent acid phosphate is applied to wheat land.

The current value of Plainfield loamy fine sand ranges from \$60 to \$125 an acre, depending on improvements and location.

The restoration and maintenance of the supply of organic matter by growing legumes, applying stable manure, and turning under green-manure crops is a very important step in the improvement of Plainfield loamy fine sand. According to tests for acidity this soil is acid, but probably does not need so much lime as does Plainfield fine sand. With the exception of supplying lime, the rotation suggested for Plainfield fine sand is suitable also for this type of soil.

COLOMA FINE SAND

The profile of Coloma fine sand in the dry, virgin condition, may be described from the surface downward as follows: A thin covering of litter, mold, and humus soil; a 1-inch layer of dark grayish-brown or dark-brown fine sand, the dark color being caused principally by the loose, organic matter it contains; a 2-inch layer of dark-brown or brown fine sand; a layer of brown or yellowish-brown, incoherent fine sand, the color of which at a depth of about 10 inches is yellowish brown and at about 26 inches is brownish yellow, which continues to a depth of 84 inches and more. Included with mapped areas of this soil are small areas of Newton fine sand.

About 40 per cent of Coloma fine sand is cultivated. Under average moisture conditions and to a depth of 8 inches, it consists of brown or yellowish-brown, loose fine sand which becomes somewhat darker in color when wet. This soil is very deficient in organic matter, but is warm early, and easy to cultivate.

Coloma fine sand is developed in Chesterfield, Dover, western Royalton, and western Pike Townships. This land is undulating or gently rolling, and drainage is excessive.

The forest growth consists of black oak, white oak, yellow oak, and pin oak. Many farmers on this soil grow watermelons for the Toledo and local markets. Other crops, as well as yields and methods of treatment, are similar to those on Plainfield fine sand.

The current land value of Coloma fine sand ranges from \$30 to \$60 an acre, depending upon improvements and location with respect to shipping points, roads, schools, and towns.

Suggestions for the improvement of Plainfield fine sand are applicable also to this soil type.

COLOMA LOAMY FINE SAND

The profile of dry virgin Coloma loamy fine sand, from surface downward, may be described as follows: A shallow covering of forest mold and humus, grading into dark grayish-brown loamy fine sand, the color of which is grayish-brown between depths of 5 and 8 inches; a layer of yellowish-brown loamy fine sand to depths ranging from 30 to 40 inches; and the underlying material is light grayish-yellow or brown loamy fine sand with a slight reddish tinge.

About 75 per cent of this soil is under cultivation. Under normal moisture conditions the cultivated surface soil to a depth of 8 inches is grayish-brown loamy fine sand, which becomes darker when wet. This soil is rather low in organic matter, but is warm, early, and easy to cultivate.

Coloma loamy fine sand is principally developed in the northern half of Clinton and the southern part of Dover Townships. The land is undulating or gently rolling, and the drainage is very good.

The trees, crops, yields, and agricultural practices are very similar to those on Plainfield loamy fine sand. The suggestions offered for the improvement of Plainfield fine sand apply also to this soil.

COLOMA VERY FINE SAND

From the surface downward Coloma very fine sand, in a dry virgin condition, may be described by layers as follows: A layer of dark grayish-brown loamy very fine sand about 1 or 1½ inches deep; a layer of grayish-brown loamy very fine sand to a depth of about 4 inches; a 2-inch layer of brown loamy fine sand; a layer of yellowish-brown loamy very fine sand to a depth of about 30 inches; a layer of light grayish-yellow loamy fine sand to depths ranging from 36 to 50 inches; a layer of yellowish-brown loamy fine sand to depths varying from 48 to 60 inches; and the underlying material is calcareous silty clay loam, light yellowish-gray mottled with gray, yellowish brown, brownish yellow, and yellowish gray. A common variation is brownish-yellow very fine sandy loam occurring at depths ranging from 48 to 60 inches, and underlain at depths ranging from 56 to 90 inches by brown silty clay loam mottled with gray and yellowish brown.

About 80 per cent of Coloma very fine sand in Fulton County is cultivated. Under average moisture conditions the tilled soil to a

depth of 8 inches is brown or yellowish-brown loamy fine sand, but when wet it is darker. This is warm, early, easily cultivated soil, which is rather low in organic matter.

Areas of Coloma very fine sand are inextensive and occur in the western part of Clinton Township. This land is gently rolling or rolling, and drainage varies from good to excessive. The crops are about the same as those grown on Coloma loamy fine sand, but yields are somewhat lower.

In general, the methods suggested for the improvement of Plain-field fine sand are also well suited to this soil.

GENESEE SILT LOAM

The profile of dry, virgin Genesee silt loam may be described from the surface downward by layers as follows: A 3-inch layer of friable, mellow, dark grayish-brown silt loam; a layer of friable, brown silt loam to a depth of about 15 inches; this is underlain by a layer of yellowish-brown loam or friable, silt loam material to depths ranging from 36 to 50 inches; and the material beneath is slightly calcareous, mottled gray, brown, reddish-brown, yellowish-brown, and brownish-gray silty clay loam or loam. The texture of the soil is extremely variable, and mapped areas include patches of Genesee loam, Genesee very fine sandy loam, and Genesee very fine sand. Although to a depth of 10 or 12 inches the soil in most areas is silt loam, the underlying layers may vary from very fine sand or fine sand to silty clay loam material. Where cultivated the surface soil to a depth of 8 inches is friable, brown silt loam.

Genesee silt loam occurs as small areas, principally in the flood plains along Tiffin River and Bean Creek, and to lesser extent along their principal tributaries which extend to the northwest. This land is flat and the drainage is very poor. The late spring rains and the usual overflow keep the soil wet until late spring or early summer, making cultivation difficult.

Probably 10 per cent of this soil is cultivated, and on the remainder is forest growth, with soft maple predominating; also elm, sycamore, beech, and hickory. There is also a scattering tree growth of white oak, pin oak, bur oak, cottonwood, sycamore, elm, black ash, and willow. Corn is the chief crop, yields ranging from 40 to 75 bushels an acre, but in some years the crop is a total loss owing to floods. Oats, wheat, and hay are successfully grown. This soil is easily cultivated and works into an excellent seed bed.

The current value of this land is much lower than that of upland of equal productiveness, because of the danger of loss of crops from inundations.

The chief needs are thorough tile drainage and protection from overflow.

Genesee silt loam, heavy phase.—Dry virgin Genesee silt loam, heavy phase, consists of brownish-gray, heavy, mellow silt loam or light silty clay loam to depths of 9 or 11 inches, below which it very gradually grades into lighter-colored material of somewhat heavier texture which may continue to depths of 30 or 40 inches. However, in most places, the material is lightly calcareous grayish-yellow clay, mottled with gray and yellow, between depths of 20 and 30 inches, underlain by mottled gray and yellow gravelly fine

sandy loam material. The zonation in this soil is indistinct and variable. In places the gravelly fine sandy loam occurs between depths of 20 and 40 inches. Under normal moisture conditions cultivated soil to a depth of 8 inches consists of brown silt loam or light silty clay loam.

Genesee silt loam, heavy phase, occurs as narrow strips along streams in Franklin and German Townships. The drainage is naturally poor, but in most places it has been improved by tiling. Practically all this soil is under cultivation and is planted principally to corn, yields ranging from 50 to 75 bushels an acre. Oats, wheat, and clover are successful under normal rainfall conditions, but in some years all crops are lost on account of floods.

For the best results this soil is in need of more adequate drainage and better protection from overflow.

GENESEE LOAM

The profile of dry, virgin Genesee loam may be described by layers from the surface downward as follows: A layer of mellow, brown loam, which gradually becomes lighter in color, to a depth of about 10 inches; a 6-inch layer of brown, friable loam material, with yellow mottlings; a 4-inch layer of brownish-gray light loam or heavy fine sandy loam material mottled with yellow; a layer of brownish-gray, yellowish-gray, or gray fine sandy loam material with yellow mottlings to depths ranging from 34 to 48 inches; and the underlying material is somewhat calcareous, mottled gray, brown, and yellowish-brown fine sandy loam. Mapped areas include patches of Genesee silt loam, Genesee silty clay loam, Genesee fine sandy loam, and Genesee gravelly fine sandy loam too small to be mapped separately.

Southeast of Delta, along the flood plain of Bad Creek, a gravelly phase of this soil occurs. The surface soil is friable brown gravelly loam to 8 or 12 inches deep, below which it gradually grades into brown or brownish-gray, friable gravelly loam material underlain at a depth of about 18 inches by mottled brownish-yellow, brownish-gray, yellowish-gray, and gray gravelly fine sandy loam. At depths ranging from 30 to 40 inches the material is slightly calcareous mottled gray and yellow fine sandy loam material. The cultivated soil to a depth of 8 inches is practically the same as the virgin soil.

Genesee loam occurs on the first bottoms along Bad Creek in the southeastern part of the county, and Bean, Spring, Iron, and Mill Creeks in the northwestern part. This land is flat or gently sloping toward streams, but is dissected by sloughs and ditchlike channels of small tributaries. Drainage is poor, and the soil is subject to occasional overflow. Where the stream channels have been straightened and deepened and tile drains installed, the movement of the ground water is rapid and the drainage is usually sufficient because of the porous subsoil.

About 30 per cent of Genesee loam is under cultivation, and on the remainder is a tree growth in which soft maple predominates. The usual crops of the county are grown on this soil, and yields of small grains are a little better than those on Wabash loam, but yields of corn are slightly lower.

Methods of improvement suggested for Genesee silt loam and Genesee clay loam are applicable also to this soil.

GENESEE FINE SANDY LOAM

The dry topsoil of Genesee fine sandy loam consists of brown very fine sandy loam or fine sandy loam, the color of which becomes lighter below a depth of 7 or 10 inches, to depths ranging from 24 to 30 inches. This is underlain by a 10-inch layer of slightly calcareous, friable, gray loam material mottled with yellow. The underlying material is gray very fine sandy loam.

Mapped with this soil is a small area of Genesee fine sand in the flood plains of Bean Creek about 3 miles southeast of Fayette. In this place the surface soil is rather incoherent, brown fine sand, which becomes somewhat lighter in color to depths ranging from 30 to 44 inches, where it is underlain by brownish-gray or grayish-brown loamy fine sand, mottled with yellow.

Genesee fine sandy loam is one of the less extensive of the flood plains soils in the county. It occurs principally along Mill and Bean Creeks in the western part of the county and along West Fork Swan Creek south of Swanton.

This land is level, but in many places it is broken by washouts and holes caused by overflows. The drainage is fair. This soil is not farmed and is covered with a tree growth in which soft maple is most abundant.

On account of the frequent inundations, it is probable that Genesee fine sandy loam is best suited for pasture.

GENESEE CLAY LOAM

The dry virgin topsoil of Genesee clay loam consists of friable, mellow, brownish-gray clay loam, which gradually becomes lighter in color and texture to depths ranging from 12 to 24 inches, where it is underlain by grayish-yellow loam material to depths of 30 or 40 inches. Below this the material is grayish-yellow, calcareous fine sandy loam. Small areas of Genesee clay, Genesee loam, and Genesee fine sandy loam are included with mapped areas of this soil.

Genesee clay loam occurs mainly in the flood plains of Bad, Swan, and Tenmile Creeks. This land is flat or gently sloping toward streams, except for sloughs, tributary stream channels, and occasional depressions due to erosion by overflow water. The natural drainage is poor.

Probably 25 per cent of this soil is under cultivation, and on a large part of the remainder is a tree growth in which soft maple predominates, with some elm, sycamore, beech, and hickory. Cleared areas that are not cultivated afford excellent pasturage. Corn, mixed clover and timothy hay, wheat, and oats are the more important crops grown on this soil. Yields of corn average about 42 bushels an acre; hay, about 1½ tons; wheat, about 20 bushels; and oats, about 40 bushels.

Where good outlets have been provided by straightening and deepening the stream channels, tile drains are very efficient because the soil is pervious. With adequate drainage this soil is very productive. An application of acid phosphate increases the yields.

WABASH SILT LOAM

Wabash silt loam, when dry and in the virgin condition, consists of friable silt loam, dark grayish brown in color to depths of 11 to 13 inches, below which mottlings of brownish yellow and yellowish brown continue to depths ranging from 20 to 26 inches, where the color grades into yellowish-gray with yellow mottlings. At a depth of about 40 or 50 inches the underlying material is gray, calcareous, heavy silt loam or light silty clay loam with yellow mottlings.

In many places very fine sandy loam material occurs between depths of 15 and 40 inches, and in other places silty loam material occurs between depths of 18 and 45 inches. Most areas of Wabash silt loam contain patches of Wabash silty clay loam and Wabash loam, and in places these occurrences are so numerous that it is difficult to determine whether or not Wabash silt loam is the predominating soil.

This soil is developed in the flood plains of Bean Creek and a small creek south of Burlington flowing west into Tiffin River. The surface of the soil is level or gently sloping toward the stream. The soil is subject to inundation and the natural drainage is poor.

Probably 30 per cent of this soil is cultivated, and the remainder is in woodland pasture. Soft maple, elm, and sycamore are the principal trees, with some bur oak, black ash, cottonwood, and willow. Corn is the main crop grown, and yields range from 35 to 75 bushels an acre, with an average of about 48 bushels.

On the greater part of this land, better drainage, more through cultivation, and deeper plowing will improve the productiveness.

Wabash silt loam, heavy phase.—The topsoil of dry Wabash silt loam, heavy phase, to a depth of about 12 inches, is dark grayish-brown silty clay loam, fairly heavy, but containing sufficient fine sand to make it friable. The subsoil is dark-gray friable silty clay loam material mottled with brownish yellow and yellowish brown. The underlying material, at a depth of about 24 inches, is gray, friable silty clay loam mottled with yellow, which is slightly calcareous at a depth of 36 inches, and very calcareous at greater depths. In places fine sandy loam occurs at depths ranging from 20 to 48 inches.

Wabash silt loam, heavy phase, is developed almost exclusively in the western part of the county along Bean Creek and some of its tributaries and along Tiffin River, over the first bottoms.

This land is flat and drainage is slow and imperfect. The low position of the soil renders it liable to floods at any season of the year, although it is not often flooded during the growing season and seldom remains inundated more than two or three days consecutively.

Probably 40 per cent of Wabash silt loam, heavy phase, is under cultivation. The remainder is used for permanent pasture and supports a growth of soft maple and elm, with some black ash, cottonwood, sycamore, basswood, and willow.

Wabash silt loam, heavy phase, is recognized as valuable corn soil, and is utilized more largely for this crop than for any other. Oats, wheat, and hay are successfully grown. Corn yields range from 45 to 75 bushels an acre.

With adequate drainage and protection from overflow this soil would be one of the most productive in the county.

WABASH LOAM

The topsoil of dry virgin Wabash loam is very dark grayish-brown, mellow, friable loam from 8 to 12 inches deep, underlain by yellowish-gray, friable loam mottled with yellow. At depths of about 12 or 14 inches the upper part of the subsoil is gray fine sandy loam mottled with yellow, and at about 16 or 18 inches the lower part is yellowish-gray fine sandy loam. Below this at a depth of about 4 feet the material is calcareous, mottled gray and yellow fine sandy loam.

Included with areas of Wabash loam are many bodies too small to map separately, in which the texture of the soil varies from typical. The surface soil may vary from heavy fine sandy loam to light clay loam within a small area, but these variations are of little consequence in their relation to agriculture. In places along Bean Creek and Tiffin River considerable gravel is present throughout the soil, and in some places a bed of gravel and sand occurs at depths ranging from 24 to 36 inches.

Wabash loam is one of the most extensive flood-plain soils in the county. Its principal occurrence is along Bean Creek, but smaller areas are along West Fork of Swan, Bad, Turkeyfoot, Brush, and Mill Creeks, and Stag Run.

This land, except for an occasional slough or ditch-like channel, is low and flat or has only a gentle slope toward the stream along which it occurs. Drainage is poor, but because the soil is open, artificial drains are very effective.

Probably 40 per cent of this soil is cultivated, the remainder being forested principally with soft maple, elm, and sycamore, with some black ash, willow, cottonwood, bur oak, basswood, and water beech. Uncultivated areas are used chiefly for grazing. This is naturally one of the most productive soils of Fulton County. Corn, hay, oats, and wheat are the leading crops. Corn yields average about 45 bushels an acre; mixed clover and timothy hay, about 1½ tons; oats, 40 bushels; and wheat, 20 bushels.

Land of this kind is sold in conjunction with other soils.

Better drainage would increase the productiveness of this soil.

WABASH CLAY LOAM

The topsoil of dry virgin Wabash clay loam consists of dark grayish-brown, friable, mellow clay loam to a depth of about 10 inches, below which it gradually merges into grayish-brown clay loam mottled with yellow. At a depth of about 14 inches the subsoil is mottled gray and yellow fine sandy loam material, and at depths varying from 36 to 48 inches the underlying material is mottled yellow and gray, calcareous fine sandy loam or gravelly fine sandy loam. Mapped areas include many small patches of Wabash loam, Wabash clay, and Genesee clay loam.

Wabash clay loam is of very small extent in the county, occurring in the first bottoms of Bad and Bear Creeks in the eastern part of the county, and along a small creek in the extreme northwestern corner. The soil is flat and poorly drained and is subject to frequent overflows.

Only a few acres of this soil are in cultivation, most of the remainder supporting a tree growth of soft maple, elm, and sycamore

with some cottonwood, willow, basswood, bur oak, black ash, and water beech. The few acres in cultivation are planted to corn and hay. Yields are slightly lower than on Wabash loam. The cleared but uncultivated areas support a good growth of grass and afford pasturage for cattle, hogs, horses, and sheep.

This is naturally a very fertile soil, and in some places it would probably be advisable to reclaim it by deepening and straightening the stream channels and establishing tile drainage.

Wabash clay loam, heavy phase.—Dry virgin Wabash clay loam, heavy phase, to a depth of about 9 inches consists of a dark grayish-brown friable clay. To a depth of 15 inches the material is gray friable clay mottled with yellow, which becomes lighter in texture with increase of depth, until at a depth of 18 inches the material is mottled gray and yellow friable clay loam. Below 24 inches the material is mottled yellow and gray loam, resting upon mottled yellow and gray calcareous fine sandy loam or gravelly fine sandy loam at depths varying from 44 to 60 inches. Areas of Wabash clay loam and Wabash loam, too small to be shown separately on the map, are included with this soil.

Wabash clay loam, heavy phase, is not extensively developed. It occurs on the flood plains of streams, the more important areas lying along Bad Creek in the eastern part of the county, and along Brush Creek and Flat Run near Archbold. The surface run-off is very slow, and internal drainage is very poor.

About 10 per cent of soil of this phase is cultivated, and a large part of the remainder is forested with trees similar to that on the typical soil. Corn and hay are the principal crops, and the average yields are slightly lower than on Wabash loam.

Wabash clay loam, heavy phase, in its present state, can not be farmed without straightening and deepening the stream channels in addition to tile draining. With good drainage it would become a very productive soil.

WABASH FINE SANDY LOAM

The topsoil of dry Wabash fine sandy loam consists of dark grayish-brown, friable fine sandy loam, underlain at a depth of about 8 inches by mottled gray and yellow fine sandy loam. To a depth ranging from 18 to 22 inches, the material is yellowish-gray loamy fine sand with gray mottlings. Below this at depths varying from 30 to 40 inches the underlying material in most places is gray gravelly loamy fine sand with yellow mottlings. In some places mottled gray and yellow friable clay loam occurs at depths ranging from 15 to 40 inches. As mapped, small areas of Wabash loam and Wabash loamy fine sand are included with the soil.

Wabash fine sandy loam is of very small extent in this county. It is a first-bottom soil and is subject to inundation. It occurs along Brush Creek in the southwestern part of the county, along Bear Creek in the northeastern part, and along Bad Creek north of Delta. This land is flat and poorly drained.

Probably 15 per cent of this soil is cultivated. The tree growth consists mainly of soft maple, elm, and sycamore. Corn and hay are the principal crops grown. Yields are somewhat lower than those on Wabash loam.

PEAT AND MUCK

Because they are not extensively developed in Fulton County, peat and muck have been indicated on the soil map by the same color, but they are described separately in the following paragraphs.

Peat, as mapped in Fulton County, consists of grasses, sedges, mosses, and other vegetable matter in various stages of decomposition. Typical peat beds are composed of dark-brown or black, almost non-fibrous or very finely divided mucky peat or granular mucky peat with a very low percentage of mineral matter. The granular structure is caused by the presence of small, subangular pieces of partly decayed wood. With increasing depth the fibrous character becomes more apparent until, at depths ranging from 6 to 16 inches, brown peat with the fiber well developed is present. This continues to depths varying from 26 to 32 inches, where the material grades into dark-brown or almost black, soft, slightly fibrous peat, underlain at depths of 34 to 36 inches by fibrous gray, marly, peaty muck. At depths ranging from 36 to 48 inches the underlying material is gray, marly, or calcareous fine sand.

Three miles northeast of Wauseon and 1 mile west of Oakshade are areas of peat, where gray, highly calcareous or marly clay occurs at depths ranging from 36 to 48 inches. In the vicinity of Ottokee, Oakshade, and Fayette the peat is shallow and higher in mineral matter than typical, and the calcareous clay underlying it is reached between depths of 16 and 24 inches. In other bodies in the vicinity of Oakshade calcareous fine sand is reached at depths ranging from 18 to 24 inches.

The peat beds of Fulton County occur in both morainic and old lake regions, in shallow basins, sloughs, or situations at the bases of slopes where seepage keeps the vegetable matter well saturated. The principal occurrences are small areas 3 miles north of Winameg, in the vicinity of Oakshade, and northeast of Fayette. This land is flat, and the drainage is extremely poor, the ground water level usually being close to the surface.

In Fulton County less than 1 per cent of the peat land has been improved. The greatest need of this soil is drainage, and most of the beds can be drained by tiling. Where properly drained, cultivated, and fertilized, good crops of corn, celery, onions, head lettuce, cabbage, and potatoes can be grown. Peat is invariably low in potash and is usually low in phosphoric acid, both of which are supplied by the use of commercial fertilizers.

Muck in Fulton County to depths varying from 8 to 14 inches consists of black or almost black, partly decomposed vegetable matter with which has been incorporated a considerable quantity of fine sand, underlain by light-gray fine sand mottled with pale yellow. At a depth of about 22 inches the material is mottled brownish-gray, yellowish-brown, and yellowish-gray loamy fine sand, which becomes calcareous at depths ranging from 44 to 60 inches.

There is an area east of Fayette along Spring Brook, and another area 1 mile west of Oakshade, where gray, friable clay, mottled with brownish yellow and yellowish brown, is underlain at depths of 12 or 15 inches by mucky material. At about 28 inches this grades to gray, calcareous clay with yellowish-brown, brownish-yellow, and

white mottlings. In some places marly clay underlies the mucky material at a depth of about 14 or 18 inches. In a few places along streams beds of dark-gray fine sandy loam or silty clay loam ranging from 1 to 4 inches thick overlies peat. The largest bodies of muck are 3 miles south of Pettisville, 2 miles southeast of Oakshade, and along Mill Creek. The muck beds have flat surfaces and occur in the flood plains of streams in shallow basins and along the bases of slopes where seepage waters keep the surfaces wet most of the year.

Muck in Fulton County is not extensive and is not cleared. It supports a tree growth of black ash, elm, bur oak, pin oak, swamp white oak, sycamore, cottonwood, willow, water beech, sumac, dogwood, shellbark hickory, soft maple, and quaking aspen.

When cleared, drained, and properly fertilized muck proves to be a fairly productive soil.

SUMMARY

Fulton County, Ohio, is in the northwestern part of the State and has an area of 405 square miles, or 259,200 acres.

This land forms a level or gently undulating plain with some rolling or ridge areas. With the exception of comparatively small areas, Fulton County is poorly drained.

The average annual temperature is 48.4° F., and the average annual precipitation is 36.81 inches.

General farming combined with dairying is practiced. Hogs in large numbers are raised and sold annually. The farm practices in general are good, but there is need of more thorough drainage, more rotation of crops, more extensive growing of legumes, and a better understanding of fertilizer requirements.

The soils of Fulton County have developed in a forested region under the influence of a humid, temperate climate, with but short periods of extreme heat and cold.

A large proportion of the county was naturally poorly or imperfectly drained. Where well drained the medium or heavy textured materials consist of a surface layer of comparatively light-textured soil, dark grayish brown or grayish brown in color; the subsoil is heavier than the surface soil, and brown or yellowish brown in color; the underlying material is calcareous glacial drift. Soils of the Miami series are representative of these normally developed well-drained soils in Fulton County. Well-drained sands or very sandy soils are included in the Coloma, Plainfield, Dunkirk, and Fox series. Sandy soils, moderately or poorly drained, are grouped in the Lucas and Wauseon series.

The profile showing the main characteristics of the heavier-textured soils of the area developed on moderately well drained uplands may be described from the surface downward by layers as follows: A layer of dark-gray material from 1 to 3 inches deep; a layer of light-gray or gray material from one-half to 3 inches thick; a layer of brownish-yellow or yellowish-brown material which varies in thickness from 12 to 20 inches; and the underlying parent material is in most places olive-gray, plastic, heavy calcareous clay, with gray, yellow, and brown mottlings. These soils are members of the Nappanee and Fulton series.

The profile of very poorly drained upland soils may be described by layers from the surface downward as follows: A layer of granular, friable, dark-gray or almost black material, to depths varying from 5 to 10 inches; a layer of granular, olive-gray material heavier in texture than the first layer and ranging in thickness from 20 to 30 inches; and the underlying parent material is calcareous, olive-gray material with gray, yellow, and brown mottlings. Soils having this profile include the clay, clay loam, and loam members of the Brookston, Toledo, and Clyde series. Soils of the Newton and Maumee series are poorly drained, dark-colored, and sandy.

The dark-colored soils in the stream flood plains are classed with the Wabash series and the light-colored soils with the Genesee series. About 0.25 per cent of the soils of the county are classed as peat and muck.

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