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Soil Survey
of
Erie County, New York

By

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and

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Cornell University Agricultural Experiment Station

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SOIL SURVEY OF ERIE COUNTY, NEW YORK

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COUNTY SURVEYED

Erie County is in the extreme western part of the State of New York. (Fig. 1.) It has an area of 1,047 square miles, or 670,080 acres. The city of Buffalo is within its borders.

Physiographically the area included within the boundaries of Erie County comprises parts of two of the great physiographic features of the United States. These are the Allegheny Plateau and the Interior Lowland. The boundary between the two, which is rather sharply defined, crosses the eastern boundary of the county near the village of Williston, thence extends west and southwest approximately through East Aurora to a point about a mile southwest of Orchard Park. From this point it runs southwestward to North Collins and thence southward to the county boundary.

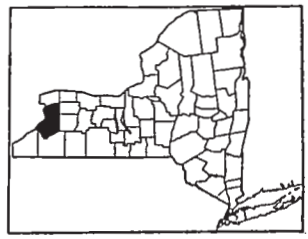

FIGURE 1.—Sketch map showing location of Erie County, N. Y.

That part of the Allegheny Plateau lying within the county comprises the northwestern fringe of the New York part of the plateau. It is cut off from its southward continuation in Cattaraugus County by the rather broad valley of Cattaraugus Creek which forms the southern boundary of Erie County. The elevation of the higher parts of the plateau in Erie County ranges around 1,700 feet, this height being attained in the southern part of the county. Southward the slope to Cattaraugus Creek Valley is moderately steep, northward the slope to the lowland is gradual, with an ill-defined escarpment, having a drop ranging to somewhat more than 100 feet, along the northern and northwestern boundaries. The upland surface is cut into several broad smooth-topped ridges by a series of broad northwest-southeast valleys each occupied by a stream flowing northwestward, but the upper or at least southern end of each valley opens into the broad valley of Cattaraugus Creek. This, together with the somewhat misfit way in which the streams occupy their valleys, shows that the valleys antedate the streams which occupy them and can not, therefore, be the product of stream cutting by the existing streams.

The slopes of the valley walls are characteristic for the northern border of the Allegheny Plateau in New York, their special features being well developed in the Finger Lakes district of the State. In normal erosional valleys in regions of horizontally bedded rock, both sandstones and shales, as in the plateau of Erie County and in

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limestones, the slopes, except in the postmature stages of the erosion cycle, are comparatively steep, many of them very steep, the valleys at plateau level being not many times, in many places not twice, the width of the valley bottoms. These plateau valleys, however, are wide open though comparatively narrow at the bottom and several times wider at the top. The lower slopes are comparatively steep, but above the first hundred or few hundred feet the slope decreases rapidly and the valley widens rapidly. The striking development of this feature is present in no other part of the eastern United States except in New York.

Another striking feature is the absence of comparably developed lateral or tributary valleys. A great number of small streams tributary to the main streams are shown on topographic maps but they have no valleys, merely flowing down the long slopes of the main valleys in hillside ditches or, when larger, occupying extremely narrow steep-sided and deep gorges called gulfs. The discrepancy in topographic age or stage of development between the main valleys and these tributaries, whether large or small, is striking and characteristic of the region.

The ridges between the main valleys are broad and smooth, free from the deep and intricate dissection by dendritic streams characterizing the Allegheny Plateau south of New York State. The surfaces of the ridges are somewhat irregular in places, owing to more or less irregular heaps of sandy and clayey stony materials which seem to be out of place. Such features are especially characteristic also of the broader parts of the main valleys and of the bordering belt where the plateau and northern lowland belt join. As the geologist knows, these are heaps of material deposited by the glacial ice which crept over and covered this region for a long time during the Pleistocene period of geological time. The characteristics of the main valleys in the plateau and the absence of a well-established network of streams tributary to the main valleys are probably other effects of ice action. Not only do the heaps of material referred to occur in great numbers, but the whole surface of the underlying country rock is covered with a layer of the same kind of material derived from the same source and deposited by the same agency. It is from this material that the soils of the region have developed and not directly from the underlying sandstones and shales.

The northern and western parts of the county lie within the Great Interior Lowland of the United States, extending eastward into northern New York State, stretching northward from the northern end of the Allegheny Plateau. This part is often designated as the Ontario lowland. Its general features consist of a great plain diversified in a broad general way by a few low ridges. The most prominent ridge in this region, though lying beyond the northern boundary of Erie County, is the low ridge underlain by limestone, the northern slope of which forms the Niagara escarpment. Within Erie County such general features are present in such faint expression that they can scarcely be said to exist. A low ridge extends northeastward from Buffalo turning eastward by Williamsville. A few other similar features exist, but, with the exception of the surface features to be mentioned below, the plain is very smooth.

In minor detail the features of the lowland have been influenced by the glacial ice, like those of the plateau, and in addition to this a large part of the lowland in Erie County, after the ice disappeared, was covered by a lake. The deposits on the bottom of this lake have determined the topographic features of part of the plain and constitute also the materials from which important soils in this part of the county have developed. In other parts of the lowland the surface has been made uneven by the irregular heaps of material deposited by the ice, and in still other places valleys have been cut below the surface by streams. The elevation of the lowland ranges from 600 to 800 feet above sea level, mainly from 600 to 700 feet.

Two old glacial lake beaches, consisting of a broken series of low gravel and sand ridges, traverse the plains region in a northeast-southwest direction. Each of these ridges represents the shore line of a large body of water formed during the glacial period. The highest one, which is farthest from Lake Erie, is described by Leverett as Belmore Beach.[1]

Belmore Beach is a much broken sand and gravel ridge which ranges in elevation above sea level from 840 to 900 feet, in width from 50 to 300 yards, and in height from 3 to 10 feet above the general level of the region. It enters Erie County along Cattaraugus Creek, 1 mile north of Versailles, and extends northeastward, passing a little east of North Collins and Hamburg through Orchard Park to Marilla.

The other well-marked ridge ranges in elevation from 780 to 860 feet, is from 100 to 1,000 yards wide, and rises from 4 to 15 feet above the old lake-bottom plain which is immediately north of it and is a beach remnant of the glacial lake described by Leverett as Lake Warren. This beach leads northeastward from Versailles, past Brant, Pontiac, Eden, Hamburg, Webster Corners, Spring Brook, and Elma to West Alden. Here it separates into two beaches, one of which extends eastward through Alden into Genesee County. The other beach bears northward through Alden Center and Crittenden into Genesee County. From Hamburg a low gravel beach, known locally as Cooper Ridge, extends westward for about 2 miles.

The first settlement in Erie County was made at Buffalo about 1794. The early settlers came from the eastern part of New York and the New England States. Since 1900 many people of Polish, Italian, and German descent have bought or rented farms, and to-day the farming population is about equally divided between these people and the descendants of the early settlers. According to the 1930 census,[2] the population of Erie County is 762,408, of which 659,405 are urban residents and the remainder rural, the rural population figures including all towns of less than 2,500 inhabitants. The rural population of 103,003 is reported as 27,988 farm population and as 75,015 nonfarm. The density of the rural population is reported as 99.6 persons to the square mile, and the distribution is fairly uniform.

Buffalo, the county seat, has a population of 573,076. It is connected by steamboat lines with all Great Lake ports to the west and

[1] LEVERETT, F. GLACIAL FORMATIONS AND DRAINAGE FEATURES OF THE ERIE AND OHIO BASINS. U. S. Geol. Survey Monog. 41, 802 p., illus. 1902.

[2] Soil survey reports are dated as of the year in which the field work was completed. Later census figures are given whenever possible.

by its many steam and interurban railroads and the Barge Canal with all parts of the United States and Canada. Its largest suburban cities, Tonawanda and Lackawanna, are important for their steel and iron industries and as Great Lakes ports. Williamsville, Depew, Lancaster, Clarence, Akron, Alden, East Aurora, Springville, Gowanda, Angola, and Hamburg are important railway shipping points. Along the shore of Lake Erie are numerous resorts which in the summer provide most excellent local markets for truck, berries, and poultry and dairy products. In addition to the cities and towns mentioned there are many small towns, and few farms are more than 2 or 3 miles from a store. Paved or waterbound pikes connect all parts of the county with Buffalo. Slag, macadam, gravel, or better roads pass 98 per cent of the farms. Practically all rural sections are served with rural delivery of mail and telephone accommodations.

CLIMATE

Erie County has a temperate climate and is not subject to long periods of extreme heat or cold. The mean annual temperature of 47° F., as recorded at Buffalo, is representative of most of the old glacial lake plains in the northern half and western part of the county. The mean annual temperature of 44.7°, at Franklinville, 10 miles south of Erie County, is fairly representative of the temperature in the hilly section in the central, eastern, and southern parts. This station is situated in a valley at an elevation of 1,598 feet. The valley, a little less than a mile wide, is flanked with slopes rising from 300 to 500 feet above the valley floor.

An average annual precipitation of 37.36 inches is recorded at Buffalo, and of 41.92 inches at Arcade which is 4 miles east of the southeastern corner of Erie County and is representative of the hilly section in the central, eastern, and southern parts of the county. The Buffalo station is located one-half mile from and 20 feet higher than Lake Erie, at an altitude of 600 feet above sea level; and the Arcade station is 30 miles from and about 1,130 feet above Lake Erie, at an altitude of 1,707 feet. Rainfall is usually well distributed throughout the year. However, a study of the climatological data for the Buffalo station, extending over a period of 70 years, indicates that excessively wet springs have occurred occasionally and that summer droughts have occurred an average of once in five years.

The tempering influence of Lake Erie, which borders the western part of Erie County, furnishes immunity from frosts in early spring and late fall. According to records of the Buffalo station the average date of the last killing frost is April 28, and of the first is October 21, giving an average frost-free period of 176 days. At the Franklinville station, the average date of the last killing frost is May 22, and of the first is September 27. Frost has been recorded at the Buffalo station as late as May 23 and as early as September 23.

There is considerable difference in the length of the frost-free period within Erie County, due to differences in location with respect to air drainage. It is commonly known that land along and adjacent to the upper slopes of the valleys of Cattaraugus, Eighteenmile, Cazenovia, and Hunter Creeks, where the cold air drains down the

slopes, are often entirely free from the severe killing frosts which occur on the floors of the valleys, where the locations are favorable for the accumulation of the cold air from the valley slopes. Certain parts of the larger valleys, as well as some of the smaller valleys, are frequented by heavy fogs which modify the effects of the low temperatures, so that crops escape some of the later killing frosts in the spring and the earlier ones in the fall.

The time of planting is greatly delayed on the level or gently rolling silt loam and silty clay loam soils of the upland, because of heavy spring rains, very poor natural drainage, and the lack of adequate tiling or ditching. When the soil water changes from liquid to vapor on evaporation, a very great quantity of heat is drawn from the soil, thus keeping it cold. About five times as much heat is required to raise the temperature of water as that of soil. Thus, the reason that the water-soaked silt loam and silty clay loam soils warm up very slowly is apparent.

Table 1, compiled from the records of the United States Weather Bureau station at Buffalo, gives the more important climatic data relative to the high plains section of Erie County.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Buffalo, N. Y.*

[Elevation, 600 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1923)	Total amount for the wettest year (1878)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	29.8	66	−9	3 37	3 00	8 55	17 1
January	24.6	70	−14	3 30	3 27	4 64	20 3
February	24.3	67	−13	2.93	1.24	1.70	18.1
Winter	26.2	70	−14	9 60	7.51	14.89	55.5
March	31.1	79	−4	2.62	1.70	5 11	10 3
April	42.2	84	5	2 45	1 17	4 71	3 6
May	54.6	94	26	3.10	3.06	3 36	.3
Spring	42.6	94	−4	8.17	5 93	13 18	14 2
June	64 4	94	39	3 14	3 64	3.46	0
July	69.8	95	47	3 40	.71	6 80	0
August	68.6	95	44	2.99	1.26	3 17	0
Summer	67 6	95	39	9.53	5 61	13.43	0
September	62.4	95	35	3.18	1 86	7.44	0
October	53.1	86	24	3 53	1.66	6.86	.5
November	39.4	71	2	3 35	2.74	4.44	5 8
Fall	51 6	95	2	10.06	6 26	18.74	6 3
Year	47.0	95	−14	37.36	25.31	60.24	76.0

AGRICULTURE

Agriculture in Erie County dates from the latter part of the eighteenth century when the early white settlers produced corn, wheat, and vegetables for sustenance and feed for livestock.

When the Erie Canal was completed in 1825, giving the county for the first time easy access to the eastern markets, prices of farm products in Erie County were more than doubled. This led to a very rapid occupation of the land and a corresponding development of agriculture, which was accelerated a few decades later by the completion of the New York Central Railroad. At this time Buffalo was the leading commercial city of the Great Lakes. With Buffalo as a market, farmers found it more profitable to produce milk, butter, cheese, truck crops, small fruits, and timothy hay, than to increase the wheat acreage.

According to a report published by the New York State Department of Farms and Markets,[3] Erie County led the State in the production of poultry and small fruits in 1917 and in creamery butter in 1919.

Federal crop statistics, from 1879 to 1924, show the three leading cereal crops in order of their acreage to have been oats, wheat, and corn, but the 1930 census reports the corn acreage to exceed that of wheat in 1929. From 1879 to 1924, hay led all crops in acreage. The census reports the maximum yields of oats, potatoes, corn, and hay in 1924, and of wheat in 1909.

The Federal census reported 107,474 acres in hay in 1929, timothy and timothy and clover mixed being the most extensively grown, with an area of 92,119 acres, followed by clover on 8,371 acres, and alfalfa on 4,296 acres. Most of the hay is fed on the farm, but a large quantity is hauled to Buffalo and sold.

Oats are the most important cereal crop. The census report shows that in 1929 the 26,998 acres planted to oats yielded 446,225 bushels, and in addition oats from 2,904 acres were cut and fed unthreshed. A large part of the oats is fed on the farms, and the rest is sold.

Wheat, the cereal crop second in both value and acreage, previous to 1924, but third in acreage in 1929, was grown on 10,638 acres in 1929 and yielded 132,874 bushels. Wheat growing in Erie County is generally considered by farmers as commercially unprofitable, because of the injury caused by rust, scab, smut, and frequent freezing and thawing of the ground during winter, which causes heaving and breaking of the root systems. However, 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 or potatoes, wheat or oats, mixed timothy and clover, or clover. Most of the wheat is sold in Buffalo.

Corn was grown on 18,604 acres in 1929, of which 2,605 acres were harvested for grain, yielding 76,514 bushels; 11,282 acres were cut for silage, yielding 77,767 tons; 4,435 acres were cut for fodder; and 282 acres were hogged off. Silage corn yields range from 4 to 8 tons an acre. An average yield of 6.89 tons an acre was reported in 1929. A small percentage of the corn planted for silage is allowed to mature and is used to feed the farm livestock.

Potatoes are an important crop on the fairly drained and well-drained soils. Weather conditions have caused a wide difference in potato yields from year to year. In 1909, the average was 91.5

[3] N. Y. STATE DEPT. FARMS AND MARKETS. AGRICULTURAL MANUAL OF NEW YORK STATE, ARRANGED BY COUNTIES. Compiled by Edith Van Wagner. N. Y. State Dept. Farms and Markets Bul. 133, 857 p., illus. 1922

bushels, in 1924 it was 145 bushels, and in 1929 it was 79.2 bushels. In 1929, 11,430 acres of potatoes were harvested, yielding 906,014 bushels. A large part of the crop is marketed in Buffalo.

Buckwheat was grown on 5,879 acres in 1929, producing 75,084 bushels. A large part of the grain is marketed in Buffalo. Many farmers sow buckwheat following the failure of wheat, oats, or corn, and the crop is occasionally plowed under as green manure.

In 1929, 1,562 acres were devoted to barley, with a yield of 25,317 bushels, and 1,370 acres to rye, with a yield of 15,961 bushels.

Truck crops were grown on 11,447 acres in 1929 and had a value of $1,460,344. The truck crops included 67 acres of asparagus, 3,384 acres of snap beans, 15 acres of Lima beans, 36 acres of beets, 776 acres of cabbage, 58 acres of cantaloupes, 80 acres of carrots, 240 acres of cauliflower, 101 acres of celery, 2,131 acres of sweet corn, 745 acres of cucumbers, 158 acres of lettuce, 227 acres of dry onions, 23 acres of green onions, 1,184 acres of peas, 28 acres of peppers, 34 acres of radishes, 165 acres of spinach, 48 acres of squashes, 1,239 acres of tomatoes, 30 acres of turnips, and more than 600 acres of mixed vegetables and those not listed here. Most of the vegetables are sold on the Buffalo and other local markets.

Berry and grape growing have become very important in the southwest quarter of the county. According to the census there were 3,129,514 grapevines of bearing age in the county in 1929, yielding 9,119,397 pounds; 1,745 acres of raspberries, yielding 1,564,558 quarts; 760 acres of strawberries, yielding 1,177,804 quarts; and 182 acres of blackberries, yielding 124,319 quarts. Commercial fruit growing is carried on, particularly in the central and southwestern parts of the county. Apples are the principal orchard fruit grown, followed by pears. Most of the fruit is either sold at stands along the leading highways or is hauled by trucks to Buffalo. In 1929, there were in the county 174,613 apple trees of bearing age, which produced 123,264 bushels; 34,449 pear trees, yielding 12,463 bushels; 3,192 peach trees, yielding 919 bushels; 11,715 plum and prune trees, which yielded 3,772 bushels; and 7,535 cherry trees, yielding 1,729 bushels.

A scarcity of farm labor has existed in Erie County for the last decade owing to the higher wages and shorter hours offered by manufacturers in Buffalo, by companies that are developing subdivisions in the county, and by road contractors. When general farming in conjunction with dairying is practiced on farms ranging in size from 40 to 160 acres, the members of the family do most of the farm work; and when extra help is needed, as during threshing and silo filling, exchange of help among neighbors is common. On such farms monthly wages for farm hands range from $40 to $80 with board and laundry; and day wages from $2 to $5.

On truck farms, where much labor is required, wages average about 20 cents an hour for children, 30 cents for women, and 50 cents for men. From 2 to 4 cents a quart is paid for picking berries. Much of the weeding, tending, and harvesting of truck crops is done by contract. The census reports $1,556,184 paid for farm labor during 1929, or an average of $542.23 for each of the 2,870 farms reporting. The high average cost for farm labor is caused by the large labor requirements on the truck, berry, and grape farms.

Although farms range in size from 5 to 1,000 acres, most farms, for general farming and dairying, range from 50 to 100 acres, and truck farms, from 20 to 80 acres. The average size of farms decreased from 73 acres in 1880 to 66.2 acres in 1925, and again increased to 73 acres in 1930.

According to the 1930 census report, 85.9 per cent of the farms are operated by owners, 12.4 per cent by tenants, and 1.7 per cent by managers. In renting dairy farms, it is common practice for the landlord to furnish the cattle, pay one-half of the feed bill, and in return to receive one-half of the income from the farm. Cash rentals range from $2 to $10 an acre. Most of the truck farms are rented for cash.

Most of the farm buildings are substantially built and are kept painted and in good repair. The barns provide ample room for housing livestock and storing crops for the winter. Sanitary conditions are well maintained on the dairy farms, and the water on most farms is pumped from deep drilled wells. The average value of land and buildings a farm in 1930 was $9,576.

Dairying is the most important agricultural industry in Erie County. According to a report issued by the State Department of Farms and Markets, Erie County produced more creamery butter than any other county in the State in 1919.[4] It further states that more than 2,250,000 pounds of American cheese were made in 1919, in addition to large quantities of Swiss, brick, Italian, and Greek cheeses. In the same year, about 32,000,000 pounds of condensed and evaporated milk were manufactured. According to the Federal census report for 1930, the value of dairy products in 1929, excluding those consumed at home, amounted to $3,934,383.

Dairying is carried on by the majority of the farmers of the county. Holstein-Friesian cattle are more numerous than those of other breeds, but there are a number of herds of Ayrshires, Jerseys, and Guernseys. Some pure-bred dairy herds are in the county, but by far the greater proportion of the dairy cattle are grade stock. Pure-bred sires are commonly used.

Many farmers raise hogs for their own use. Most of the hogs are of the Berkshire, Yorkshire, Duroc-Jersey, Poland China, and Chester White breeds. A small percentage of the farmers keep small flocks of sheep, mainly of the Shropshire breed. Very few horses are raised, though some farmers breed their working mares and raise enough work animals for their own farms.

The value of poultry and eggs produced in 1929 is given as $2,832,384. This branch of farming is a very important source of income. Most farmers keep from 50 to 150 chickens, and many farmers are specializing in poultry on farms ranging in size from 10 to 20 acres. White Leghorn is the favorite breed. The average farmer prefers a mixed flock of several breeds.

Factories at Eden, North Collins, and Springville can peas, string beans, sweet corn, and some other vegetables, as well as fruits.

Most farmers practice a rotation consisting of corn, oats, and mixed alsike clover and timothy. Buckwheat or potatoes may take the place of corn, and wheat of oats. Land which is to be planted

[4] See footnote 8, p. 6.

to corn, wheat, or buckwheat usually receives an acre application of about 200 pounds of a fertilizer with rather high percentages of potash and phosphoric acid and a low percentage of nitrogen. The same fertilizer is used for potatoes, about 300 to 400 pounds being applied. Many farmers plow their land in the fall so that the upturned soil will crumble under the action of freezing and thawing, making possible a more thorough pulverization of the seed bed and thus increasing the supply of available plant-food elements. In addition to stable manure, some farmers plow under green-manure crops in order to increase and maintain the supply of organic matter. Organic matter in the soil tends to increase the moisture-holding capacity, retards loss of moisture by surface evaporation, aids in warming the soil by the absorption of heat, helps to control erosion on the more rolling areas, assists in overcoming the tendency of the soil to run together or puddle, gives better tilth, and, in decomposing, supplies nitrogen and tends to liberate other plant-food elements. Some farmers have also applied from 2 to 3 tons of finely pulverized limestone on plowed land before planting in the fall or spring. This practice has greatly assisted in obtaining good stands of red clover and alsike clover.

SOILS AND CROPS

The soils of Erie County occur in a humid region, where soil characteristics have not been well developed, and the agricultural adaptations of the soils are dependent mainly on drainage and textural differences. The textural differences of most of the soils are determined by the texture of the parent materials. Fairly well drained and well-drained soils are light in color and are low in organic matter, because they were formed under a dense forest cover which was unfavorable to the accumulation of much organic matter in the soil. Soils lying south of a line extending along the shore of Lake Erie from near Irving to Walden Cliffs and thence northeastward to Alden are acid or very acid, except in some comparatively small areas, most of which are in stream-flood plains, others on slopes and along intermittent stream courses, and some underlain by marl. North of this line the heavy-textured soils, such as silt loams and heavier soils, are, in most places, slightly acid or neutral, and lighter-textured soils, such as loams, fine sandy loams, and sands, are slightly acid or acid. Most areas of a particular soil bordered by other soils, include areas of the bordering soils too small to be indicated on the map.

The crops grown and types of agriculture practiced can be associated with four general groups of soils. The first group includes the heavy-textured soils, which have silt loam and silty clay loam surface soils underlain by heavy plastic or hard and compact silty clay loam and silty clay subsoils; the second group includes the sandy and gravelly soils, or those having light friable surface soils, such as loams, gravelly loams, very fine sandy loams, fine sands, and very fine sands, grading downward into sandy or gravelly, friable and easily drained subsoils; the third group includes the alluvial or flood plain soils; and the fourth group consists of organic soils, or muck. In addition three classes of miscellaneous soil mate-

rials, rough stony land, dune sand, and unclassified city land are mapped.

Members of the heavy-textured soil group are the only soils on the ridges and valley slopes in the southeastern quarter and east-central part of Erie County. Sandy soils predominate in a zone, from 1 to 4 miles wide, which extends northeastward from Versailles, passing into Genesee County east of Alden and Crittenden. In the remainder of the county the soils of all groups are intermingled, but in most places the heavier soils predominate. Muck soils are well distributed in small areas throughout the plains regions and the larger valleys.

The heavy-textured soils are used largely for the production of small grains, hay, and corn for silage; but the better-drained areas are used to some extent for potatoes. On the ridges and slopes between Lawton and North Boston very extensive vineyards have been developed on these soils where the disintegrated beds of interstratified very fine grained sandstone and shale are within 3 feet of the surface.

The sandy and gravelly soils occur in level or gently rolling areas and by virtue of their texture, friability of the subsoils, good natural drainage and aeration, warm up early in the spring and are comparatively easy to till. Because of their natural adaptation, together with their accessibility to the Buffalo market, these soils are used very extensively in the production of berries, fruit, and truck crops, such as potatoes, beans, tomatoes, cabbage, carrots, parsnips, peppers, cauliflower, beets, onions, radishes, and cucumbers. Between Eden and Versailles, thousands of acres are planted to raspberries, strawberries, and grapes. A small percentage of these soils, remote from the Buffalo market, as in the vicinity of Sand Hill and in the valleys about Springville and Chaffee, is farmed in conjunction with the heavy-textured soils and is used for the same crops.

Muck soils are inextensive and only a small percentage of them has been cleared. They are used for truck crops, particularly celery, onions, and cabbage.

Many thousands of acres of soils in Erie County, now lying idle were farmed 20 years ago. Most of the idle fields are on the heavy-textured soils. The factors that have been instrumental in bringing about this change are largely economic. They are, in part, local, owing to the proximity of the large city of Buffalo and its factories, and in part general, such as decreased demand for hay, owing to the replacement of horses by automobiles and trucks. The construction of hundreds of miles of concrete and water-bound pike roads, better schools, new county parks, and new subdivisions have necessitated a very marked upward trend in land valuation so that in many places, and most particularly within 5 miles of Buffalo, taxes have advanced so high that farm incomes are insufficient to cover them.

At distances of 15 or more miles from Buffalo, where city demands for labor and improvements are less keen, a comparatively low percentage of farms have been abandoned. In Erie County the gross income from truck farming is 10 or 20 times more an acre than that realized from general farming. As sandy soils are much better suited for this kind of farming than the heavy soils, they are pre-

ferred for this purpose near Buffalo. This city not only provides a ready market for truck crops, but supplies labor to tend and harvest them. The laborers are largely Italian and Polish women and children.

The soils of Erie County are divided into series on the basis of differences in structure, color, consistence, degree of leaching, and minor details of the soil profile, and the source, character, and process of accumulation of the material from which the soils have been derived. A further differentiation into types has been made on the basis of the texture of the surface soil. Minor variations in the soil, not sufficient to produce type or series differences, are indicated as soil phases. The distribution of the different soils is shown on the accompanying soil map, and their actual and proportionate extent are shown in Table 2.

TABLE 2.—*Acreage and proportionate extent of soils mapped in Erie County, N. Y.*

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Langford silt loam	53,504	8.0	Tonawanda silt loam	8,576	1.3
Langford silt loam, slope phase	8,000	1.2	Tonawanda silty clay loam	6,016	.9
Langford silty clay loam	3,136	.5	Wolcottsburg silt loam	3,712	.6
Aurora silt loam	11,200	1.7	Wolcottsburg silty clay loam	1,600	.2
Aurora silt loam, steep phase	2,112	.3	Maumee silt loam	1,600	.2
Aurora silty clay loam	10,048	1.5	Chenango loam, gravelly phase	22,016	3.3
Aurora shaly silt loam	4,352	.7	Chenango shale loam	4,800	.7
Lordstown shaly silt loam	3,584	.5	Chenango loam	1,280	.2
Lordstown silt loam	448	.1	Chenango very fine sandy loam	2,688	.4
Erie silt loam	29,312	4.4	Chenango fine sandy loam	896	.1
Volusia silt loam	6,144	.9	Palmyra gravelly loam	7,680	1.1
Allis silt loam	14,336	2.1	Palmyra loam	4,928	.7
Angola silt loam	16,000	2.4	Palmyra shaly loam	1,536	.2
Angola silt loam, steep phase	896	.1	Palymyra very fine sandy loam	1,152	.2
Alden silt loam	2,688	.4	Palmyra fine sandy loam	2,432	.3
Chippewa silt loam	6,336	1.0	Tonawanda loam	896	.1
Darien silty clay loam	21,952	3.3	Schoharie loam	1,600	.2
Darien silty clay loam, dark-colored phase	192	.1	Schoharie loam, light-textured phase	18,560	2.8
Darien silt loam	3,712	.6	Cazenovia loam	16,832	2.5
Fulton silty clay loam	11,264	1.7	Cazenovia silt loam	2,688	.4
Fulton silt loam	3,520	.5	Ontario gravelly loam	3,392	.5
Fulton silt loam, light-textured phase	4,352	.7	Berrien fine sandy loam	2,944	.4
Lyons silty clay loam	2,432	.3	Berrien very fine sandy loam	4,864	.7
Lyons silty clay loam, light-textured phase	512	.1	Ottawa very fine sand	1,984	.3
Toledo silty clay loam	1,472	.2	Farmington loam	6,336	1.0
Toledo silt loam	3,136	.5	Farmington cherty loam	2,432	.3
Schoharie silty clay loam	41,984	6.2	Wooster gravelly loam	8,192	1.2
Schoharie silt loam	3,328	.5	Otisville gravelly loam	5,888	.9
Poygan silty clay loam	5,248	.8	Groton loam, gravelly phase	1,152	.2
Poygan silt loam	4,480	.7	Groton loam	4,224	.6
Mahoning silty clay loam	20,224	3.0	Poygan loam	7,232	1.1
Mahoning silt loam	4,224	.7	Poygan very fine sandy loam	3,584	.5
Mahoning silt loam, steep phase	5,696	.8	Wolcottsburg loam	2,432	.3
Caneadea silty clay loam	4,544	.7	Wolcottsburg loam, light-textured phase	512	.1
Caneadea silt loam	11,520	1.7	Maumee loam	832	.1
Caneadea very fine sandy loam	640	.1	Newton loam	2,176	.3
Dunkirk silt loam	960	.1	Newton very fine sandy loam	384	.1
Dunkirk silt loam, eroded phase	2,560	.4	Genesee silt loam	14,272	2.1
Angola silty clay loam	33,024	4.9	Genesee silt loam, high-bottom phase	2,816	.4
Alden silty clay loam	5,760	.9	Chagrin silt loam	9,536	1.4
Allis silty clay loam	7,232	1.1	Chagrin silt loam, high-bottom phase	3,328	.5
Wooster silt loam	17,792	2.7	Eel silt loam	5,312	.8
Farmington silt loam	4,032	.6	Meadow	4,032	.6
Farmington silt loam, dark-colored phase	256	.1	Muck	2,176	.3
Chenango silt loam	10,176	1.5	Muck, shallow phase	2,944	.4
Chenango silt loam, gravelly phase	256	.1	Rough stony land	5,376	.8
Mentor silt loam	1,152	.2	Dune sand	256	.1
Mentor sandy loam	704	.1	Unclassified city land	35,072	5.2
Braceville silt loam	1,280	.2	Gravel pits and quarries	192	.1
Lorain silty clay loam	1,664	.2	Total	670,080	------
Newton silt loam	1,344	.2			

HEAVY-TEXTURED SOILS

The heavy-textured soils can be subdivided into four subgroups, each of which is composed of soil types having certain common soil characteristics which have much influence in determining productiveness. These subgroups are as follows: (1) Very acid soils underlain, at a depth ranging from 10 to 30 inches, by hard compact impervious layers overlying hard substrata or bedrock, and occurring on ridges and slopes in the southeastern quarter and the east-central part of the county; (2) soils having heavy compact impervious lower subsoil layers, covering most of the northwestern quarter of the county and well represented in the northeastern quarter and southwestern corner; (3) soils which have friable well-drained surface soils and subsoils; and (4) soils which have heavy-textured surface soils and subsoils underlain by sandy or gravelly material.

VERY ACID SOILS UNDERLAIN BY HARD SUBSTRATA OR BY BEDROCK

The Langford, Aurora, Lordstown, Erie, Volusia, and Chippewa soils, and the light-textured members of the Angola, Alden, and Allis series are classed in the first subgroup. All these soils are closely related in their soil characteristics, but they differ from one another in that the depth from the surface to the underlying beds of interstratified shales and very fine grained sandstones ranges from 4½ to 20 feet in the Langford, Erie, Volusia, and Chippewa soils; from 2 to 4½ feet in the Aurora soils; and from 6 inches to 4½ feet in the Lordstown, Allis, Alden, and Angola soils. Furthermore, the sandstone underlying the Langford, Aurora, Erie, Chippewa, Alden, and Angola soils is in most places neutral or calcareous, but it is acid where underlying the Lordstown, Volusia, and Allis soils. The Aurora, Angola, Alden, Allis, and Lordstown soils also differ from the Langford, Erie, Volusia, and Chippewa soils in that they contain a greater quantity of irregular fragments of shale and sandstone throughout the surface soil and subsoil and scattered over the surface. The Langford, Aurora, and Lordstown soils are more closely related in having, to a depth of 6 or 7 inches, brown friable surface soils, and, to a depth ranging from 18 to 24 inches, upper subsoil layers, of firm but friable materials, which are underlain by lower subsoil layers consisting of very compact hard impervious material; whereas the Erie, Volusia, Chippewa, Angola, and Allis soils, to a depth of 6 or 7 inches, have friable surface soils underlain by compact friable materials which grade abruptly, at a depth of about 12 inches, into a very compact hard impervious layer.

Where this hard impervious layer is near the surface, or where impervious interstratified beds of shale and very fine grained sand stone are near the surface, as in some areas of Angola and Allis soils, the downward movement of ground water is greatly impeded, so that both surface and internal drainage are very poor and artificial drainage is difficult.

On such soils, silver and red maple, and American elm constitute the principal tree growth. Less common trees are basswood or American linden, black ash, white ash, sugar maple, American beech, Canadian hemlock, butternut, cucumbertree, whitewood or tuliptree, ironwood or hophornbeam, American hornbeam, cottonwood,

quaking aspen, red mulberry, sassafras, wild black cherry, pin cherry, honey locust, sumac, horsechestnut, chokecherry, red elm, rock elm, flowering dogwood, pagoda dogwood, bitternut, shagbark, shellbark, pignut and mockernut hickory, gray, yellow and sweet birch, common red, black, white, swamp white, and pin oak, and Juneberry or shadblow.

In soils in which the hard layer or bedrock is from 18 to 24 inches beneath the surface, as the Langford, Aurora, and Lordstown soils, both surface and internal drainage range from fair to good. In wood lots on these soils the predominating tree growth is hard maple, beech, hemlock, white ash, chestnut, wild cherry, basswood, and yellow birch; and trees of less importance are whitewood or tuliptree, red elm, bitternut, shagbark, shellbark, pignut, and mockernut hickory, white and sweet birch, red, black, and white oak, white pine, butternut, cucumbertree, cottonwood, locust, sumac, horsechestnut, and chokecherry.

With the exception of the Alden and Chippewa soils, the soils of this subgroup have a comparatively low organic-matter content.

Langford silt loam.—Langford silt loam is the most extensive soil in the county, covering a total area of 83.6 square miles. It is well distributed over the ridges and slopes of the southeastern quarter of the county. The surface ranges from undulating to rolling.

The cultivated surface soil of Langford silt loam, to a depth of 6 or 7 inches, consists of grayish-brown friable silt loam. The upper subsoil layer is grayish-brown or yellowish-brown firm but friable silt loam, and the lower subsoil layer is very compact hard impervious brownish-gray silty clay loam containing mottlings of gray and yellow. Throughout the surface soil and subsoil, as well as scattered over the surface, are numerous irregular flat fragments of very fine grained sandstone and shale.

About 70 per cent of Langford silt loam is cultivated. Of the cultivated soil about 54 per cent is used for mixed timothy and clover (mostly alsike), 21 per cent for meadow, 10 per cent for oats, 7 per cent for silage corn, and the rest for such crops as buckwheat, potatoes, wheat, barley, millet, rye, cabbage, truck crops, and orchard crops. Of the uncultivated land, about two-thirds is used for pasture and one-third is in wood lots.

The principal type of agriculture practiced on this soil consists of general farming in conjunction with dairying, although potatoes, buckwheat, and a small quantity of wheat are grown as cash crops. Almost all the hay and oats produced is fed to livestock on the farm. According to the estimates of farmers, there is about one dairy cow to each 13 acres of land. Oats yields average about 40 bushels an acre; timothy and clover mixed, or timothy alone, about 1 ton; buckwheat, 21 bushels; silage corn, 8 tons; corn for grain, when the growing season allows it to mature, 37 bushels; potatoes, 100 bushels; millet, 2 tons; barley, 22 bushels; wheat, 18 bushels; and cabbage, 2¾ tons.

Langford silt loam, slope phase.—Areas of Langford silt loam in which the slope is too steep for cultivation have been mapped as a slope phase. Soil of this phase differs from the typical soil in that the surface soil, because of erosion, is thinner, and greater

quantities of shale and fine-grained sandstone fragments occur throughout the surface soil and subsoil and scattered over the surface.

Langford silty clay loam.—Langford silty clay loam resembles Langford silt loam, but differs in having less compaction and hardness and more heaviness or plasticity in the impervious subsoil layer. The surface soil is silty clay loam and the subsoil is more compact, heavier silty clay loam.

This soil occurs principally on the broken plains east of Orchard Park, east of Webster Corners, and northwest of East Aurora. Its aggregate area is 4.9 square miles. The surface relief is undulating or gently rolling.

The percentage of land cultivated, crops grown, acreage devoted to various crops, and farm practices are about the same as for Langford silt loam, but crop yields are a little lower. The lower yields are due to the heavier surface soil and subsoil, which restrict drainage and make cultivation more difficult.

Aurora silt loam.—Bordering areas of Langford silt loam on the north and occurring on gentle or steep slopes and rather narrow ridges are areas of Aurora silt loam. This soil has an aggregate area of 17.5 square miles.

Aurora silt loam is similar to Langford silt loam except that the interstratified beds of shale and very fine grained sandstone are nearer the surface than in the Langford soil. The crops, yields, and methods of treatment are essentially like those described for Langford silt loam.

Aurora silt loam, steep phase.—A steep phase of Aurora silt loam is shown on the soil map. It occurs on slopes too steep for cultivation. It differs from typical Aurora silt loam in having a thinner surface soil, due to erosion. The underlying formation of interstratified shale and very fine grained sandstone is within 3 feet of the surface, and outcrops of this formation are numerous.

Aurora silty clay loam.—Occurring on steep slopes and narrow ridges, with the principal Langford silty clay loam areas bordering it on the north and Aurora silt loam areas on the south, are the main bodies of Aurora silty clay loam, which are south of Orchard Park. Smaller areas occur throughout the east-central part of the county. The total area of this soil is 15.7 square miles.

Aurora silty clay loam is like Aurora silt loam in the color and thickness of the surface soil and the upper and lower subsoil layers, but it differs from that soil mainly in the texture of the surface soil which is a heavy silt loam. The subsoil consists of silty clay loam. A shaly variation, totaling about one-third square mile, occurs in small scattered areas in the east-central part of the county. Except that the subsoil rests on interbedded layers of shale and very fine grained sandstone within a depth ranging from 1 to 3 feet and that a greater quantity of small angular fragments of these formations are embedded throughout the surface soil and subsoil and scattered over the surface, this variation deviates little from the typical soil.

About 40 per cent of Aurora silty clay loam is cultivated, 40 per cent is in permanent pasture, and 20 per cent is in wood lots. The types and methods of farming are similar to those practiced on Langford silt loam, but crop yields are slightly lower. This is probably

due to the poorer drainage and greater difficulty of cultivation, caused by the heavier surface soil and subsoil.

Aurora shaly silt loam.—Aurora shaly silt loam is closely associated with Aurora silt loam, Langford silt loam, and Erie silt loam, and it occurs in the east-central part of the county, principally on steep slopes and less extensively on gently rolling or undulating ridges and gentle slopes. The total area comprises 6.8 square miles, 10 per cent of which is cultivated. The steep slopes are used only for wood lots and permanent pasture.

Aurora shaly silt loam is similar to Aurora silt loam, except that the surface soil is somewhat thinner and lower in organic matter on account of erosion; that the underlying bedrock, consisting of interbedded very fine grained sandstone and shale, is within a depth ranging from 6 to 30 inches from the surface; and that many more small angular fragments of this formation are scattered over the surface and embedded in both surface soil and subsoil, causing both surface and internal drainage to be somewhat better. Numerous outcrops of very fine grained sandstone and shale occur on the steep slopes.

The crops grown and agricultural practices are about the same as those on Langford silt loam, but yields are somewhat lower, owing to a thinner surface soil, lower content of organic matter, and lower water-absorbing power of both the surface soil and subsoil.

Lordstown shaly silt loam.—Lordstown shaly silt loam is like Aurora shaly silt loam, except that it is much more acid throughout, has less organic matter in its surface soil, and is less compact in the subsoil. It lies on steep slopes east of Eden and on low ridges and comparatively gentle slopes north of Derby, west of North Collins, and east of Fenton. It is an inextensive soil in Erie County.

Under cultivation the surface soil of Lordstown shaly silt loam is light-gray friable shaly silt loam, underlain, at a depth of about 6 inches, by brownish-yellow shaly silt loam which, at a depth ranging from 6 to 24 inches, rests on interstratified beds of shale and very fine grained sandstone. Throughout the surface soil and subsoil, as well as scattered over the surface, are many small irregular flat fragments of fine-grained sandstone or shale, which tend to produce an openness that facilitates drainage.

About 40 per cent of the land is cultivated, 40 per cent is in permanent pasture, and 20 per cent in wood lots. The production of grapes in connection with general farming and a small amount of trucking are the types of agriculture practiced on this soil. The yields of general farm crops are lower than on Aurora shaly silt loam, because of the thinner surface soil which is more acid and deficient in organic matter.

Lordstown silt loam.—Lordstown silt loam is much like Lordstown shaly silt loam, except that the interstratified beds of very fine grained sandstone and shale lie from 2 to 4½ feet beneath the surface. This soil occurs in only a few small areas. It occupies low ridges and gentle slopes in the vicinity of Weyer and steep slopes in the vicinity of Springville.

About 40 per cent of Lordstown silt loam is cultivated. Near Weyer, it is used in the production of grapes, small grain, and hay.

Erie silt loam.—Erie silt loam is closely associated with Langford silt loam and is one of the most extensive soils of the county, com-

prising an aggregate area of 45.8 square miles. It occurs in large areas on the broad ridges and more gentle slopes in the southeastern quarter of the county. The land ranges from gently undulating to gently rolling. Owing to the hard impervious layer lying at a depth of about 12 inches the downward movement of ground water is greatly impeded, so that both surface and internal drainage are very poor and artificial drainage is difficult.

The cultivated surface soil of Erie silt loam, under normal moisture conditions, consists of a layer of grayish-brown mellow silt loam about 6 or 7 inches thick. It is underlain by brownish-yellow friable silt loam with gray mottlings, which rests, at a depth of about 12 inches, on mottled gray, yellowish-brown, and brown hard brittle compact impervious silty clay loam. At a depth of about 3 feet this material shows the presence of lime. Much of the surface soil is lighter in color than it was when first broken, indicating a probable depletion in the supply of organic matter. Both surface soil and subsoil contain numerous irregular flat fragments of shale and very fine grained sandstone, which range in diameter from 1 to 10 inches.

In almost all areas of Erie silt loam a distinct variation from the typical soil has developed, in which the very compact hard impervious layer occurs within 9 inches of the surface. Deep-rooted plants fail to extend their roots downward into this layer and consequently make only a stunted growth. In some places, where the impervious layer lies deeper than normal, drainage and root penetration are better than average, and in crop production such areas approach Langford silt loam.

About 50 per cent of Erie silt loam is tilled, 30 per cent is in permanent pasture, and 20 per cent is in wood lots. Of the cultivated soil, 55 per cent is devoted to mixed timothy and alsike, 25 per cent to meadow, 8 per cent to oats, 6 per cent to silage corn, 5 per cent to buckwheat, and 1 per cent to all other crops.

Agricultural practices are very similar to those employed on Langford silt loam, but because of poor drainage, the low content of humus in the surface soil, and the presence of numerous spots in which the hard impervious layer is so near the surface that it interferes with the development of roots, yields are lower. Great care is exercised by the farmers to work this soil when at the optimum moisture content.

Volusia silt loam.—The main difference between Volusia silt loam and Erie silt loam is that the surface soil and subsoil of Volusia silt loam are more acid, and the substratum material is very acid rather than alkaline in reaction, as in Erie silt loam.

Volusia silt loam occurs in large areas on broad ridges and rather gentle slopes in the vicinity of Shirley, north of Clarksburg, and north of Boston Center. The total area is 9.6 square miles. Approximately 40 per cent of this soil is tilled, and the rest is used for permanent pasture and wood lots. Farm practices are similar to those described for Erie silt loam, except that somewhat less dairying is engaged in, and consequently less barnyard manure is applied to the land. In order of their acreage, hay, small grain, and corn are the leading crops. A number of grape vineyards are planted on this soil in the vicinity of Shirley. Owing to a lower content of humus in the surface soil and a more acid condition throughout, yields are somewhat lower than on Erie silt loam.

Allis silt loam.—Allis silt loam is closely associated with and resembles Volusia silt loam, but it differs from that soil in that the underlying beds of interstratified very fine grained sandstone and shale are within a depth ranging from 2½ to 4 feet from the surface.

Under average moisture conditions, the cultivated soil of Allis silt loam, to a depth of 8 inches, consists of grayish-brown friable silt loam. It is underlain by brownish-yellow friable silt loam containing gray mottlings. At a depth of about 12 inches is mottled yellowish-brown or brown hard compact impervious silty clay loam which, at a depth ranging from 2½ to 4 feet, rests on a bed of interstratified very fine grained sandstone and shale. On most of the steep valley slopes, this bed is within 1½ feet of the surface and outcrops are numerous.

This soil occurs in large areas, aggregating 22.4 square miles, on ridges and slopes in the southwestern quarter of the county. About half of the land is gently rolling, and the other half is too steep for cultivation.

About 40 per cent of the land is cultivated, 40 per cent is in permanent pasture, and 20 per cent in wood lots. The crops, yields, and agricultural practices are practically the same as for Volusia silt loam.

Angola silt loam.—Angola silt loam is like Allis silt loam in color, texture, and depth to the underlying interstratified beds of very fine grained sandstone and shale, but it differs from that soil in having a lower degree of acidity in its surface soil and subsoil and in resting on a calcareous shale substratum. Where interstratified beds of very fine grained sandstone and shale are 2½ feet or more below the surface this soil is very much like Langford silt loam.

A variation, covering a total of about 1 square mile west of Farnham, is unlike the typical soil in that the surface soil and subsoil material are free from irregular rock fragments to a depth ranging from 30 to 40 inches, where a calcareous shale bed occurs.

Angola silt loam occupies large areas on the ridges and valley slopes of the southeastern quarter of the county. It lies north of the main areas of Erie silt loam and Langford silt loam and south of Aurora silt loam. Its total area is 25 square miles. The land ranges from gently undulating to sloping or gently rolling.

The percentages of land tilled, in permanent pasture, and in wood lots, and the crops, yields, and agricultural practices for Angola silt loam are essentially the same as those given for Erie silt loam.

Angola silt loam, steep phase.—In the vicinities of Boston and Glenwood an aggregate area of about 1.4 square miles has been mapped as Angola silt loam, steep phase. It differs from the typical soil in that it is situated on very steep slopes, where part of the surface soil has been removed by erosion. It has more irregular rock fragments scattered over the surface and embedded throughout the surface soil and subsoil and more outcrops of the underlying formation. It is used for permanent pasture and woodland.

Alden silt loam.—Alden silt loam has a neutral surface soil and a very friable silt loam texture throughout. It covers a total area of 4.2 square miles and occurs in seepage spots on slopes or in depressions in the hills of the east-central part of the county. Much of the soil material has accumulated through colluvial wash.

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In cultivated fields, under normal moisture conditions, the surface soil, to a depth of 8 inches, is very dark gray friable silt loam. It is underlain by brownish-gray friable silty clay loam. At a depth ranging from 2 to 4½ feet interstratified beds of shale and very fine grained sandstone occur.

About 50 per cent of the land is cultivated, 40 per cent is in permanent pasture, and 10 per cent is in woodland. Essentially the same crops are grown and the same agricultural practices followed as on Erie silt loam, but yields, owing to the greater supply of organic matter and the more porous subsoil, are higher on Alden silt loam.

Chippewa silt loam.—Within areas of Erie silt loam and Langford silt loam are many bodies of land which are water-logged much or all of the year. Such areas occur where water seeps out on slopes or in depressions and along sluggish drainage courses where no distinct stream channels have been developed. They are mapped as Chippewa silt loam. The total area of this soil is 9.9 square miles.

Chippewa silt loam has a dark-gray neutral surface soil with a high content of organic matter. The subsoil shows less compaction than the subsoil of Erie silt loam, and where the soil material is comprised largely of colluvial wash, the subsoil is slightly compact friable silt loam. Calcium carbonate occurs at a depth of about 3 feet. The natural reaction of the surface soil is caused by the presence of seepage water which has an alkaline reaction. A variation from the typical soil, covering about one-half square mile, occurs 2 miles southwest of Collins Center, where both surface soil and subsoil consist of friable silt loam and are very acid.

About 5 per cent of this land is ditched and cultivated in conjunction with other soils. The areas with friable subsoils and without the compact impervious layer are very productive. The principal use of this soil is for permanent pasture and wood lots.

SOILS HAVING HEAVY IMPERVIOUS LOWER SUBSOIL LAYERS

To the second group of heavy-textured soils, those having heavy compact impervious lower subsoil layers, belong the heavy members of the Alden, Darien, Lyons, Allis, Angola, Mahoning, Schoharie, Poygan, Dunkirk, Caneadea, Fulton, and Toledo series. The subsoils of soils of the last five series are comparatively homogeneous, consisting of heavy compact very fine materials; but those of the remaining series are heterogeneous, being composed of different-textured materials in which are embedded rock fragments and some crystalline pebbles and bowlders. The surface soils of the Darien, Caneadea, Dunkirk, Mahoning, Fulton, Schoharie, Allis, and Angola soils are light colored and are low in organic matter, whereas those of the other soils of this group are dark colored and are well supplied with organic matter. The Allis, Angola, and Alden soils differ from other soils of the group in that they are underlain by shale interbedded with a small quantity of very fine grained sandstone at a depth ranging from 1 to 4½ feet. At a depth of about 4 feet the formation underlying the Allis soils is very acid, but that underlying the Angola and Alden soils is neutral or calcareous. Calcareous materials underlie the silty clay loam of the Darien, Schoharie,

Poygan, Lyons, Toledo, and Fulton series at a depth ranging from 18 to 28 inches. Beneath the silt loam of these series the depth to calcareous material ranges from 24 to 32 inches; beneath the silty clay loams of the Angola, Alden, and Mahoning series, from 30 to 48 inches; and beneath the silt loams of the Mahoning and Dunkirk series, from 40 to 50 inches.

The typical surface relief of the Caneadea, Fulton, Dunkirk, Toledo, and Alden soils is level; that of the Darien, Lyons, and Schoharie soils ranges from level to undulating; but that of the Allis, Angola, and Mahoning soils ranges from level to rolling or steep. Drainage, both surface and internal, of the silty clay loam members of this group is very poor, owing to the heavy compact subsoil layers which do not allow free movement of either ground water or air; but drainage is better, though poor, in the silt loam members which are more porous.

The tree growth on the better-drained soils of this group consists principally of hard maple, beech, yellow birch, hemlock, basswood, and white ash; and on the more poorly drained soils white elm, soft maple, black ash, and sycamore predominate.

Darien silty clay loam.—Darien silty clay loam is the most important agricultural soil of this subgroup. It covers a total area of 34.3 square miles and occurs in a broad belt of low broad ridges which extend from North Evans and Athol Springs along Lake Erie northeastward to Alden. The surface relief ranges from undulating to gently rolling.

In cultivated fields, under normal moisture conditions, the surface soil of Darien silty clay loam, to a depth of 8 inches, is brownish-gray or grayish-brown neutral silty clay loam. The subsoil is highly mottled gray and brown heavy firm rather impervious silty clay loam or silty clay. More or less flat angular shale and very fine grained sandstone fragments, also some crystalline pebbles and bowlders, occur throughout the surface soil and subsoil, and irregular fragments of limestone are present in the lower part of the subsoil.

About 60 per cent of this soil is under cultivation, of which 55 per cent is used for mixed timothy and alsike, 20 per cent for meadow, 12 per cent for oats, 6 per cent for silage corn, 2 per cent for buckwheat, and 5 per cent for all other crops.

Agricultural practices are similar to those for Erie silt loam, but the yields, because of a slightly higher organic content and a neutral surface soil, are somewhat higher. Because this soil has a tendency to be sticky when wet and to clod when dry, farmers find it necessary to work it only at optimum moisture conditions. Most farmers apply barnyard manure to the sod land in the fall, after which they plow the land, 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.

A very satisfactory rotation that has been tried by a few farmers for this soil is corn, oats, clover, or clover and timothy, wheat, and sweetclover, the sweetclover being left for one year so that the roots will have time to penetrate downward and open up the heavy compact subsoil. Deep plowing in connection with the turning under of green legumes is known to improve the tilth of the surface soil, to

deepen the root zone, and to render elements of plant food available. With good drainage, alfalfa grows well without the use of lime.

Darien silty clay loam, dark-colored phase.—A dark-colored phase of Darien silty clay loam, in which the surface soil is dark brownish gray, is shown on the soil map in a small body northwest of Spring Brook station. This soil differs from typical Darien silty clay loam, in the darker color of the surface soil, caused by a higher content of organic matter.

Darien silt loam.—The main difference between Darien silt loam and Darien silty clay loam is in the lighter-textured surface soil and subsoil of the silt loam. The silt loam drains out more readily and warms up more quickly than the silty clay loam. It occurs in small areas east of Windom and Ebenezer and north of Spring Brook. This is an inextensive soil.

Areas of Darien silt loam in which the surface soil is lighter textured occur in the vicinities of Alden and Marilla. Here the soil closely corresponds to Darien silt loam in most of its characteristics but it has a more friable and porous surface soil and upper subsoil layer, a more compact and less plastic lower subsoil layer, and a higher content of very fine sand and fine sand throughout.

About 70 per cent of the land is cultivated. The percentage of cultivated land in various crops and the type of farming are comparable to those for Darien silty clay loam, but yields, owing to better drainage and a more favorable texture, are a little higher.

Fulton silty clay loam.—Bordering Darien silty clay loam and silt loam areas on the north are large areas of Fulton silty clay loam, which are almost continuous between Buffalo and Town Line. Smaller areas are near Athol Springs and Orchard Park. The total extent of these areas is 17.6 square miles.

Fulton silty clay loam differs from Darien silty clay loam in having more of the gray color in the surface soil and subsoil and in having more heaviness and plasticity but less compactness in the lower part of the subsoil. A dark-colored variation, covering about one-half square mile southwest of Spring Brook, differs from the typical soil in having a dark-gray surface soil.

About 50 per cent of the land is tilled. The percentage of various crops grown and methods of treatment are essentially the same as on Darien silty clay loam, but on account of the poorer drainage, yields are a little lower on the Fulton soil.

Fulton silt loam.—Associated with Fulton silty clay loam between Buffalo and Alden Center is Fulton silt loam. This soil is similar to Fulton silty clay loam, except that the surface soil and upper part of the subsoil is silt loam and the lower part of the subsoil is as compact as, but less plastic than, the corresponding layer in the silty clay loam.

About 60 per cent of Fulton silt loam is cultivated. It is used chiefly for the production of hay, oats, beans, potatoes, silage corn, and buckwheat. Owing mainly to the better drainage of the more friable and lighter-textured surface soil and subsoil, the yields are higher than those obtained on Fulton silty clay loam.

Fulton silt loam, light-textured phase.—A light-textured phase of Fulton silt loam occurs in comparatively large areas, associated with Fulton silt loam and Fulton silty clay loam, east and southeast of

Buffalo, and in small areas near Elma. It differs from Fulton silt loam in containing more very fine sand and fine sand, in being lighter textured throughout, in having a compact rather than a heavy lower subsoil layer, and in having calcareous material at a depth ranging from 28 to 36 inches. A few areas of Fulton loam aggregating about four-fifths of a square mile and occurring principally in the vicinity of Gardenville and in very small areas near Spring Brook and Elma have been combined in mapping with the light-textured phase of Fulton silt loam because of their inextensiveness. In these areas, the surface soil and upper subsoil layer are loam, but the lower subsoil layer is very fine sandy loam or fine sandy loam. A great variety of truck crops is grown on this light-textured soil.

Lyons silty clay loam.—Occurring between Buffalo and Alden, within areas of Darien silty clay loam and associated soils, are smaller areas of Lyons silty clay loam. They occur in very poorly drained situations, such as long narrow strips along indefinite drainage courses, depressions, seepage surfaces of ridges, and bases of slopes.

Under average moisture conditions, the 8-inch surface soil of Lyons silty clay loam, in cultivated fields, consists of dark brownish-gray silty clay loam. Below this is the subsoil of mottled yellowish-gray, grayish-yellow, and brown silty clay loam. Between depths of 20 and 30 inches the material is compact and hard and contains a noticeable quantity of limestone gravel. This gravelly layer rests on a substratum of calcareous hard gray silty clay loam containing much limestone gravel.

About 40 per cent of this soil is under cultivation, 40 per cent in permanent pasture, and 20 per cent in woodland. The percentages of various crops grown and the agricultural practices are about the same as those described for Darien silty clay loam. Because of the presence of more organic matter in the surface soil, this soil is better suited for silage corn than the Darien soil, but small grains tend to develop a heavy stalk and lodge.

Lyons silty clay loam, light-textured phase.—The soil mapped as a light-textured phase of Lyons silty clay loam has a friable silt loam surface soil and a heavy silt loam upper subsoil layer. The lower subsoil layer is as compact but not so heavy as that of Lyons silty clay loam. The soil colors are similar to those of the typical silty clay loam. This light-textured soil is more productive than the typical soil, because of its better natural drainage.

Toledo silty clay loam.—Toledo silty clay loam occurs in small scattered areas, in many places occupying situations lower than Fulton silty clay loam areas. It is very inextensive.

In cultivated fields, where the moisture condition is normal, Toledo silty clay loam, to a depth of 8 inches, has a very dark gray silty clay loam surface soil which is underlain by a gray plastic silty clay subsoil containing brownish-yellow mottlings. The subsoil, at a depth of about 30 inches, rests on a mottled gray and yellowish-brown calcareous silty clay substratum.

About 30 per cent of the land is cultivated, and the remainder is used for permanent pasture and wood lots. The crops grown and the methods of treatment of this soil are about like those prevailing

on Darien silty clay loam, but yields, where adequate drainage has been installed, are better, as a result of the high content of organic matter in the surface soil.

Toledo silt loam.—Toledo silt loam resembles Toledo silty clay loam but differs from that soil in that it has a friable silt loam surface soil, a heavy friable silt loam upper subsoil layer, and a less plastic lower subsoil layer of fairly heavy compact silty clay loam. The soil throughout contains an appreciable quantity of very fine sand and fine sand.

This soil occurs in a broken succession of areas, associated with Fulton silty clay loam and Fulton silt loam, extending from Graymont northeastward past Alden into Genesee County.

In Erie County approximately 40 per cent of this soil is cultivated, of which about 45 per cent is devoted to hay, 15 per cent to oats, 15 per cent to meadow, 15 per cent to corn, and 10 per cent to truck crops. The soil is well supplied with organic matter and is one of the best corn soils in the county. Because of its lighter texture and, consequently, better aeration and drainage, it is more productive than Toledo silty clay loam.

Schoharie silty clay loam.—Schoharie silty clay loam is the most extensive soil of this subgroup, covering a total area of 65.6 square miles. Extensive areas occur north of the Fulton soils between Sand Hill and Buffalo and throughout the northwestern quarter of the county.

Under normal moisture conditions, the cultivated soil of Schoharie silty clay loam, to a depth of 6 inches, consists of brownish-gray heavy neutral silty clay loam. Beneath this is mottled olive-gray, gray, reddish-gray, yellowish-gray, and reddish-brown plastic compact silty clay, which, at a depth of 12 or 15 inches, grades into light reddish-brown plastic compact silty clay. Crystalline pebbles and bowlders occur in most places throughout the surface soil and subsoil, and limestone fragments are in the lower part of the subsoil.

Areas of Schoharie silty clay loam, free from stones and pebbles, are well distributed over the northwestern quarter of the county.

Only about 10 per cent of this soil is cultivated. The heavy surface soil and heavy compact impervious subsoil greatly retard the circulation of both water and air, causing the surface soil to warm up very slowly in the spring, to puddle when wet, and to become extremely hard and crack when dry, breaking into large lumps when plowed.

The uncultivated areas are used extensively for permanent pasture and wood lots, but within several miles of Buffalo large unfenced areas are not used for agricultural purposes. The percentages of land devoted to various crops and the agricultural practices are much the same as for Darien silty clay loam, but as a result of the greater difficulty in obtaining good drainage and in cultivation, yields are lower.

Schoharie silt loam.—Fringing the principal Schoharie silty clay loam areas on the south, north, and east are comparatively large bodies of Schoharie silt loam. This soil is well distributed over the northern third of the county and covers an aggregate area of 5.2 square miles.

This soil resembles Schoharie silty clay loam in color, but it differs from that soil in that the texture is lighter throughout and the surface soil and upper subsoil layer are friable silt loam. Near Hunts Corners the surface soil contains more organic matter and is darker than elsewhere. In a large body in the vicinity of Cheektowaga and in smaller areas scattered over the northern third of Erie County the soil is free of gravel and rock. The surface relief of such areas is level.

Probably 60 per cent of Schoharie silt loam is cultivated, 20 per cent is in permanent pasture, 10 per cent is in wood lots, and 10 per cent is unfenced and not used for agricultural purposes. The percentages of cultivated land in various crops, crop yields, and methods of handling and fertilizing the land are essentially the same as for Darien silt loam.

Poygan silty clay loam.—Poygan silty clay loam is closely associated with Schoharie silty clay loam. It is well distributed over the northern third of Erie County, but its aggregate area is small.

The tilled surface soil of Poygan silty clay loam, to a depth of 8 inches, is very dark gray silty clay loam. Underlying this layer is the subsoil of dark-gray plastic silty clay loam, with yellow and gray mottlings, and below a depth of 15 inches is a reddish-purple or purplish-brown plastic silty clay. Below a depth of 30 inches is the substratum of calcareous purple plastic clay or heavy silty clay loam.

Poygan silty clay loam is somewhat like Schoharie silty clay loam in most of its soil characteristics, but is dissimilar in that it has a dark-gray surface soil, with a high content of organic matter, and a somewhat less plastic and a little lighter textured subsoil. Some areas of Poygan silty clay loam are free of gravel and stone.

About 10 per cent of this soil is cultivated, 10 per cent is in permanent pasture, 15 per cent is in wood lots, and 15 per cent is unfenced and unused. Somewhat more corn and less oats are grown than on Schoharie silty clay loam. Where adequate drainage has been installed the yields, particularly of corn, are better than on the Schoharie soil, owing to the higher humus content and the slightly lighter texture of the Poygan soil.

Poygan silt loam.—Poygan silt loam is much like Poygan silty clay loam, except that it has a friable silt loam surface soil and upper subsoil layer and the lower subsoil layer is heavy compact silty clay loam, similar to that of Schoharie silt loam. No pebbles or rock fragments occur throughout the surface soil and subsoil. A variation from the typical soil, in which crystalline pebbles and bowlders occur in the surface soil and upper subsoil layer and limestone fragments in the lower subsoil layer, occurs in small areas southeast of Getzville and in the northeastern corner of the county.

Poygan silt loam areas are well distributed over the northern third of the county. About 30 per cent of the land is cultivated, 50 per cent is in permanent pasture, 10 per cent is in woodland, and 10 per cent is in commons. About the same percentage of land is devoted to hay as of Schoharie silt loam, but a little more is planted to silage corn and cabbage. Less oats are grown on Poygan silt loam than on the Schoharie soils. The high content of organic matter renders this soil especially well suited to silage corn and cabbage.

Mahoning silty clay loam.—Mahoning silty clay loam is like Darien silty clay loam in color and texture. The main differences between the soils are the higher degree of acidity of the Mahoning soil and the greater depth to calcium carbonate in the subsoil.

Mahoning silty clay loam occurs on valley slopes north of Dutchtown, southeast of Boston, around Collins Center, and in smaller valley and plains areas well distributed over the southern half of Erie County. It covers a total area of 31.6 square miles.

A light-textured variation of Mahoning silty clay loam occurs in large areas occupying undulating or gently sloping to hilly positions south of Concord, south of Holland, and in the vicinity of Dutchtown, and in small areas near Chafee. It differs from the typical soil in having a lighter-textured surface soil and subsoil and consequently better natural drainage and better soil tilth.

A heavier-textured variation of Mahoning silty clay loam is like the typical soil in color, but the surface soil is heavy plastic silty clay which is underlain by a very plastic silty clay subsoil. This variation occurs on the valley slopes north of Dutchtown.

About 60 per cent of Mahoning silty clay loam is cultivated, 30 per cent is in permanent pasture, and 10 per cent is in woodland. The percentages of various crops and the agricultural practices are much like those reported for Darien silty clay loam, but the yields are somewhat less. This is, in part, owing to the lower content of organic matter and to the acid surface soil.

Mahoning silt loam.—Mahoning silt loam corresponds to Mahoning silty clay loam in soil color and character of the lower subsoil layer, but it differs from that soil in having a friable silt loam surface soil and upper subsoil layer.

This soil occurs in large undulating areas east and northeast of Hamburg and northwest of East Concord. About 60 per cent of the land is tilled, 35 per cent is in permanent pasture, and 5 per cent is in woodland. The percentages of the cultivated soil used for various crops and the agricultural practices are very much like those for Mahoning silty clay loam, but yields are higher, owing to the lighter texture of the surface soil and upper subsoil layer, which allows better aeration and drainage.

Mahoning silt loam, steep phase.—The steep phase of Mahoning silt loam comprises an aggregate area of 8.9 square miles, and it occurs on steep valley sides and steep escarpments in the outwash plains and valley fills of Cattaraugus Valley in the extreme south-central and southeastern parts of the county. It differs from the typical soil in having a thinner surface soil, due to erosion. It is used only for permanent pasture and wood lots.

Caneadea silty clay loam.—Caneadea silty clay loam is closely related to Fulton silty clay loam, both in color and texture, but it differs from the Fulton soil in having an acid surface soil. Where cultivated and under normal moisture conditions, the surface soil, to a depth of 8 inches, is gray plastic silty clay loam with yellowish-brown and brownish-yellow mottlings. The subsoil is gray plastic silty clay which, at a depth of about 30 inches, is underlain by the mottled gray and yellowish-brown calcareous substratum.

Caneadea silty clay loam occurs in fairly large bodies in the southwestern part of Erie County, and a number of small areas, con-

tiguous to drainage courses, are well distributed over the southern half of the county.

About 30 per cent of the land is cultivated, 60 per cent is in permanent pasture, and 10 per cent is in woodland. The relative acreages of cultivated land in various crops and the agricultural practices are similar to those on Darien silty clay loam, but, on account of poorer run-off and underdrainage, less organic matter in the surface soil, and the acid condition of the soil, yields are lower than on the Darien soil.

Caneadea silt loam.—Associated with Caneadea silty clay loam and occurring on an old lake plain in the southwestern corner of the county and along many stream courses throughout the southern half, is Caneadea silt loam. Its total area is 18 square miles.

This soil differs from Caneadea silty clay loam in having a friable silt loam surface soil, a silt loam upper subsoil layer, and a compact but not so heavy-textured silty clay loam lower subsoil layer. Areas in which the surface soil is more shallow than typical occur along the shore of Lake Erie.

About 60 per cent of Caneadea silt loam is tilled, 35 per cent is in permanent pasture, and 5 per cent is in wood lots. Similar relative acreages are devoted to certain crops and about the same agricultural practices are followed as on Caneadea silty clay loam. The friability of the surface soil, its better texture, and the better surface and internal drainage allow better development of seed beds and make the soil more productive than the silty clay loam. In places, particularly between Collins and Hamburg, the land is used largely for truck crops, as it is situated in the principal trucking district of the county.

Caneadea very fine sandy loam.—Caneadea very fine sandy loam differs from Caneadea silt loam in having a very fine sandy loam surface soil and upper subsoil layer. The lower subsoil layer consists of interbedded very fine sandy loam, loam, silt loam, and very fine sand.

This soil occurs southeast and northeast of Pontiac. It is very inextensive.

Dunkirk silt loam.—Dunkirk silt loam differs from Caneadea silt loam in its greater friability, better aeration and drainage throughout, and in that it is fairly compact but not heavy in the lower part of the subsoil.

Under cultivation and normal moisture conditions Dunkirk silt loam, to a depth of 8 inches, consists of light grayish-brown friable silt loam which is underlain by a yellowish-brown friable silty clay loam subsoil containing gray mottlings. The subsoil rests, at a depth of about 36 inches, on the calcareous yellowish-brown silty clay loam substratum.

An area of Dunkirk silt loam, including perhaps 80 acres, in which the land is very badly dissected and the surface soil is partly washed away, lies north of New Oregon.

Dunkirk silt loam is inextensive. It occurs on terraces along streams. About 85 per cent of the land is cultivated, 12 per cent is in permanent pasture, and 3 per cent is in wood lots. Essentially the same crops are produced and the same agricultural practices are

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followed as on Caneadea silt loam, but, owing to the better drainage and more favorable texture of the Dunkirk soil, yields are better.

Dunkirk silt loam, eroded phase.—Dunkirk silt loam, eroded phase, occurs in fairly large areas in the hilly morainic region around Protection. It is similar to Dunkirk silt loam in color, texture, and compactness of the surface soil, upper subsoil layer, and lower subsoil layer, but it differs from the typical soil in that it is situated on steep slopes and narrow ridges, where erosion has removed part of the surface soil.

About 70 per cent of Dunkirk silt loam, eroded phase, is cultivated, 15 per cent is in permanent pasture, and 15 per cent is in wood lots. General farming, in conjunction with dairying, is the leading type of agriculture. Yields are a little lower than on typical Dunkirk silt loam, owing to the partial washing away of the surface soil, thus reducing the quantity of organic matter, which has resulted in a diminution of fertility.

Angola silty clay loam.—Angola silty clay loam occurs in large bodies in the undulating or gently rolling plains region which extends northeastward from Irving across the county to and beyond Williston. It covers a total area of 51.6 square miles.

The 8-inch surface soil where tilled and under normal moisture conditions consists of grayish-brown or yellowish-brown silty clay loam. The subsoil is grayish-brown silty clay loam, with brown and gray mottlings, underlain by heavy plastic gray, mottled with yellowish-brown, silty clay loam. At a depth ranging from 36 to 48 inches is the gray calcareous shale substratum.

Between Hamburg and Fenton, areas which aggregate about 3½ square miles comprise a light-textured variation of Angola silty clay loam. Here the soil differs from the typical soil in having a heavy friable silt loam surface soil, a friable silty clay loam upper subsoil layer, and a friable compact silty clay loam lower subsoil layer containing considerable sand.

About 50 per cent of the land is tilled, 40 per cent is in permanent pasture, and 10 per cent is in wood lots. Crops, yields, and agricultural practices are much the same as on Mahoning silty clay loam. Owing to the friability of the soil and the better drainage throughout, the light-textured areas of Angola silty clay loam are decidedly more productive than the typical soil. About 70 per cent of the light-textured soil is cultivated, part of which is used for general farming and the rest for truck crops and grapes. In some places the soil is darker colored than typical Angola silty clay loam. About 5 per cent of such soil is drained and is under cultivation. On account of the greater supply of organic matter in the surface soil, it is more productive than the typical soil.

Alden silty clay loam.—Alden silty clay loam occurs in shallow basins which dot large tracts of Angola silty clay loam. It occupies many small areas.

Alden silty clay loam differs from Angola silty clay loam mainly in its dark-gray color, large quantity of organic matter in the surface soil, and extremely poor drainage throughout.

A variation from the typical soil lies northwest of East Evans. Here, the chief difference is in the dark-brown color of the subsoil, caused by small fragments of dark-brown shale. Southwest of Elma

Center, south of Marilla, and in the vicinity of Williston, are small scattered areas of this soil, in which the surface soil and subsoil are more friable than typical.

Allis silty clay loam.—East and south of the main Angola silty clay loam areas are large areas of Allis silty clay loam. This soil occurs on slopes ranging from gentle to steep and on broad ridges in the hilly section of the county between North Collins and Blanchard Hill. Small areas are on gentle slopes and low ridges in the vicinities of North Evans, Newtown, and Derby.

The tilled soil of Allis silty clay loam, under normal moisture conditions, to a depth of 8 inches is gray silty clay loam with some mottlings of grayish yellow. Beneath this is plastic silty clay of similar color. This layer, at a depth of about 24 inches, rests on gray shale.

This soil is, in general, very much like Angola silty clay loam, but it differs from that soil in that it has a high degree of acidity in the surface soil, subsoil, and underlying formation and less organic matter in the surface soil.

About 10 per cent of the land is cultivated, 50 per cent is in permanent pasture, and 40 per cent is in woodland. The cultivated soil is used for the production of small grains, grapes, and silage corn, and for meadow. Oat yields average about 32 bushels an acre, timothy three-fourths ton of hay, buckwheat 15 bushels, and silage corn 6 tons. The smaller yields of grain and silage than those obtained on Angola silty clay loam are owing to the higher degree of acidity and lower content of organic matter in the surface soil.

FRIABLE WELL-DRAINED SOILS

The third subgroup, which is composed of friable well-drained soils, includes Wooster silt loam, Farmington silt loam, and Farmington silt loam, dark-colored phase.

Wooster silt loam.—The cultivated soil of Wooster silt loam, under normal moisture conditions, is dark-brown very acid friable silt loam, underlain by a very acid brown friable slightly compact upper subsoil layer, and this, in turn, by a grayish-brown acid friable fairly compact lower subsoil layer which contains many shale and very fine grained sandstone fragments and some crystalline gravel. A very noticeable quantity of fine sand and very fine sand occurs throughout the surface soil and subsoil.

This soil covers a total area of 27.8 square miles. It occurs on gentle to steep valley slopes and on the lower-lying ridges of the valleys in the southeastern quarter of the county.

About 30 per cent of Wooster silt loam is tilled, 45 per cent is in permanent pasture, and 25 per cent is in woodland. The trees, crops, yields, and agricultural practices are essentially the same as on Langford silt loam, except that potatoes are grown more extensively.

Farmington silt loam.—Farmington silt loam, like Wooster silt loam, is well drained throughout but differs from the Wooster soil in having a grayish-brown, dark grayish-brown, or reddish-brown surface soil and a reddish-brown or brown compact friable silt loam subsoil, resting on cherty limestone at a depth ranging from 12 to 42

inches but averaging about 24 inches. Small irregular fragments of chert, ranging from one-fourth inch to 6 inches in diameter, and larger fragments of limestone are embedded in both the surface soil and subsoil. In places where the cherty limestone lies more than 3 feet below the surface numerous variations from typical occur, in which the lower subsoil layer shows some plasticity and poor or only fair drainage.

This soil is well distributed over the limestone ridge extending northeastward from Buffalo into Genesee County. The land ranges from level to undulating, except on the comparatively steep north escarpment.

About 50 per cent of Farmington silt loam is cultivated. Most of the remainder was once cleared and tilled but is now in permanent pasture. Large areas within 10 miles of Buffalo are unfenced and are lying idle. Small wood lots support a growth of hard maple, beech, white ash, hemlock, hickory, oak, and locust.

The production of general farm crops in support of dairying is the leading type of agriculture practiced, although some potatoes and other truck crops are grown. Crop yields are about the same as those on Wooster silt loam. In places where the limestone is within less than 2 feet of the surface, crops suffer seriously from drought.

Farmington silt loam, dark-colored phase.—A dark-colored phase of Farmington silt loam is mapped in a small wooded area one-half mile east of Gunnville.

HEAVY-TEXTURED SOILS UNDERLAIN BY SANDY AND GRAVELLY MATERIAL

The fourth subgroup includes soils having heavy-textured surface soils and upper subsoil layers and sandy or gravelly lower subsoil layers. This subgroup includes the heavy members of the Chenango, Mentor, Tonawanda, Wolcottsburg, Braceville, Newton, Maumee, and Lorain series. The members of the first three series have light-colored surface soils which have a comparatively low content of organic matter, and the members of the remaining series have dark-colored surface soils which have a high content of organic matter. The surface relief of all these soils is flat.

The Chenango and Mentor soils have good surface and internal drainage, brown or grayish-brown friable surface soils, and grayish-brown or grayish-yellow friable slightly compact subsoils. Both surface and internal drainage of Tonawanda silty clay loam, and of the Wolcottsburg, Lorain, Newton, and Maumee soils are very poor. That of Tonawanda and Braceville silt loams ranges from fair to poor. Although calcareous materials may underlie the Chenango, Newton, Lorain, and Mentor soils at a depth ranging from 45 to 60 inches, the surface soils are very acid, the upper subsoil layers are acid, and the lower subsoil layers are neutral. Calcareous materials underlie the Tonawanda, Maumee, and Wolcottsburg soils at a depth ranging from 18 to 30 inches. The surface soils of these soils are neutral or slightly acid, the upper subsoil layers are neutral, and the lower subsoil layers are calcareous.

On the better-drained areas of these soils, hard maple, beech, hemlock, white ash, basswood, and wild cherry constitute the principal

tree growth. The dominant tree growth on the poorly drained soils includes soft maple, white elm, and black ash.

Chenango silt loam.—Chenango silt loam is the most extensive soil of this subgroup. It covers a total area of 15.9 square miles, and is well distributed on stream terraces throughout the southern half of Erie County.

Under normal moisture conditions the cultivated soil of Chenango silt loam, to a depth of 8 inches, is brown mellow very acid silt loam. Underlying this is brownish-yellow friable silt loam which becomes distinctly heavier and more compact below a depth of 15 inches. At a depth of about 20 inches this material grades into loam or gravelly loam and rests, at a depth of about 40 inches, on stratified beds of gravel and sand, which are calcareous below a depth of 45 inches.

Areas in which the surface soil is dark brownish gray and is high in organic matter occupy a total area of about 100 acres north of Griffins Mills.

About 95 per cent of the land is cultivated, of which about half is used for general farm crops, such as hay, small grain, and corn, and half for truck crops, such as berries, grapes, potatoes, beans, tomatoes, cabbage, cucumbers, beets, carrots, parsnips, squashes, peppers, lettuce, currants, raspberries, and strawberries. Oat yields range from 30 to 50 bushels an acre, and wheat yields average about 15 bushels. Mixed timothy and clover hay averages about 1 ton an acre, buckwheat 19 bushels, corn 35 bushels, potatoes 115 bushels, and beans 18 bushels.

Chenango silt loam, gravelly phase.—A gravelly area of Chenango silt loam lies west of Orchard Park. It is like the typical soil, except that it has much more gravel embedded in the surface soil and subsoil and scattered over the surface.

Mentor silt loam.—Mentor silt loam resembles Chenango silt loam in color and texture but is dissimilar in that the lower subsoil layer is friable silt loam underlain by brownish-yellow loam.

This soil occurs on terraces along streams north of Brant. About 95 per cent of the land is under cultivation, principally to truck crops, berries, and grapes. Yields are comparable to those reported for Chenango silt loam.

Mentor sandy loam.—Mentor sandy loam is developed on stream terraces in the southwestern part of Erie County. It resembles Chenango silt loam, gravelly phase, in the color and good drainage of both its surface soil and subsoil.

The cultivated soil of Mentor sandy loam to a depth of 8 inches is brown sandy loam. It is underlain by brownish-yellow or yellowish-brown sandy loam which is well stratified at a depth ranging from 25 to 30 inches and at a depth of 44 inches is calcareous.

Probably 95 per cent of the land is tilled and is used mainly for truck crops, grapes, and berries.

Braceville silt loam.—South of Fenton along Cattaraugus Creek and forming the north border of Chenango silt loam areas, are bodies of Braceville silt loam. This soil has a dark-gray loamy silt loam surface soil overlying a gray subsoil of gravelly loam which continues downward to a depth of 5 feet or deeper. The soil is very acid throughout.

About 85 per cent of Braceville silt loam is tilled, and the remainder is in permanent pasture and wood lots. Crops and agricultural practices are similar to those reported for Mentor silt loam, but yields, because of poorer drainage, are somewhat lower.

Lorain silty clay loam.—Lorain silty clay loam resembles Toledo silty clay loam in color of the surface soil, but it differs from that soil in that the surface soil is more friable and the subsoil is composed of stratified silty clay loam, silt loam, loam, and very fine sandy loam.

Under normal moisture conditions, the cultivated soil consists of an 8-inch layer of very dark gray or dark-gray friable silty clay loam which is underlain by gray friable silty clay loam, mottled with brownish yellow. With increasing depth the subsoil becomes more friable and lighter in texture and, at a depth ranging from 30 to 38 inches, rests on a substratum consisting of mottled gray and yellowish-brown calcareous laminated silty clay.

This soil occurs in low flat areas, along drainage courses and elsewhere, north of Eden and east of Hamburg.

About 30 per cent of Lorain silty clay loam is cultivated, 60 per cent is in permanent pasture, and 10 per cent is in woodland. The crops, handling of the soil, and yields are about like those on Toledo silty clay loam, but reclamation of this land by artificial drainage is less difficult because of the more open subsoil.

Newton silt loam.—Newton silt loam, like Chenango silt loam, is well distributed on stream terraces over the southern half of the county.

The surface soil of Newton silt loam, under normal moisture conditions, is loamy dark-gray silt loam. It grades into mottled gray, yellow, and brown silt loam which becomes more compact with increasing depth and rests, at a depth ranging from 20 to 30 inches, on fine sandy loam material underlain by stratified beds of sand and gravel. An area of about 20 acres north of North Collins has been included with Newton silt loam in mapping. The soil of this area differs from Newton silt loam in having a black surface soil containing a much larger quantity of organic matter than typical. Another variation, that is more or less interspersed throughout this soil and predominates in many places, occurs in areas in which a silt loam or silty clay loam layer begins at a depth ranging from 34 to 40 inches and extends to a depth of 60 or more inches.

About 80 per cent of Newton silt loam is cultivated. Truck crops, silage corn, mixed alsike and timothy hay, and oats, named in the order of their importance, are the leading crops.

Tonawanda silt loam.—Of the soils in this subgroup, Tonawanda silt loam ranks next to Chenango silt loam in extent, covering a total area of 13.4 square miles. It occurs in large areas along Tonawanda Creek and in smaller areas along Cayuga Creek.

Under normal moisture conditions the tilled soil of Tonawanda silt loam to a depth of 8 inches is light yellowish-gray or grayish-brown mellow neutral or slightly acid silt loam. Beneath this is light grayish-yellow somewhat compact but very friable silt loam which, at a depth ranging from 13 to 18 inches, is cream colored with yellowish-brown mottlings. This layer is underlain by very compact mottled yellowish-gray and yellowish-brown very fine sandy

loam. Many areas of this soil are inundated during periods of extremely high water.

Areas of a lighter-textured soil mapped as Tonawanda silt loam occur along Ellicott and Tonawanda Creeks, west and northwest of Getzville. This soil differs from typical Tonawanda silt loam in having a more friable and lighter texture throughout the surface soil and subsoil.

About 80 per cent of Tonawanda silt loam is cultivated, and the remainder is used for permanent pasture and wood lots. General farming in conjunction with dairying is the chief type of agriculture, except near Tonawanda where much attention is devoted to trucking, especially on the light-textured areas. The most important crops produced on the soil are small grains, mixed clover and timothy, and corn for silage. Practically all the hay and grain, except wheat and buckwheat, is fed to livestock on the farms. According to estimates of farmers in the dairy section, there is one dairy cow to each 12 acres of this soil.

On Tonawanda silt loam oats yield from 40 to 60 bushels an acre, wheat from 15 to 30 bushels, hay from 1 to 2 tons, potatoes from 80 to 120 bushels, cabbage from 8 to 12 tons, beans from 14 to 20 bushels, and alfalfa from 1½ to 3 tons. Because of better drainage, the light-textured soil warms up earlier and is a little more productive than the typical soil.

Tonawanda silty clay loam.—Associated with areas of Tonawanda silt loam are areas of Tonawanda silty clay loam. This soil differs from Tonawanda silt loam in having a light-gray somewhat plastic neutral silty clay loam surface soil, a mottled light-gray, brown, and yellowish-brown somewhat plastic silty clay loam upper subsoil layer, and a grayish-white or very light gray calcareous silty clay loam lower subsoil layer which rests on calcareous grayish-brown very fine sandy loam. Like Tonawanda silt loam, this soil is subject to rather infrequent inundations.

About 70 per cent of Tonawanda silty clay loam is cultivated, 25 per cent is in permanent pasture, and 5 per cent is in wood lots. General farming and dairying are the prevailing types of agriculture, and farming operations for the most part center around the production of feed crops for use on the farm. Crop yields are somewhat lower than on Tonawanda silt loam, owing to the heavier-textured and more plastic surface soil and subsoil, which impede drainage and make cultivation more difficult.

Wolcottsburg silt loam.—More or less intermingled with and bordering areas of Tonawanda silt loam and Tonawanda silty clay loam are areas of Wolcottsburg silt loam.

Under normal moisture conditions the cultivated soil of Wolcottsburg silt loam to a depth of 8 inches consists of dark-gray neutral mellow silt loam. The subsoil is light grayish-yellow somewhat compact friable silt loam with light-gray and brownish-yellow mottlings, and the underlying material is grayish-brown calcareous very fine sandy loam with gray mottlings. At times of excessively high floods a large part of this soil is overflowed.

About 50 per cent of the land is under cultivation, 30 per cent is in permanent pasture, and the remainder is in wood lots.

The leading type of farming consists of growing small grains, mixed timothy and alsike clover, and silage corn in conjunction with dairying, and a considerable acreage is devoted to trucking. With proper drainage, silage corn and many truck crops do better than on Tonawanda silt loam, largely because of the greater supply of organic matter; but for the same reason the stalks of small grains become too heavy and lodge.

Wolcottsburg silty clay loam.—Wolcottsburg silty clay loam is unlike Wolcottsburg silt loam in that it has a surface soil of dark-gray rather plastic silty clay loam underlain by a subsoil of similar texture and consistence. Probably once in five years most of this soil is subject to overflow from Tonawanda Creek.

About 30 per cent of the land is drained and cultivated, 40 per cent is in permanent pasture, and 30 per cent is in woodland. Crops and farm practices are similar to those on Wolcottsburg silt loam, but yields are lower because of the heavier and somewhat plastic surface soil which does not pulverize readily except within a very narrow range of moisture conditions.

Maumee silt loam.—Maumee silt loam occurs in broken areas along the southern boundaries of Wolcottsburg and Tonawanda silt loam and silty clay loam areas. It differs from Wolcottsburg silt loam in its very dark gray or almost black friable and, in some places, mucky surface soil and the dominant gray color of the upper subsoil layer. Almost all of this soil is subject to annual inundation.

About 30 per cent of Maumee silt loam is cultivated, 50 per cent is in permanent pasture, and 20 per cent is in woodland. The crops grown, yields, and farm practices are similar to those on Wolcottsburg silt loam.

SANDY AND GRAVELLY SOILS

The sandy and gravelly soils may be separated into (1) well-drained soils and (2) poorly drained soils.

WELL-DRAINED SOILS

To the first of these subgroups belong the members of the Berrien, Cazenovia, Groton, Palmyra, Ontario, Otisville, and Ottawa series and the lighter-textured members of the Chenango, Farmington, Schoharie, Tonawanda, and Wooster series. All these soils have light-colored surface soils. The surface relief of the Chenango, Palmyra, Schoharie, and Tonawanda soils is level; of the Berrien, Cazenovia, Ontario, Ottawa, and Farmington soils is undulating or gently rolling; and of the Groton, Otisville, and Wooster soils is rolling and broken. In the Groton and Ontario soils, calcareous material lies within a depth ranging from 30 to 36 inches from the surface; in the Palmyra, Cazenovia, Schoharie, and Tonawanda soils, within a depth ranging from 3 to 4 feet; in the Chenango and Berrien soils, within a depth ranging from 5 to 6 feet; and in the Ottawa, Wooster, and Otisville soils, calcareous material, if present, is below a depth of 6 feet. The Farmington soils differ from the other soils in this subgroup in that they are underlain by a cherty limestone formation within a depth ranging from 1 to 4 feet from the surface. On the loams and sandy loams of the well-drained soils,

the principal tree growth includes hard maple, beech, hemlock, basswood, chestnut, white ash, yellow birch, and wild cherry; and less common trees are white pine, butternut, cucumbertree, whitewood, ironwood, sumac, horsechestnut, bitternut, shagbark, and pignut hickory, red, black, and white oak, red elm, chokecherry, cottonwood, poplar, locust, and white and sweet birch.

The loams and sandy loams of these soil series are more productive than the sands, owing to a larger content of organic matter in the surface soil and a texture more favorable to the maintenance of fertility and the retention of moisture.

In those parts of the county most remote from the Buffalo markets, general farming, in conjunction with dairying, and a small amount of trucking are the leading types of agriculture practiced on these soils; but in other parts, the growing of truck crops, berries, and grapes is more important than general farming and dairying.

In the southwestern quarter of the county about 85 per cent of the land occupied by these soils is cultivated. Of the cultivated land, 15 per cent is devoted to berries; 15 per cent to grapes; and 15 per cent to truck crops, such as potatoes, sweet corn, snap beans, tomatoes, cucumbers, cabbage, beets, carrots, parsnips, squashes, peppers, lettuce, and cauliflower; 20 per cent to small grains, such as oats, wheat, barley, and buckwheat; 30 per cent to mixed timothy and clover; and 5 per cent to corn for silage.

Chenango loam, gravelly phase.—The most extensively developed of the sandy and gravelly soils is Chenango loam, gravelly phase. It covers an aggregate area of 34.4 square miles. It occurs in large areas on stream terraces along Cattaraugus Creek and its tributaries in the southern part of the county. Smaller areas lie on stream terraces well distributed throughout the hilly section of the southeastern part and the plains region of the southwestern quarter of the county.

The cultivated surface soil consists of very acid brown or yellowish-brown friable mellow gravelly loam. The subsoil is brownish-yellow gravelly loam which is fairly compact below a depth of 16 inches. At a depth ranging from 20 to 40 inches are stratified beds of gravel and sand. At a depth of 36 inches the material is neutral, and at a depth of 48 inches it is alkaline in reaction.

This is a warm early soil well suited to the production of early vegetables, potatoes, grapes, berries, and nursery stock. Probably 95 per cent of the land is cultivated. Oat yields average about 40 bushels an acre, hay about 1 ton, silage corn 6 tons, potatoes 110 bushels, cabbage 3 tons, and beans 15 bushels.

Chenango shale loam.—Chenango shale loam bears a close resemblance to Chenango loam, gravelly phase, but differs from that soil in having a larger quantity of angular fragments of shale scattered over the surface and embedded in both the surface soil and subsoil.

Chenango shale loam occurs mainly in the vicinities of Eden, Eden Valley, and Hamburg. Smaller areas are well distributed over the east-central part of the county.

About 98 per cent of the land is cultivated and is used very largely for truck crops, grapes, and berries. Yields, owing to the presence

of more loam and organic matter in the surface soil, are somewhat better than those obtained on Chenango loam, gravelly phase.

Chenango loam.—Chenango loam has much the same soil characteristics as Chenango loam, gravelly phase, but is unlike that soil in that it contains less gravel throughout the soil mass. A dark variation of this soil, about 1 square mile in extent, lies a few miles southwest of Springville. This area differs from the typical soil in having a dark-brown surface soil with a fairly high content of organic matter.

Chenango loam occurs mainly in the vicinity of North Collins, and small areas are near Hamburg.

Crops and agricultural practices are similar to those on Chenango shale loam, and yields are about the same as those reported for Chenango loam, gravelly phase.

Chenango very fine sandy loam.—Chenango very fine sandy loam differs from Chenango loam, gravelly phase, in that it has a surface soil and subsoil almost free from gravel and that it consists of very fine sandy loam to a depth ranging from 2 to 6 feet, beneath which are stratified beds of gravel and sand.

This soil occurs principally on terraces along streams of the plains region between Farnham, North Collins, and Eden.

About 95 per cent of the land is cultivated. The growing of berries, grapes, potatoes, beans, and other truck crops is the leading type of agriculture. Yields are about the same as those obtained on Chenango loam, gravelly phase.

Chenango fine sandy loam.—In the vicinity of Fenton and southeast of Collins are small areas of Chenango fine sandy loam. This soil is similar to Chenango very fine sandy loam in color and thickness of the surface soil and subsoil layers, but it differs from the very fine sandy loam in having a fine sandy loam texture.

Palmyra gravelly loam.—Palmyra gravelly loam is similar to Chenango loam, gravelly phase, in the color and texture of its surface soil and subsoil. It differs from that soil mainly in its slightly acid surface soil and in the presence of much limestone gravel at and below a depth of 2 feet.

To a depth of 8 inches, the cultivated surface soil consists of brown friable gravelly loam. Below this is the subsoil of brownish-yellow or reddish-brown gravelly loam. At a depth ranging from 18 to 22 inches, the material is somewhat plastic, and at a depth ranging from 30 to 34 inches it rests on stratified beds of calcareous sand and gravel.

An area of Palmyra gravelly sandy loam, including about 1 square mile and occurring on an old glacial lake beach immediately northeast of Elma Center, has, because of its small extent, been included with Palmyra gravelly loam in mapping. Except for the gravelly sandy loam texture of the surface soil and subsoil this area is similar to typical Palmyra gravelly loam.

Palmyra gravelly loam occurs in that part of the plains region lying south of Clarence and Crittenden and north of Wales Center, East Aurora, and Orchard Park. It occurs on old glacial lake beaches, on terraces along streams, and on glacial outwash plains.

About 95 per cent of the land is cultivated. It is devoted partly to the production of oats, wheat, red clover, alsike, timothy, alfalfa,

and silage corn, in conjunction with dairying, and partly to potatoes and beans, with smaller acreages of tomatoes, sweet corn, peas, turnips, carrots, onions, parsnips, cabbage, cauliflower, apples, pears, and berries.

Owing to a little more humus and less acidity in the surface soil, yields are a little better on this soil than on Chenango loam, gravelly phase.

Palmyra loam.—Palmyra loam is like Palmyra gravelly loam except in the texture of the surface soil and subsoil, which are loam instead of gravelly loam. The two soils are closely associated between Orchard Park and Alden.

About 95 per cent of this soil is under cultivation. The crops grown, yields, and agricultural practices are practically the same as on Palmyra gravelly loam.

Palmyra shaly loam.—Palmyra shaly loam is similar to Chenango shale loam in color, texture, and consistence of both surface soil and subsoil, but it is unlike that soil in that it contains limestone gravel within a depth ranging from 30 to 36 inches from the surface and has a slightly acid surface soil, a neutral upper subsoil layer, and an alkaline reaction of the soil material at a depth of about 3 feet.

This soil occurs between Porterville and Marilla and northwest of East Aurora. About 98 per cent of the land is cultivated. Crops and farm practices are practically the same as on Palmyra gravelly loam, but yields are a little better. This is probably owing to a little more organic matter and loam in the surface soil, both of which are conducive to the maintenance of fertility and to a greater water-holding capacity.

Palmyra very fine sandy loam.—Palmyra very fine sandy loam is closely associated with Palmyra loam and occurs principally in a succession of long narrow areas between Elma and Crittenden. It resembles Palmyra loam in color, but is unlike that soil in that it has a very fine sandy loam texture and less silt in both the surface soil and subsoil.

A variation covering about one-fourth square mile is south of Elma where, below a depth of 2 feet, the soil material is yellowish-brown or brownish-yellow very fine sandy loam with some gray mottlings which indicate rather poor drainage.

About 95 per cent of the land is cultivated. Crops, yields, and farm practices are essentially the same as on Palmyra gravelly loam.

Palmyra fine sandy loam.—Palmyra fine sandy loam is similar to Palmyra very fine sandy loam in the color and thickness of the surface soil and subsoil layers, but it differs from that soil in having a fine sandy loam texture, less organic matter, and less silt in the surface soil and a fine sandy loam texture and less silt in the subsoil.

This soil occurs in comparatively large irregular-shaped areas between Doyle and Town Line, but from Town Line to the Genesee County line the areas constitute a series of long narrow belts extending northeast and southwest.

About 95 per cent of the land is cultivated. The same crops are grown and the same agricultural practices followed as on Palmyra loam and Palmyra very fine sandy loam, but yields are somewhat lower, probably owing to the lighter texture of the soil material and the lower content of organic matter in the surface soil, both condi-

tions tending toward more rapid leaching and inability of the soil to hold water and maintain fertility.

Tonawanda loam.—On the border of the large area of Palmyra fine sandy loam east of Doyle, a large area of Tonawanda loam lies on the south terrace of Cayuga Creek. Smaller areas occur north of Swifts Mills and on terraces along Ellicott Creek near Alden.

The cultivated soil of Tonawanda loam, when dry, is grayish-brown or yellowish-brown friable mellow loam underlain by brownish-yellow or light-yellow slightly compact but very friable loam. Below a depth of 18 inches faint mottlings of yellowish gray and yellowish brown occur, and at a depth ranging from 20 to 24 inches, the subsoil rests on stratified beds of very fine sandy loam and fine sandy loam. Small areas of Tonawanda very fine sandy loam, occurring 1 mile southeast of Bellevue and 1½ miles east of Wolcottsburg, are included in this soil as mapped. They differ from the typical soil only in having a very fine sandy loam texture in both the surface soil and subsoil.

Most of the areas of Tonawanda loam along Cayuga Creek are submerged annually when the flood waters are very high.

About 50 per cent of this soil is cultivated, 40 per cent is in permanent pasture, 5 per cent in wood lots, and 5 per cent in commons. About the same crops are grown and similar yields are obtained as on Palmyra gravelly loam.

Schoharie loam.—Schoharie loam differs from the Palmyra and Tonawanda soils in having a brownish-gray friable surface soil. The subsoil is yellowish-brown friable somewhat compact loam or very fine sandy loam which, at a depth of about 30 inches, rests on reddish-pink or pink calcareous plastic silty clay loam or plastic silty clay.

Schoharie loam occurs in small areas between Akron, Sand Hill, and Harris Hill and in still smaller areas between Clarence and Crittenden.

About 80 per cent of this soil is cultivated, 15 per cent is in permanent pasture, and 5 per cent is in wood lots. General farming, including dairying, in conjunction with trucking, is the common practice. The principal crops grown are oats, hay, silage corn, beans, and potatoes. Yields are about the same as those obtained on Palmyra gravelly loam.

Schoharie loam, light-textured phase.—Schoharie loam, light-textured phase, occurs in large areas in the northeastern quarter of the county. It differs from typical Schoharie loam in having a surface soil and subsoil with a very fine sandy loam texture. Its aggregate area is 29 square miles.

Cazenovia loam.—Cazenovia loam is closely associated with Schoharie loam. It occurs in large areas in the northeastern quarter of the county and aggregates 26.3 square miles.

Under normal moisture conditions the cultivated soil of Cazenovia loam consists of grayish-brown or dark grayish-brown loam or light friable silt loam. The upper subsoil layer is brownish-yellow, grayish-yellow, or light purplish-brown friable loam underlain by a lower subsoil layer of brownish-yellow, grayish-yellow, or purplish-brown compact loam. In places, a cherty limestone formation lies at a depth ranging from 40 to 50 inches.

About 60 per cent of Cazenovia loam is cultivated. Some areas, once cleared, are now used for permanent pasture, and others are covered with small wood lots. This soil is devoted largely to the production of small grain, hay, and silage corn in support of dairying, but a small acreage is used for beans, potatoes, cabbage, and other truck crops. Oats yield from 40 to 60 bushels an acre, wheat from 12 to 20 bushels, mixed clover and timothy from 1 to 1½ tons, alfalfa from 2 to 3 tons, potatoes from 75 to 100 bushels, cabbage from 7 to 9 tons, and beans from 3 to 6 bushels.

Cazenovia silt loam.—From 1 to 4 miles north of East Aurora are small areas of Cazenovia silt loam. This soil differs from Cazenovia loam in having a silt loam surface soil and upper subsoil layer.

Ontario gravelly loam.—Bordering Palmyra gravelly loam south of Clarence is a large area of Ontario gravelly loam. Smaller areas occur within large areas of Cazenovia loam around Akron.

Both the surface soil and subsoil of Ontario gravelly loam are similar to the corresponding layers of Palmyra gravelly loam, except for the presence of many large crystalline bowlders and large irregular fragments of limestone.

Where cultivated under normal moisture conditions, Ontario gravelly loam consists of brown friable gravelly loam which is underlain by a brownish-yellow or reddish-brown friable gravelly loam subsoil. With increasing depth the material becomes somewhat plastic and heavier and grades downward, at a depth of about 32 inches, into stratified beds of calcareous sand and gravel.

About 95 per cent of this soil is cultivated. Essentially the same crops are grown, yields obtained, and agriculture practiced as on Palmyra gravelly loam.

Berrien fine sandy loam.—Berrien fine sandy loam resembles Palmyra fine sandy loam in both the color and texture of the surface soil and subsoil, but it differs from that soil in that very little gravel is present and stratified beds of sand but no beds of gravel underlie it. In many places, at a depth ranging from 5 to 7 feet, plastic silty clay loam is present.

Under normal moisture conditions cultivated Berrien fine sandy loam, to a depth of 8 inches, is grayish-brown fine sandy loam. Below this is the subsoil of yellow or yellowish-brown loamy fine sand which, at a depth of 30 inches, is splotched brown, yellow, and gray. This material, at a depth of about 50 inches, rests on a substratum of gray calcareous laminated silty clay.

The principal occurrences of Berrien fine sandy loam are in the northeastern and southwestern corners of the county. Smaller areas are in the vicinity of Bowmansville.

About 85 per cent of the land is cultivated. About the same crops are grown and the same type of agriculture is practiced as on Ontario gravelly loam, but yields are lower, because of the greater porosity of both surface soil and subsoil and the smaller content of organic matter in the surface soil. These conditions are conducive to rapid leaching, low water-holding capacity, and inability to maintain fertility.

Berrien very fine sandy loam.—Berrien very fine sandy loam is similar to Berrien fine sandy loam in color and character of the sub-

strata, but it differs from that soil in that it has a fine sandy loam surface soil and subsoil and a higher content of organic matter in the surface soil. An area of heavy-textured soil, which occurs south of Williamsville and covers about one-third square mile, is included with this soil in mapping. The texture of the surface soil of this area is loam and that of the subsoil is distinctly heavier than that of typical Berrien very fine sandy loam.

Berrien very fine sandy loam occurs on terraces along drainage courses, on old glacial lake beaches, and in morainic areas throughout the extreme northern part of the county. Smaller areas are in the vicinity of Alden.

About 85 per cent of this soil is cultivated. Crops and farm practices are about the same as on Berrien fine sandy loam, but yields are higher, as a result of the finer texture and larger content of organic matter, which give the soil greater water-holding capacity and make it easier to increase and maintain the productiveness.

Ottawa very fine sand.—Bordering areas of Berrien very fine sandy loam, in the vicinities of Getzville, Swormville, and Sand Hill, are areas of Ottawa very fine sand. This soil occurs on low morainic ridges and old glacial lake beaches.

Under normal moisture conditions the cultivated soil of Ottawa very fine sand consists of brown loamy very fine sand which grades downward into yellowish-brown very fine sand showing some compaction below a depth of 14 inches.

In the Tonawanda Indian Reservation and north of Swifts Mills are small areas of Ottawa fine sand, aggregating three-fourths square mile, which because of their small extent are included on the soil map with Ottawa very fine sand. Because of its leachy character this soil is practically all in woodland.

About 20 per cent of Ottawa very fine sand is cultivated. It is used in the production of oats, rye, wheat, cabbage, beans, potatoes, and hay. It is a very warm and early soil, but because of its porosity and the low content of organic matter in its surface soil, yields are lower than those obtained on the very fine sandy loam or fine sandy loam soils of the county.

Farmington loam.—Bordering and intermingled with the larger areas of Cazenovia loam, Farmington silt loam, and Ontario gravelly loam are extensive areas of Farmington loam. The aggregate area of this soil is 9.9 square miles.

The cultivated soil of Farmington loam, under normal moisture conditions, is grayish-brown or reddish-brown friable loam. The subsoil is brown or reddish-brown friable loam which, at a depth ranging from 10 to 50 inches but averaging about 24 inches, rests on a cherty limestone formation. Scattered over the surface and embedded in the surface soil and subsoil are numerous small angular pieces of chert, and outcrops of cherty limestone are numerous. Covering an area of about one-fourth square mile 1½ miles southeast of Williamsville is a body of soil mapped with this soil that is darker colored than the typical soil. The soil in this area differs from Farmington loam in having a dark-gray poorly drained surface soil high in organic matter and a mottled gray, brown, and yellow poorly drained subsoil. An area of light-textured soil lying immediately south of Wilhelm and covering approximately one-half

square mile is also included. The soil in this area differs from Farmington loam in having a very fine sandy loam texture in both the surface soil and subsoil.

About 50 per cent of Farmington loam is cultivated. Probably 10 per cent is in wood lots, and the remainder, having once been cleared, is now in permanent pasture, except between Clarence and Buffalo where large areas are unfenced and lying idle. Crops and agricultural practices are similar to those on Farmington silt loam, but yields are slightly lower on account of greater porosity throughout the surface soil and subsoil. This tends to lower the ability of the soil to withstand droughts and maintain its fertility.

Farmington cherty loam.—Farmington cherty loam differs from Farmington loam in that a much higher content of sharp angular chert fragments are strewn over the surface and are embedded in both the surface soil and subsoil, forming from 10 to 70 per cent of the soil mass; that outcrops of the cherty limestone are far more numerous; and that the underlying cherty limestone formation is within a depth ranging from 10 to 20 inches below the surface.

The larger areas of Farmington cherty loam border Farmington loam and Farmington silt loam areas on the north, and they include much of the escarpment and more elevated parts of the limestone ridge which extends through Snyder and Akron.

Although 80 per cent of the land has been cleared, very little is cultivated. Its principal use is for pasture, but large areas within 10 miles of Buffalo have been abandoned for all agricultural purposes and are being held by real estate companies for future subdivision. The soil is extremely droughty, and the abundance of sharp angular chert fragments makes cultivation very difficult.

Wooster gravelly loam.—Wooster gravelly loam resembles Chenango loam, gravelly phase, in color, texture, and drainage but differs from that soil in that it has a thinner surface soil with a lower content of organic matter. Both conditions have resulted from sheet erosion.

Wooster gravelly loam, where under cultivation and normal moisture conditions, is very acid yellowish-brown gravelly loam to a depth of 8 inches. Below this the subsoil consists of brownish-yellow gravelly loam which is fairly compact below a depth of 18 inches. Below a depth of 24 inches are interstratified beds of gravel and sand, which are neutral to acid in reaction, at a depth of 36 inches, and calcareous at and below a depth of 48 inches.

An area covering about three-fourths square mile southeast of Collins, has been included with Wooster gravelly loam in mapping because of its small extent. In this area the fine soil material, in both surface soil and subsoil, is similar to Wooster gravelly loam, the chief difference being the almost total absence of gravel.

Wooster gravelly loam occurs mainly in hilly morainic areas, in the vicinities of Dutchtown, East Concord, and Concord, and in much pitted and hummocky areas of valley fills near Springville. Smaller areas are on the valley slopes south of Griffins Mills and east of South Wales.

About 70 per cent of this soil is cultivated, 20 per cent is in permanent pasture, and 10 per cent in wood lots. It is devoted to the same crops as nearby tracts of Chenango loam, gravelly phase, but it pro-

duces lower yields. The lower yields are caused by sheet erosion which reduces the thickness of the surface soil and carries away a large part of the organic material.

Otisville gravelly loam.—Otisville gravelly loam is essentially like Wooster gravelly loam, except that very little, if any, compaction occurs in the subsoil material or in the underlying material. One-half mile southeast of Lawton, on a morainic ridge, is an area including about 80 acres of Otisville very fine sandy loam which is included with Otisville gravelly loam in mapping. It differs from Otisville gravelly loam in that it contains very much less gravel and in that it has a very fine sandy loam texture throughout both the surface soil and subsoil. An area of Otisville gravelly silt loam including about 100 acres, occurs on a hummocky area with a deeply pitted surface about 1 mile southwest of Sardinia. On the map it is combined with Otisville gravelly loam. It differs from the gravelly loam mainly in having a surface soil with a gravelly silt loam texture.

Otisville gravelly loam areas are extensively developed on steep escarpments which lead down from the large areas of Chenango loam, gravelly phase, in Cattaraugus Valley to the flood plains along Cattaraugus Creek, and on the steep valley slopes of South Branch, Eighteenmile Creek. Smaller areas occur on valley slopes widely distributed over the southern half of the county.

About 10 per cent of this soil, only those areas on the less steep slopes, is cultivated, about 60 per cent is in permanent pasture, and 30 per cent is in woodland. Crops and agricultural practices are about the same as on Wooster gravelly loam, but yields, owing to greater leaching in the less compact and more porous materials, are slightly lower.

Groton loam, gravelly phase.—As mapped in Erie County, Groton loam, gravelly phase, is almost identical with Palmyra gravelly loam in color, texture, and compactness of both the surface soil and subsoil and in the slight acidity of the surface soil, but it has a somewhat thinner surface soil and a lower content of organic matter because of a much greater degree of surface slope, which has been conducive to sheet erosion.

About 80 per cent of this soil is cultivated. Crops and agricultural practices are almost identical with those on Palmyra gravelly loam, but the yields, because of the lower organic-matter content and thinner surface soil, are somewhat lower.

Groton loam.—Areas of Groton loam are intermingled with areas of Groton loam, gravelly phase. This soil differs from Groton loam, gravelly phase, only in the texture of the surface soil and subsoil, which is loam instead of gravelly loam. The quantity of land under cultivation, crops, yields, and farming practices on the two soils are almost identical.

POORLY DRAINED SOILS

The poorly drained sandy and gravelly soils are correlated in the Newton, Maumee, Poygan, and Wolcottsburg series. The soils of all of these series have dark-colored friable mellow surface soils with high contents of organic matter. The surface relief is level. The surface soils of the members of the Poygan, Maumee, and Walcotts-

burg series are slightly acid, but a lime reaction occurs at a depth ranging from 20 to 30 inches; whereas the surface soils of the members of the Newton series are very acid and lime is not found in the underlying material above a depth of 45 inches.

The more common trees growing on these soils are white elm, black ash, soft maple, cottonwood, poplar, and willow, and less numerous trees are cedar, butternut, ironwood, sassafras, plum, sumac, horsechestnut, dogwood, chokecherry, rock elm, hickory, birch, pin oak, and aspen.

Poygan loam.—Poygan loam is the most extensive soil of the poorly drained sandy and gravelly soil group. It occurs in large areas in the northeastern quarter of the county and covers a total area of 11.3 square miles.

The cultivated surface soil of Poygan loam, under normal moisture conditions, consists of dark brownish-gray loam. It is underlain by brownish-yellow friable and somewhat compact loam or very fine sandy loam, with gray mottlings, which, at a depth ranging from 22 to 32 inches, rests on plastic pink or reddish-pink calcareous silty clay loam or silty clay. Throughout a vertical section of this soil, in most places there are no gravel and bowlders, but in the vicinity of Millgrove and Sand Hill crystalline gravel and bowlders are scattered over the surface and are embedded in the surface soil and subsoil, and in addition limestone gravel and large irregular blocks of limestone occur in the underlying material.

In the vicinity of Alden are small areas of Toledo loam, aggregating about 200 acres, which have been included with mapped areas of Poygan loam. This soil differs mainly from Poygan loam in that heavy calcareous gray silty clay loam, mottled with yellow and brown, underlies the subsoil.

About 50 per cent of Poygan loam is cultivated, and the remainder is in permanent pasture and wood lots. Crops and farming practices are about the same as on Palmyra gravelly loam, but where the drainage is adequate this soil gives higher yields of silage corn and truck crops, owing to the greater supply of organic matter which is conducive to good tilth and moisture-holding capacity, aids in warming the soil by the absorption of heat and tends to liberate nitrogen and other plant-food elements. Small grains develop very large stalks and tend to lodge, and yields average a little lower than yields on Palmyra gravelly loam.

Poygan very fine sandy loam.—Poygan very fine sandy loam occurs in large areas bordering areas of Poygan loam, between Getzville and Swormville, and in smaller areas within areas of Poygan loam between Swormville and the Genesee County line.

In most of its soil characteristics Poygan very fine sandy loam is similar to Poygan loam, the chief difference between the two soils being in the very fine sandy loam texture of both the surface soil and subsoil of Poygan very fine sandy loam. In the vicinity of Sand Hill and within the Tonawanda Indian Reservation are a number of small areas, in which both the surface soil and subsoil are fine sandy loam. Owing to their small extent these areas have been mapped with Poygan very fine sandy loam.

About 50 per cent of Poygan very fine sandy loam is cultivated, 35 per cent is in permanent pasture, and 15 per cent is in woodland.

Crops and farming practices are about the same as on Poygan loam, but the yields are somewhat lower, owing to the more open and coarser texture which allows more rapid leaching.

Wolcottsburg loam.—Wolcottsburg loam is closely associated with Wolcottsburg silt loam and Tonawanda silt loam, and it is well distributed throughout the extreme northern part of the county.

Under normal moisture conditions Wolcottsburg loam to a depth of 8 inches is dark-gray or very dark gray neutral loam. This layer is underlain by a subsoil consisting of light grayish-yellow loam with brownish-yellow mottlings. This material, at a depth of about 18 inches, grades into grayish-brown very fine sandy loam with gray mottlings, and this, in turn, at a depth of about 44 inches, into calcareous stratified beds of sand, very fine sand, and silt.

Wolcottsburg loam is similar to Wolcottsburg silt loam except that it has a loam texture in the surface soil and upper subsoil layer and less compaction in the lower subsoil layer.

About 70 per cent of this soil is cultivated. Crops and farming practices are comparable to those on Wolcottsburg silt loam, but yields are somewhat better, owing largely to the more porous character of Wolcottsburg loam, which is conducive to good aeration and drainage.

Wolcottsburg loam, light-textured phase.—A few small areas of a light-textured phase of Wolcottsburg loam occur northwest of Getzville and east of Wolcottsburg. The surface soil and subsoil of the soil in these areas is very fine sandy loam.

Maumee loam.—Maumee loam is like Wolcottsburg loam, except that it has a black mucky surface soil with a much higher content of organic matter. An area of black mucky very fine sandy loam, which occurs 2 miles southeast of Getzville and covers about 80 acres, is, because of its small extent, combined with this soil. This area is subject to inundation almost annually.

Areas of Maumee loam lie northwest of Getzville, north of Clarence Center, 2 miles southwest of Spring Brook, 2 miles south of Town Line, and 1 mile southeast of Swormville.

About 30 per cent of the land is cultivated, 30 per cent is in permanent pasture, and 40 per cent is in woodland. About the same crops are grown and similar farm practices followed as on Wolcottsburg silt loam, but the yields are comparable with those on Wolcottsburg loam.

Newton loam.—Newton loam resembles Wolcottsburg loam in color but differs in having an acid surface soil, subsoil, and underlying soil material to a depth of more than 3 feet and in being underlain by stratified beds of gravel and sand, which are calcareous at a depth ranging from 5 to 6 feet.

In the cultivated condition, with a normal amount of moisture, Newton loam, to a depth of 8 inches, is dark-gray or very dark gray very acid loam. Underlying this material is the subsoil of light yellowish-gray or light grayish-yellow loam with brown, yellow, and gray mottlings. With increasing depth the texture becomes lighter and the soil material grades, at a depth of about 18 inches, into very fine sandy loam which, at a depth of 40 inches, grades into stratified beds of mottled gray, brown, and yellow sand showing an acid reaction.

Newton loam areas are well distributed throughout the sandy belt of soils extending from Versailles northeastward, crossing the Genesee County line east of Alden.

About 60 per cent of this soil is cultivated, 30 per cent is in permanent pasture, and 10 per cent is in wood lots. The cultivated soil is used mainly for growing truck crops similar to those grown on Chenango gravelly loam, but yields, where adequate drainage has been installed, are somewhat better, owing, probably, to the much greater quantity of organic matter in the surface soil.

Newton very fine sandy loam.—Newton very fine sandy loam is like Newton loam, except that it has a very fine sandy loam texture both in the surface soil and subsoil. Between Elma Center and Alden are a number of small areas, aggregating about 300 acres, of Newton fine sandy loam which, because of its small extent, has been combined with Newton very fine sandy loam in mapping. The soil in these areas differs from Newton very fine sandy loam in the fine sandy loam texture of the surface soil and subsoil.

Newton very fine sandy loam is well distributed throughout the belt of sandy soils described under Newton loam. About 70 per cent of the land is cultivated, and the remainder is used for permanent pasture and wood lots. About the same agricultural practices are pursued and about the same crops are grown as on Newton loam, but, owing largely to better drainage, yields are somewhat better on the very fine sandy loam.

FLOOD-PLAIN SOILS

Those soils occurring on the flood plains along streams are correlated in the Chagrin, Eel, and Genesee series, and meadow. All these soils have neutral surface soils. The surface relief is level or gently sloping toward the streams, but in places the land surface is cut by sloughs. The tree growth consists of white elm, soft maple, willow, sycamore, butternut, cottonwood, poplar, sassafras, dogwood, white birch, sweet birch, ironwood, plum, sumac, red elm, hickory, pin oak, and aspen.

Genesee silt loam.—Genesee silt loam is the most important and most extensive of the stream flood-plain soils. Its total area is 22.3 square miles, and its larger developments are along Cattaraugus, Cayuga, and Ellicott Creeks. Small areas lie along all the streams in the northern half of the county.

The cultivated surface soil of Genesee silt loam, under normal moisture conditions, consists of brown mellow silt loam. It is underlain by somewhat lighter colored material which continues to a depth of 4 feet or deeper. Some limestone, shale, very fine grained sandstone, and crystalline gravel is scattered over the surface and embedded in the surface soil, subsoil, and underlying formation.

This soil is characterized by many local textural variations which can not be shown on the map. The surface soil ranges in texture from loam to silty clay loam. In places the subsoil is yellowish brown, and in other places faint mottles of yellowish brown and grayish brown occur below a depth of 18 inches. Small inclusions of dark grayish-brown meadow soils are common.

About 50 per cent of the land is cultivated, 40 per cent is in permanent pasture, and 10 per cent is in wood lots. Silage corn, oats, wheat, mixed clover and timothy, alfalfa, and truck crops are produced. Yields, where drainage is well established, are somewhat better than on Palmyra gravelly loam, owing to a greater content of organic matter, a thicker surface soil, and its renewal through deposition of new materials at times of inundation.

Genesee silt loam, high-bottom phase.—Along all the principal streams are areas of Genesee silt loam aggregating 4.4 square miles, which are not subject to inundation, except, possibly, once in 20 years. These areas are mapped as a high-bottom phase of Genesee silt loam.

Chagrin silt loam.—Of the stream flood-plain soils, Chagrin silt loam is next to Genesee silt loam in extent and importance. It occurs along all the streams of the southern half of Erie County, except Cattaraugus Creek.

Chagrin silt loam is very much like Genesee silt loam but differs from that soil in that it has no limestone gravel scattered over the surface or embedded in the surface soil, subsoil, or underlying formation.

About 50 per cent of this soil is cultivated. Essentially the same crops are grown and the same yields obtained as on Genesee silt loam.

Chagrin silt loam, high-bottom phase.—Along Buffalo, Cazenovia, Eighteenmile, Clear, Cattaraugus, and some smaller creeks, are areas of Chagrin silt loam that are subject to inundation about once in 20 years. Such areas are mapped as a high-bottom phase of the silt loam.

Eel silt loam.—Occurring on the stream flood plains, in poorly drained situations in the same general area as Chagrin silt loam, is Eel silt loam. Its surface soil, under normal moisture conditions, is grayish-brown friable silt loam. It is underlain by mottled grayish-brown, yellowish-brown, and gray friable silt loam which continues downward to a depth of 4 feet or deeper.

Probably 5 per cent of this soil is under cultivation. Most of the timber has been removed, and the land is used mainly for permanent pasture. Where good artificial drainage has been established, crops and yields are comparable to those on Genesee silt loam.

Meadow.—Meadow is a term chosen to designate the dark-colored soil occurring in the flood plains of smaller streams throughout the northern half of the county. The dominant soil, under normal moisture conditions, consists of friable dark grayish-brown silt loam which is underlain by yellowish-gray silt loam with yellow mottlings. At a depth ranging from 20 to 35 inches the material is gray calcareous silty clay loam. Differences in texture are numerous, ranging from fine sandy loam or very fine sandy loam to silty clay loam. In places the dark surface layer is 5 inches thick, and in other places it is black mucky material to a depth of 18 or 20 inches.

Only about 1 per cent of meadow is cultivated. Most of it is covered with a second growth of black ash, soft maple, elm, swamp, white, and pin oak, shellbark hickory, sycamore, cottonwood, willow, sumac, dogwood, quaking aspen, and sweet and white birch. With good drainage, the yields of silage corn and cabbage are higher than on Genesee silt loam.

MISCELLANEOUS SOIL MATERIALS

ORGANIC SOILS

Muck.—Areas of muck are well distributed over the county, the largest bodies occurring in the vicinities of Getzville, Wolcottsburg, Akron, Protection, and Concord.

Muck, as mapped in Erie County, consists of Sphagnum moss, grasses, sedges, wood, and other vegetable matter in various stages of decomposition. This material is mixed with different proportions of mineral matter, such as fine sand, very fine sand, silt, and clay, and rests at a depth ranging from 2½ to 10 feet, on silty clay loam, silt loam, loam, fine sandy loam, or very fine sandy loam. In many places muck has a granular structure caused by the presence of small subangular pieces of partly decayed wood. The organic matter in most places is almost nonfibrous or very finely divided, but in other places it is in reality peat, consisting of fibrous organic material that contains numerous roots, partly decayed plants, and very little inorganic material.

North of Sardinia and north of Springville are a number of small areas of muck, in which the brown organic matter is underlain at a depth ranging from 2 to 6 feet by very light gray or almost white marl.

About 5 per cent of the muck land is cultivated, and most of the remainder supports a tree growth of black ash, white elm, swamp, white, and pin oak, sycamore, cottonwood, willow, sumac, dogwood, soft maple, sweet and white birch, quaking aspen, and shellbark hickory in the drier areas, and tamarack, poison sumac, alder, and highbush huckleberry in the wetter areas. On areas which are well drained and to which sufficient phosphorus and potash have been supplied by fertilization, silage corn, onion, celery, cabbage, and potato yields are above the average for the county.

Muck, shallow phase.—A shallow phase of muck is shown on the map. Like typical muck, it is well distributed over the county. The shallow phase resembles typical muck, but it has a larger admixture of mineral matter and extends to a depth ranging from 8 inches to 2½ feet, where it rests on soil materials similar to those underlying typical muck.

OTHER MISCELLANEOUS CLASSIFICATIONS

Rough stony land.—The term "rough stony land" applies to precipitous bluffs, very steep valley and gully slopes, and terrace escarpments where the degree of slope prohibits cultivation. On these slopes are numerous outcrops of shale and sandstone, in many places appearing as vertical bluffs.

Probably 95 per cent of the rough stony land is covered with trees, including hard maple, beech, hemlock, basswood, chestnut, white pine, wild cherry, whitewood, white ash, red and white elm, chestnut, red, white, and black oak, bitternut and shellbark hickory, yellow and white birch, soft maple, dogwood, cottonwood, poplar, sassafras, Juneberry, butternut, cucumbertree, ironwood, and sumac.

The slopes are suitable only for permanent pasture and forestry.

Dune sand.—Areas mapped as dune sand consist of low sand ridges occurring along the shore of Lake Erie in the extreme western part of the county. Dune sand material consists of loose incoherent fine sand which is subject to movement by the wind.

Unclassified city land.—Unclassified city land, as its name implies, includes nonagricultural areas within the limits of the numerous towns and cities in the county. Almost 55 square miles of land in the county are accounted for in this classification.

SOILS AND THEIR INTERPRETATION

The soils of Erie County have developed under the influence of a humid temperate climate, and the annual rainfall has been sufficient to compensate the loss of moisture by evaporation and surface run-off and, in addition, to afford an almost constant supply for downward movement through the soil. Where drainage is fair or good, the soils are light in color. This is explained by the fact that they were formed under a dense forest cover which was unfavorable for a heavy development of grass roots and for the accumulation of much organic matter in the soil. Under these conditions the soil materials have undergone chemical and physical changes that have so modified them that the original geologic characteristics of the material have, in part, given place to the subsequently developed true soil characteristics. The carbonates have been leached from these soils to a depth ranging from 2 to 5 feet.

On the basis of their most striking and widely developed characteristics, the soils of the county may be classed as those having indurated substratum layers and those having heavy subsoils and substrata. These two groups are nearly everywhere coextensive with two kinds of surface features.

Soils with indurated substratum layers have developed on the broad smooth undulating or gently rolling ridges and steep to gentle valley slopes of the southwestern quarter of the county, whereas the soils with heavy subsoils are confined mainly to the plains region and lower valley slopes, that constitute the remainder of the county. Associated with soils of both groups are light-textured soil materials in which little soil development has taken place.

The most extensive and the best-developed representative of the soils with indurated layers is Langford silt loam which occurs only in the better-drained areas of the broad ridges and valley slopes. Although Langford silt loam is far from reaching a stage of complete soil development, its A and C horizons are distinct. From the surface downward, a representative profile of this type of soil is described in detail as follows:

1. A 1-inch layer of a very dark grayish-brown mixture of partly decayed leaves, forest litter, leaf mold, and humous soil. The pH value is 4.7.[5]
2. Dark brownish-gray friable silt loam, high in organic matter, about 2 inches thick. The pH value is 4.65.
3. Grayish-brown or brownish-gray friable silt loam, ranging from 3 to 6 inches in thickness. The pH value is 4.3, and the plasticity number[6] is 2.

[5] All pH determinations given in this report were made by the hydrogen-electrode method by Ernest H Bailey

[6] Plasticity numbers given in this report were determined according to the Atterberg method by Arthur E Taylor.

Layers 1, 2, and 3 may be regarded as constituting the A horizon.

4 A layer, ranging from 8 to 17 inches in thickness, of yellowish-brown or brownish-yellow vesicular friable silt loam which is heavier than the layers above it. This is probably an incipient horizon of concentration of clay and sesquioxides, or a B horizon. The pH value is 4 57, and the plasticity number is 3.6.

5. A C horizon, composed of very hard, very compact, brittle, grayish-brown silt loam which breaks rather indefinitely into irregular-shaped fragments. The color of the breakage surfaces is usually gray, this color resulting from podzolization, whereas the color of the interior of these fragments is brown. On the gray breakage surfaces are numerous hairlike roots which seem to be largely confined to these surfaces. At a depth ranging from 36 to 50 inches the material becomes slightly calcareous.

The Aurora soils have profiles resembling the Langford soils, but they are unlike the Langford in having an underlying formation consisting of interbedded slightly calcareous very fine grained sandstone and shale within a depth ranging from 6 to 54 inches below the surface.

The profiles of the Lordstown soils differ from those of the Aurora soils in that the underlying beds of interstratified shale and very fine grained sandstone are very acid.

Erie silt loam is representative of the poorly drained upland soils. It occurs on the larger smooth areas, associated with Langford silt loam. Inasmuch as the parent material has been subjected to alternate wet and dry conditions since its deposition during the glacial period, the profile shows those features which indicate that here the soil-forming forces have been limited in their activity by poor drainage conditions. The profile, or succession of layers, of Erie silt loam may be described as follows:

1. A very dark grayish-brown layer, about 1 inch thick, composed of partly decayed leaves, twigs, and roots. The pH value is 4.12.
2. A very dark gray mellow layer of humous silt loam, about 3 inches thick, which shows a pH value of 4.28.
3. A 2-inch layer of grayish-brown mellow silt loam.
4. A mottled gray and brownish-yellow layer of vesicular friable silt loam about 6 inches thick. The material shows no sign of breaking into definite structure particles but breaks into irregular-shaped particles. Along breakage planes and as a coating on the walls of old root channels are thin films of gray material, whereas the remainder of the material is brownish yellow or yellowish brown. Numerous dark-brown or black splotches occur throughout this layer. The pH value is 4.5.
5. A very compact hard brittle friable impervious vesicular layer of mottled gray, brown, and yellowish-brown silt loam, containing many irregular fragments of very fine grained sandstone and shale, and many segregations of iron oxide. Along breakage surfaces are many hairlike roots, some of which are living and others in various stages of decomposition. As this layer is subject to the rise and fall of the groundwater level, decomposition is, in many places, largely owing to submergence. It is probably through this decomposition that hydrogen and carbon dioxide are formed, that iron and manganese are reduced, and that calcium and magnesium are carbonized. These changes may account for the gray leached coatings on the breakage surfaces. Between depths of 12 and 17 inches the pH value is 4 74, between depths of 28 and 33 inches it is 6 1, and at a depth of 48 inches the material is slightly calcareous.

The profile of the Chippewa soils is like that of the Erie soils, except that the very dark gray and dark-gray organic layers are

thicker in the Chippewa soils, the dark-gray layer extending to a depth of 8 or 9 inches.

The profile of the Volusia soils is like that of the Erie soils, except that the Volusia soils are derived from very acid parent material.

The profiles of Allis and Angola silt loams of the high ridges resemble the profile of Erie silt loam but differ in that the underlying beds of interstratified shale and very fine grained sandstone are within a depth ranging from 6 to 54 inches from the surface. At a depth of 4 feet the sandstone underlying the Angola soil is calcareous, whereas that underlying the Allis soil is very acid. The profile characteristics of Allis and Angola silty clay loams occurring in the high ridges are much the same as in areas of these soils in the plains region.

The imperfectly drained soils of the plains region are well represented by Mahoning silt loam. A typical profile of this soil from the surface downward may be described as follows:

1. A surface layer of leaf litter underlain by a very thin layer of leaf mold.
2. A 2-inch layer of dark grayish-brown silt loam.
3. A 5-inch layer of brownish-gray or grayish-brown silt loam.
4. A 6-inch layer of mottled yellowish-gray and brown vesicular friable smooth silt loam which shows a laminated arrangement and breaks up along lamellar surfaces into small irregular blocks. On lamellar and other breakage surfaces are thin coatings of yellowish-gray podzolized material, whereas the materials in the interstices between lamellar surfaces or within the blocks are mottled yellowish gray and brown. Roots and old root channels are far more numerous on the surfaces of the blocks than in their interiors. Therefore, it might be assumed that much more organic matter decomposed on the surfaces and that a reduction of the iron would in that case be more active, thus accounting for the differences in color. The friability of this layer, in contrast to the heaviness and compactness of the underlying layer, suggests that a downward movement of the fine material has taken place.
5. A 16-inch layer of heavy hard mottled gray and yellow silty clay loam. The material breaks into large irregular blocks, averaging 1 by 2 by 4 inches in size. Numerous roots, old root channels, and well-defined films of podzolized materials occur on the faces of the blocks, but the interiors are comparatively free from roots and have a mottled gray and brown color. Some iron concretions and small crystalline rock fragments occur in this layer.

Below layer 5, the breakage surfaces continue with their thin films of gray podzolized materials scarcely penetrating beyond the surfaces, to a depth ranging from 6 to 8 feet. At a depth of 35 inches, local segregations of calcium carbonate occur on some of the breakage planes but do not penetrate beyond the surface. At a depth of 4 feet the material is calcareous.

Throughout this soil section the materials are heterogeneous, many crystalline pebbles, some bowlders, and very fine grained sandstone fragments being in evidence. The substratum is glacial till.

Heavy-textured Caneadea soils differ from Mahoning silt loam in having more of the gray color throughout on account of poorer drainage, very little eluviation in the upper layers, and a homogeneous soil material consisting of lacustrine and fluvial sediments.

Heavy members of the Fulton series are similar to the Caneadea soils, except that calcium carbonate occurs much nearer the surface, at a depth ranging from 18 to 28 inches, and the pH value is about

7 in the A horizon. The Toledo soils differ from the Fulton soils in having dark-gray surface soils.

The Dunkirk soils have profiles which are like those of the Canadea soils. They have the same pH values at particular depths and homogeneous parent materials, but they differ from the Canadea soils in that they are more friable, less plastic, and show evidence of better drainage throughout.

The Darien soils resemble the Mahoning soils in color, consistence, and texture but are unlike them in having calcium carbonate at a depth ranging from 18 to 28 inches.

The profile of the Lyons soils is like that of the Darien soils, except that the A horizon is dark gray.

The Angola and Allis soils of the plains region have profiles like the Mahoning soils, except that interstratified beds of shale and very fine grained sandstone occur at a depth ranging from 1 to 4½ feet. At a depth of about 4 feet the shale and sandstone underlying the Angola soils are more or less calcareous, but those underlying the Allis soils are very acid.

The heavy members of the Schoharie series are like the Mahoning soils in the consistence and texture of their various layers, but they differ in that the Schoharie soils have a mottled reddish-brown, gray, olive-gray, reddish-gray, and yellowish-gray plastic layer between depths of 6 and 12 inches, grading downward into a light reddish-brown layer that is calcareous at a depth of about 30 inches. Some heavy soils of the Schoharie series, such as the silty clay loam and silt loam, include areas in which the underlying parent materials are lacustrine in origin and are free from rocks and gravel as are the Caneadea soils.

The profiles of the heavy members of the Poygan series are like those of the Schoharie soils, except that the surface soils are dark gray. The Poygan soils, like the Schoharie soils, include areas in which the underlying material is lacustrine instead of glacial in origin and is free from rocks and gravel.

The essential features of the typical soil profile of well-drained medium-textured material, in which oxidation and leaching have been effective to a depth ranging from 40 to 50 inches, are given in a description of the profile of Palmyra gravelly loam as follows:

1. A 1-inch layer of a very dark brown or blackish-brown mixture of leaf mold, forest litter, and partly decayed leaves. The pH value is 6.
2. A 1-inch layer of humous soil and leaf mold. The pH value is 6.
3. A 4-inch layer, consisting of a dark mixture of mineral and organic matter, which has a gravelly loam texture, a dark grayish-brown or dark-brown color, and a pH value of 7. The dark color is imparted largely by finely divided organic matter derived mainly from the decay of plant roots and intimately mixed with the mineral constitutents of the soil.
4. A 6-inch layer of brown or reddish-brown gravelly loam with some limestone fragments and an alkaline reaction.
5. A 14-inch layer of reddish-brown heavy loam. This layer is somewhat heavier in texture than either the layers above or below it.

Beneath this layer is a light reddish-brown rather loose interstratified bed of calcareous sand and gravel. About 80 per cent of the gravel is limestone, 10 per cent chert, 8 per cent crystalline rock, and 2 per cent shale.

The Groton soils have profiles very similar to those of the Palmyra soils. The presence of large crystalline bowlders and a rough broken morainic surface are the distinguishing features of the Groton soils. The profiles of the Ontario soils differ from those of the Palmyra soils only in the presence of bowlders and large limestone fragments.

In the sandy soils of the Palmyra series, as well as in those of the Berrien, Ottawa, Mentor, Otisville, and Wooster series, the soil characteristics described for Palmyra gravelly loam are imperfectly developed because of the loose consistence, light texture, and siliceous composition of the parent material.

The profile of the Cazenovia soils is unlike that of the Palmyra soils in having somewhat more compaction in the purplish-brown subsoil; a parent material consisting of friable glacial till, containing bowlders, limestone, and chert fragments; and beds of cherty limestone within a depth ranging from 4 to 8 feet below the surface.

The Farmington soils have profiles very much like the Cazenovia soils, except that the color of the subsoil material is reddish brown and the cherty limestone occurs at a depth ranging from 12 to 42 inches below the surface.

Medium-textured soils of the Chenango series have profiles resembling the Palmyra soils in color, texture, and consistence, but are unlike the Palmyra soils in that no limestone gravel is present, the surface soil and upper subsoil layer are very acid, the lower subsoil layer is alkaline, and the underlying material is calcareous at a depth ranging from 50 to 60 inches below the surface.

Profiles of the Mentor soils are comparable to profiles of the Chenango soils in all their soil characteristics except that the Mentor soils are not underlain by beds of gravel but by finer-textured material such as loam, fine sandy loam, and very fine sandy loam.

The profiles of the Otisville soils bear the same relation to those of the Chenango soils as the Groton profiles bear to the Palmyra. Medium-textured Wooster soils have profiles like the Chenango soils but differ from those soils in that they contain large crystalline bowlders, the underlying substratum is glacial till, and the A horizon is thinner because of erosion.

Along the streams of the county are a number of soils developed on deposits of old alluvium, including the Tonawanda and Wolcottsburg soils of the extreme northern part of the southern half of the county and the Newton soils and Braceville soils of the southwestern part. Of these, Tonawanda silt loam, because of better drainage, has partly developed, yet distinct, A and B horizons. Because of poor drainage the Wolcottsburg and Newton soils and Tonawanda silty clay loam have developed little more than color profiles.

The profile of Tonawanda silt loam from the surface downward may be described as follows:

1. A layer of vegetal mold, partly decayed leaves and grasses, fine roots, and litter, about 1 inch thick.
2. A very dark grayish-brown friable neutral silt loam layer, 1 or 2 inches thick.
3. A 3-inch dark-gray friable neutral silt loam layer.

4. A 5-inch layer of grayish-brown silt loam.
5. A 19-inch layer of light grayish-yellow compact friable silt loam which is heavier than the material in any layer above or below it and probably represents a partly developed alluvial horizon.

Below this are stratified beds of calcareous sand and silt.

The profiles of the Wolcottsburg, Braceville, and Newton soils are not so well developed as the profile of Tonawanda silt loam, because of restricted drainage, but all have a color profile, some compaction in the subsoil, and are underlain by lighter-textured materials, such as interstratified beds of sand and silt, in the Wolcottsburg, and of gravel, silt, and sand in the Newton and Braceville soils.

In the deposits constituting the stream flood plains, definite soil characteristics have not yet developed. The light-colored stream-bottom soils are classed in the Genesee, Chagrin, and Eel series, and the dark-colored soils are classed as meadow.

About 59 per cent of the soil material in Erie County is glacial till, of which half consists largely of limestone and shale materials and half of sandstone and shale materials; 26 per cent is water-laid deposits, of which 40 per cent consists of outwash and valley fill materials, 30 per cent of stream terrace deposits, 15 per cent of lacustrine beds, and 15 per cent of stream flood-plain materials; 12½ per cent is shale and sandstone; 1½ per cent is shale and limestone; and 1 per cent is peat and muck.

By weathering, the surfaces of these soil materials have been reduced to more uniformity of composition in respect to texture and consistence. The most outstanding characteristics have resulted from the accumulation of organic matter, oxidation, leaching, and the partial development of horizons by the translocation of the finer materials. Muck has formed from the partial decomposition of organic matter in the presence of water.

SUMMARY

Erie County is in the western part of New York bordering Lake Erie. The central part and southeastern quarter are hilly, and the remainder of the county consists of level or gently rolling plains.

The county has excellent market facilities. Buffalo, the county seat and largest city, is connected by steamboat lines with all Great Lake ports to the west and by many steam and interurban railroads and the Barge Canal with all parts of the United States. The numerous summer resorts along Lake Erie provide excellent local markets for truck crops.

The frost-free season of the plains section, near Lake Erie, is much longer than in the hilly section.

Soil characteristics throughout the county are not well developed, so that soil differences are dependent mainly on textural differences of the soil materials. The soils are prevailingly light in color and have been formed in a forested region under the influence of a humid temperate climate, with but short periods of extreme heat and cold.

According to their dominant characteristics, the soils of Erie County belong to two main groups: (1) The heavy-textured soils consisting of silt loam and silty clay loam surface soils underlain by heavy plastic or hard compact silty clay loam subsoils; and (2) sandy

and gravelly soils, or those having light friable surface soils grading downward into sandy or gravelly friable subsoils. The heavy-textured soils are the only representatives on the ridges and valley slopes of the hilly region. Sandy soils predominate in a zone from 1 to 4 miles wide crossing the county between Versailles and Crittenden. In the remainder of the county the soils of both groups are intermingled, but the heavy-textured soils predominate in most places.

The heavy-textured soils are used largely for the production of small grains, hay, and corn for silage, in support of dairying, and the light-textured soils are used principally for the production of truck crops, berries, grapes, and orchard fruits.

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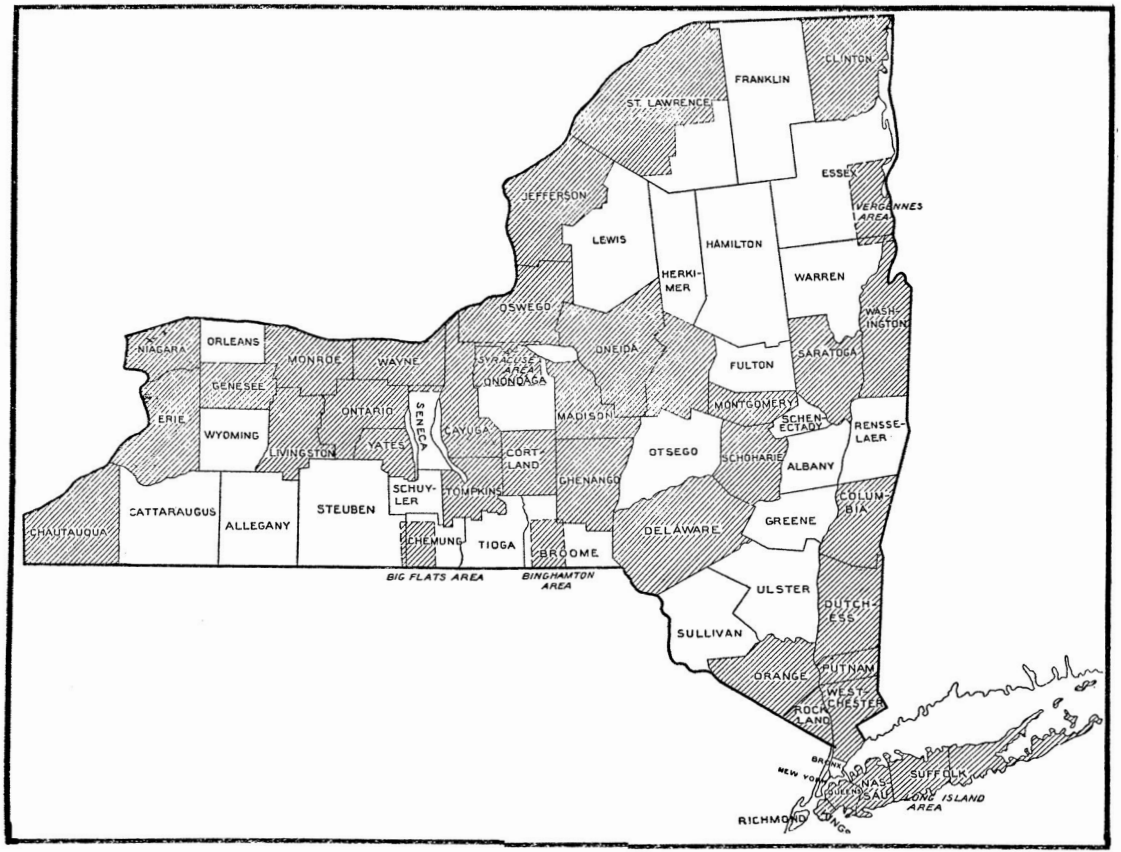
There shall be printed as soon as the manuscript can be prepared with the necessary maps and illustrations to accompany it a report on each soil area surveyed by the Bureau of Chemistry and Soils, Department of Agriculture, in the form of advance sheets bound in paper covers, of which not more than two hundred and fifty copies shall be for the use of each Senator from the State and not more than one thousand copies for the use of each Representative for the congressional district or districts in which a survey is made, the actual number to be determined on inquiry by the Secretary of Agriculture made to the aforesaid Senators and Representatives, and as many copies for the use of the Department of Agriculture as in the judgment of the Secretary of Agriculture are deemed necessary.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