Issued May 22, 1916.

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE NEW YORK STATE COLLEGE OF AGRICULTURE, CORNELL UNIVERSITY, BEVERLY T. GALLOWAY, DIRECTOR; E. O. FIPPIN, IN CHARGE OF SOIL SURVEY.

SOIL SURVEY OF CHAUTAUQUA COUNTY, NEW YORK.

BY

T. M. MORRISON, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND C. C. ENGLE AND G. L. FULLER, OF THE NEW YORK STATE COLLEGE OF AGRICULTURE.

W. E. McLENDON, INSPECTOR, NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1914.]

WASHINGTON:
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1916.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., October 18, 1915.

SIR: During the field season of 1914 a soil survey was made of Chautauqua County, N. Y. This work was done in cooperation with the New York State College of Agriculture, the selection of the area being made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this survey and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1914, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. D. F. HOUSTON,
Secretary of Agriculture.

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MAP.

Soil map, Chautauqua County sheet, New York.

SOIL SURVEY OF CHAUTAUQUA COUNTY, NEW YORK.

By T. M. MORRISON, of the U. S. Department of Agriculture, and C. C. ENGLE and G. L. FULLER, of the New York State College of Agriculture.

DESCRIPTION OF THE AREA.

Chautauqua County is the extreme western county of New York State. On the north it is bounded by Lake Erie, on the south and west by the Pennsylvania State line, on the east by Cattaraugus County, N. Y., and its northeast corner, for a short distance, touches Erie County. The county contains 1,069 square miles, or 684,160 acres.

In its broad physiographic features Chautauqua County consists of a plateau of moderate height occupying more than four-fifths of the total area of the county, and a low smooth plain occupying the remainder. The latter consists of a belt ranging in width from 2 to 5 miles lying along the lake in the northwestern part of the county.

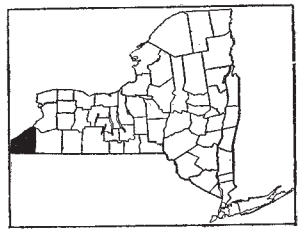

FIG. 1.—Sketch map showing the location of the Chautauqua County area, New York.

The lake-border lowland belt is as a whole smooth, but it varies in degree of smoothness from place to place. In general it slopes toward the lake from the foot of the declivity terminating the plateau, and ranges in elevation above the lake from a few feet to about 300 feet. In detail of surface relief it consists of two belts, the one comparatively smooth and low, the other higher and rougher. The smoother belt lies almost wholly along the lake and consists of a sloping plain free from relief features, except for a series of very narrow and shallow ravines cut across it by a number of small streams. Its surface aside from these features is constructional and is due to the action of the lake waters at a time when the water level stood nearly 200 feet higher than at present. It is a lake bottom so recently exposed that the destructive action of weathering and erosion has not had time to modify its surface features except by cutting the narrow valleys referred to above.

The remainder of the belt has only slightly more relief than this, owing to the fact that it has remained—part of it completely, the rest mainly—above the level of the lake waters. Its lower side was covered from time to time by the lake, but not for a sufficient period

to change its topographic features. Its surface is typically that of a smooth lowland modified through glacial action by the deposition of a shallow layer of ground moraine material and later modified by erosion, still in a very early stage of development, though further advanced than in the lower belt. Its original gently rolling surface has been modified by faint dissection, a little more complete, yet very little deeper, than that of the lake-border surface. The boundary between the two belts lies along the zone of gravel beds followed approximately by the Ridge Road through Fredonia, Brocton, and Westfield.

The plateau, occupying most of the county, is terminated along the lake plain by a well-defined escarpment, varying in steepness from a maximum in the western part of the county, where a rise of about 700 feet takes place in about 1½ miles, to a minimum in the northeastern part, where the grade is less steep but still well marked. As a rule, the slope is steepest near the top, rounding off above and flattening out below until the plateau merges gradually into the lake plain without sharp boundary, and also without the long alluvial fans characteristic of the footslopes of escarpments and adjacent lowland slopes in arid regions. The alignment of the escarpment is almost straight and its front is almost unmodified by erosion. In its main features it is preglacial, but its smoothness of outline and the absence of raggedness from erosion are in part undoubtedly due to the abrading and depositing action of the ice of the glacial period. Twenty-mile, Chautauqua, and Canadaway Creeks have worked their headwaters back beyond its front rim, but with these exceptions it is merely scratched, and not dissected, by drainage ways. Its front profile is notched by a few high gaps, which are old valleys formerly heading on the plateau northwest of its existing front before it had been driven back to its present position. They were probably widened and possibly deepened by ice action during the glacial period, though at present their floors are covered with a layer of morainic material considerably thicker than that on the top of the plateau.

The surface of the plateau has been rather deeply and thoroughly dissected, but either this has taken place on not so minute a scale as in many regions or else the minute features of relief due to such dissection were smoothed out by the ice during glaciation. The fact is that the existing relief is that of a well-dissected plateau whose slopes are all rounded and in which small ravines and the minute details of relief produced by them are not noticeable features.

The elevation of the upper surface of the plateau is between 1,600 and 2,100 feet, the greater part of it ranging between 1,600 and 1,800 feet. The maximum elevation is found in the southeast corner of the

county, where there is also a maximum of detail of surface relief. This corner lies on the glacial border where the smoothing action of the ice was at a minimum.

The plateau is intersected by a number of broad, flat-bottomed valleys, occupied at present in many cases by small streams, unable to do more than find their way through the more or less swampy valley floors. They are not dominating the valleys either by deposition or erosion. These valleys extend from the escarpment front, where they still exist as well-defined gaps, southward across the State line.

One of them is occupied by Chautauqua Lake for about 20 miles of its length, the emponding being due to the deposition of morainic material forming a low ridge across the valley at Jamestown. The valleys vary greatly in width and somewhat in depth, but, consistently, they are disproportionately broad compared with the size of the traversing streams. The streams do not follow them continuously, but one part of a valley may be drained in one direction and another part in another direction, the watershed lying on the valley floor. Many of the valleys lie at two levels, with a rather rapid drop between them, as is the case at Watts Flats, for example.

In the western part of the county the valley floors lie at elevations ranging from about 1,400 to 1,500 feet, while in the eastern part of the county the elevations are about 200 feet lower.

The upland portion of the plateau, or the true plateau, has a strongly rolling surface with rounded slopes, few of them too steep to cultivate. The minor valleys are usually open and often broad "sags." The dissection is typical of the New York, and therefore the glaciated, part of the Allegheny Plateau, rather than of the Pennsylvania or unglaciated portion, though its small valleys are less in evidence, both as to number and size, and its broad ones are more in evidence than is the case in the south-central part of New York State.

In detail of surface relief the western part of the county is much richer than the eastern. Its features are those of ice construction or destruction, consisting of a great number of low, elongated, rounded hills, drumlinlike in form, all with their longer axes lying parallel and in a northwest-southeast direction. In the eastern part the outlines are bolder and broader.

In the eastern two-thirds of the county the principal drainage system for the uplands is Conewango Creek and its tributaries. Conewango Creek rises in Mud and East Mud Lakes and flows southward through a broad, flat valley ranging from 1½ to 3 miles in width and with more or less abruptly sloping sides 200 to 300 feet high. From Balcom to the south county line it takes a meandering

course and in a distance of 40 miles has a fall of 50 feet. East of Ellington the creek leaves the county, but returns at Waterboro, flowing through a narrow, gorgelike valley to Kennedy, and through a broad one beyond this place.

Another important drainage way is Cassadaga Creek, which heads in the Cassadaga Lakes. Just to the north of South Stockton the Bear Lake Valley, which heads at Bear Lake, joins the Cassadaga Valley. These valleys have level, low-lying, poorly drained bottoms, varying in width from 1 to 2 miles, and have rather abrupt sides, which rise 200 to 300 feet above the streams. Cassadaga Creek takes a southeasterly course and empties into the Chadakoin River at Levant.

The Chautauqua Lake Valley extends from the vicinity of Hartfield and Mayville in a southeasterly direction to Celoron, where the lake narrows and has an outlet through the Chadakoin River, which flows meanderingly in a narrow valley and joins Conewango Creek about 3 miles north of Frewsburg. The hills on both sides of Chautauqua Lake rise with even slopes and their drainage is carried to the lake by numerous small streams.

Most of the drainage in the southwestern part of the county is by French Creek. Three miles southwest of Sherman, where Alder Bottom Creek empties into French Creek, the valley of the latter narrows and the stream meanders through the hills in a confined valley to the town of French Creek, where the valley widens again. At Marvin, a short distance from where it leaves the county, the valley again narrows. Findley Lake, near the western county line, has no visible outlet, but may be drained underground into Black Brook and thence into French Creek.

The drainage of the northern escarpment slope and the lake plain is north into Lake Erie through numerous small waterways.

Originally the county was inhabited by the Erie Nation of Indians, and some of their descendants still live in that part of the county located 3 miles east of Silver Creek which comprises part of the Cattaraugus Indian Reservation. In 1798 and 1799 the towns[1] were surveyed and the land sectionized. The first settlement in the county was made in 1802, at Westfield. Chautauqua County was formed from Genesee County and took its present boundaries in 1808.

The main route from New England to the Western Reserve followed the lake shore through Chautauqua County, and many of the early settlers came from Pennsylvania and New England. Most of the inhabitants are descended from New England ancestors; among the remainder the English, German, Irish, and Dutch nationalities are represented. In late years through the fruit belt there has

[1] The word "town," as used in this report, is synonymous with "township."

been a large immigration of Italians and people from other southern European countries, especially in the vicinity of Fredonia, where they are employed in the fruit, trucking, and canning industries.

Chautauqua County is more thickly settled throughout the lake plain than in the plateau section. In 1880 the population was 65,342; in 1890, 75,202; in 1900, 88,314; and in 1910, 105,126, showing an increase of 39,784 in 30 years. This increase has been due to the growth of the cities of Jamestown and Dunkirk, and to some extent to the inflow of foreigners into the grape belt, rather than to any conspicuous increase in the rural population. Mayville is the county seat.

The largest city in the county is Jamestown, with a population of 31,297. It is situated at the foot of Chautauqua Lake. Dunkirk, on Lake Erie, is the next largest city, with a population of 17,221. This city has a good harbor and facilities for water transportation. Silver Creek, Fredonia, Brocton, and Westfield are three locally important places in the lake region, with populations of 2,512, 5,285, 1,181, and 2,985, respectively. Besides these there are numerous other trading points.

The industries of Chautauqua County are many and varied. The value of the manufactured articles produced in Jamestown and Dunkirk in the year 1909 aggregated almost $21,000,000. The manufactures of Chautauqua County include textile fabrics, art metal, brick, wood products, tools, farm implements, machinery, locomotives, cheese, condensed milk, canned goods, grape juice, and wine. At Sherman and Clymer there are large milk condenseries. Throughout the plateau section, where dairying is important, cheese factories are numerous. In the fruit belt there are grape-juice and wine establishments. At Silver Creek, Cherry Creek, Sherman, and Fredonia there are canneries.

Chautauqua County is well supplied with transportation facilities. The county has one lake port, Dunkirk, and excellent railway service. Three trunk lines between New York and Chicago traverse it—the New York Central and the New York, Chicago & St. Louis paralleling the Lake Erie shore, and the Erie Railroad passing through Jamestown. A branch of the Pennsylvania system serves the southwestern part of the county. The Dunkirk, Allegheny Valley & Pittsburg Railway runs from Dunkirk south beyond Fentonville. This line, together with two branches of the Erie system, reaches much of the eastern part of the county. Electric lines parallel the lake-shore steam roads and connect Barcelona and Westfield through the Chautauqua Lake Valley with Jamestown and with Pennsylvania points. The various transit routes provide efficient service for the shipping of fruit, dairy products, and vegetables.

A ready market for some of the agricultural products exists in the manufacturing cities of Jamestown and Dunkirk. For many weeks in the summer season splendid markets for farm products are afforded in the resorts along Chautauqua Lake, and especially at the Chautauqua Assembly, which 20,000 to 30,000 people usually visit during the season. The grape crop of Chautauqua County is shipped to practically all the Northern and Middle Western States, while grape juice, canned fruits, and vegetable products and the condensed-milk output have an even wider distribution. The cheese manufactured in the county goes largely to New York and Philadelphia for consumption there or for further shipment.

The principal highway between the east and west running along the lake plain through Chautauqua County is an improved road built on a gravel ridge. East from Silver Creek to the county line this road has been concreted. Almost every town in the county has machinery for repairing roads, and a more or less systematic effort is made to keep the roads in good condition. Hauling is fairly easy, except for numerous steep grades. It is only in the more remote and rougher sections of the county that marked difficulty is experienced in transporting farm products. From Jamestown improved roads run southeast to Frewsburg, east to Falconer and Kennedy and to the county line, and northwest along the north side of Chautauqua Lake to Mayville and Westfield.

CLIMATE.

Corresponding to the two distinct physiographic divisions in Chautauqua County, there is considerable difference in the climatic conditions, and this difference of climate is responsible in a great measure for the forms of agriculture carried on in these two sections. The peculiar climate of the lake-shore region, touching Lake Erie on the north and bounded by the escarpment to the south, has been responsible for the development of the grape industry in this section on such a large scale. In a way the critical factor in the production of grapes and fruit in this section is climate.

Prof. R. S. Tarr, in a paper on the "Geological History of the Chautauqua Grape Belt,"[1] says:

> The lake is a great modifier of climate. In the spring, by reason of the low temperature of its waters, it holds back vegetation; and this tends to keep it behind the ordinary frosts. Its very presence checks frosts by moderating the temperature of the neighboring air. In the summer the water tends to cool the air of the day and keeps the nocturnal temperature fairly high. During the fall the water has been warmed by the summer sun, and the influence of this warm body of water lengthens the growing season and tends to keep off the early frosts.

[1] Bul. 109, Cornell Univ. Expt. Sta., 1896.

The escarpment tends to confine to the lake plain the tempering influences of the inshore breezes of the day and the offshore breezes of the night. These keep the air in almost continuous circulation, minimizing the danger from late frosts in the spring and early frosts in the fall.

Weather data are available for two stations in the plateau country and one in the lake plain. The lake-plain station is located at Westfield, about a mile from the lake shore, at an elevation of 700 feet above sea level and 120 feet above the lake. One of the upland stations is located on the escarpment crest at Volusia, 1,557 feet above the sea level, and the other, at Jamestown, at the southern end of Lake Chautauqua, is at an altitude of 1,400 feet.

The first table following gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at Jamestown, and the second table gives comparative records of normal monthly and annual temperature and precipitation for the year 1912 for the stations of Volusia, Westfield, and Jamestown:

Normal monthly, seasonal, and annual temperature and precipitation at Jamestown.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*
December	27.5	62	−12	4.03	4.00	4.84
January	27.0	72	−31	3.28	1.30	5.55
February	23.1	77	−17	2.97	0.77	4.54
Winter	25.9	77	−31	10.28	6.07	14.93
March	34.3	82	−10	3.41	2.98	3.64
April	44.9	86	12	3.10	2.04	3.39
May	56.9	88	22	3.48	2.98	4.61
Spring	45.4	88	−10	9.99	8.00	11.64
June	64.9	90	34	3.68	1.56	5.01
July	69.8	95	42	4.87	2.81	2.18
August	67.4	91	36	3.83	3.29	7.21
Summer	67.4	95	34	12.38	7.66	14.40
September	61.9	89	24	3.68	4.30	2.15
October	50.5	85	17	3.54	6.07	4.90
November	38.6	70	− 6	3.68	2.33	4.70
Fall	50.3	89	− 6	10.90	12.70	11.75
Year	47.2	95	−31	43.55	34.43	52.72

Normal monthly and annual temperature and precipitation at Volusia, Westfield, and Jamestown.

Month.	Volusia.		Westfield.		Jamestown.	
	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.
	°F.	Inches.	°F.	Inches.	°F.	Inches.
January	24.1	3.01	26.2	2.55	27.0	3.28
February	20.4	2.60	22.7	2.24	23.1	2.97
March	32.2	2.53	34.6	2.52	34.3	3.41
April	45.5	2.83	44.7	2.46	44.9	3.10
May	55.3	3.36	56.4	3.77	56.9	3.48
June	63.7	3.42	65.3	3.65	64.9	3.68
July	68.5	3.97	70.3	4.25	69.8	4.87
August	66.7	2.65	62.3	2.89	67.4	3.83
September	61.9	3.91	63.2	3.20	61.9	3.68
October	50.9	3.84	51.9	3.74	50.5	3.54
November	37.4	3.52	40.2	3.42	38.6	3.68
December	26.5	3.29	28.3	2.75	27.5	4.03
Year	46.1	38.93	47.2	37.44	47.2	43.55

There is little variation in mean annual temperature between the three stations, but there is a noticeable monthly and seasonal difference. While there is some seasonal difference in temperature between the upland and the lake plain for the spring and summer months, the lake plain being generally cooler in late spring and warmer in early summer, the most marked variation is in the fall. On the Erie forelands the average temperature for the three months, September, October, and November, is 1.5° higher than on the uplands, showing plainly the modifying effect of the lake on the temperature. The temperature at Jamestown is probably influenced slightly by Chautauqua Lake.

The rainfall at Jamestown is rather evenly distributed throughout the year, but in some years periods of drought or excessive precipitation may occur during the growing season and damage the crops. Generally over the county the heaviest rainfall occurs within the summer months. In the total amount of rainfall there is an evident difference between the two physiographic sections of the county. At Westfield, in the lake plain, the mean annual precipitation is 37.44 inches and at the upland stations, Volusia and Jamestown, it amounts to 38.93 and 43.55 inches, respectively.

The subjoined table shows the dates of actual frosts, first in fall and last in spring, at the three stations, as well as the average dates of frost occurrence:

Dates of first and last killing frosts.

Year.	Volusia.		Westfield.		Jamestown.	
	First in fall.	Last in spring.	First in fall.	Last in spring.	First in fall.	Last in spring.
1900	Oct. 20	May 10	Oct. 20	May 10	Oct. 18	May 10
1901	Oct. 17	Apr. 21	Oct. 25	Apr. 21	.....	Apr. 21
1902	Oct. 10	May 11	Oct. 10	May 11	Sept. 15	May 29
1903	Sept. 29	May 2	Oct. 27	May 2	Sept. 29	May 6
1904	Sept. 22	Apr. 22	Oct. 28	Apr. 22	Sept. 22	Apr. 22
1905	Oct. 12	May 21	Oct. 25	May 1	Sept. 26	May 24
1906	Oct. 10	May 10	Oct. 11	May 8	Oct. 8	May 21
1907	Oct. 9	May 28	Oct. 21	May 22	Oct. 9	May 22
1908	Sept. 29	May 4	Oct. 12	May 3	.....	.....
1909	Oct. 13	...do....	Oct. 13	May 2	.....	.....
1910	...do....	May 14	Oct. 28	May 12	.....	.....
1911	Oct. 8	May 5	...do....	May 5	.....	.....
1912	Oct. 16	May 14	Nov. 3	Apr. 28	.....	.....
Average	Oct. 9	May 8	Oct. 22	May 4	Oct. 1	May 12

There is a marked difference between the lengths of the growing seasons on the lake plain and in the plateau regions. The last frost in the spring generally occurs slightly earlier at Westfield than at either Volusia or Jamestown, and the first frost in the fall usually two weeks, and sometimes a month, later than at Jamestown or Volusia. The length of the growing season on the lake plain averages about 170 days and in the uplands about 148 days. In seasons, however, when the country is visited by exceptionally heavy frosts there is little difference in the time of occurrence in the lake plain and in the uplands, as in the years 1902, 1906, and 1909.

Poorly drained lands, as well as those on a northern exposure in either the lowland or upland regions, necessarily have a shorter growing season and are more subject to unseasonable frosts. Crops grown on the valley lands in the upland section of the county are more than ordinarily subject to late spring and early fall frosts, because the cooler, heavier air settles in these valleys and the calm atmospheric conditions are favorable for frosts.

AGRICULTURE.

During the first years of the occupation of the county the settlers produced corn, potatoes, wheat, and vegetables in small fields for their own consumption and devoted most of their time to lumbering. The chief timber growth was pine, hemlock, oak, chestnut, elm, and beech. A dense white-pine forest 12 miles square covered parts of the present towns of Carroll, Poland, Ellicott, Kiantone, and Busti,

and the site of Jamestown. This timber was all cut and rafted down Conewango Creek to sawmills on the Allegheny River. A great quantity of maple sugar was made. In 1850, 767,653 pounds were produced, but by 1870 the production had declined to 342,732 pounds.

With the removal of the timber the settlers turned to stock raising. Hogs were kept and fattened on beechnuts. Sheep as well as cattle were raised. The stock was driven to market in Philadelphia, Troy, Albany, and New York. In the season of 1850, 15,000 head of cattle were taken to Philadelphia to be fattened for the market.

In 1851 the first Erie train from New York reached Dunkirk, at that time the western terminus of the road. With the building of the railroads the county developed rapidly and by 1873 Chautauqua had become one of the foremost agricultural counties of the State. From stock raising the farmers had come to devote more attention to dairying and general farming in the uplands and to orcharding and viticulture in the lake plain.

In 1805 the first apple seeds were brought from New England and a nursery was started at Fredonia. Grape vines were introduced from New England in 1818. Viticulture, however, as an extensive industry in the lake-plain region really began in 1824, when plantings of Isabella and Catawba vines were made. Apples, pears, plums, cherries, and berries of all kinds were later produced, but they are now all subordinate to the grape in commercial importance.

The grains and staple crops have in general steadily increased in acreage and production. Hay and forage crops have increased in production from 162,272 tons in 1869 to 228,735 in 1909. According to the census, 119,540 acres were in hay in 1909.

The production of oats showed a steady increase from 755,451 bushels in 1869 to 1,081,340 bushels in 1899. In 1899 there were seeded to oats 29,343 acres and in 1909, 28,467 acres.

In 1869, 254,110 bushels of corn were produced. In 1879 the area devoted to corn was 16,806 acres, with a production of 542,889 bushels. In 1889 the area in corn was only 8,700 acres and the production 285,318 bushels. In 1899, according to the census, 547,350 bushels were produced and in 1909, 500,858 bushels. The decrease in production of grain in the last 10 years is due to the increased use of corn as ensilage for dairy stock feed.

The greatest production of wheat recorded in Chautauqua County was in 1869, when 148,849 bushels were grown. In 1909 the 918 acres sowed produced 19,379 bushels.

Buckwheat as a staple crop has steadily gained in importance. From 14,097 bushels in 1869 the production increased to 257,341 bushels in 1909. The upland soils of Chautauqua County are pecu-

liarly suited to buckwheat, which is highly valued both as a cash crop and for cattle feed.

Only a small acreage has at any time been devoted to rye. The largest production, 10,078 bushels, was in 1889. In 1909, 8,841 bushels were grown.

In 1869, 43,927 bushels of barley were produced, and the production continued to increase until 1889, when it amounted to 96,796 bushels. In 1909 the output had declined to 36,392 bushels.

A staple crop of Chautauqua County is Irish potatoes. In 1869 314,873 bushels were harvested, and the production steadily increased until 1899, when 7,463 acres produced 814,684 bushels. By 1909 there had come a falling off in the potato acreage and 778,277 bushels were produced from 6,329 acres. Potatoes are one of the main cash crops in the uplands.

In recent years, owing to the development of the canning industry, excellent opportunity has been afforded in Chautauqua County for such products as tomatoes, sweet corn, and peas. Tomatoes are at present grown extensively only in the lake plain. They do well on the upland soils, but canneries are not readily available. Corn for canning purposes is grown in the lake plain and in the Sherman district, yielding about a ton to the acre. The growing of peas has met with considerable success and generally the returns per acre are $50 to $60 or more. The peas are not only a profitable crop in themselves, but the vines can be used for cattle feed when cured, and the plant, being a legume, has a beneficial effect on the soil. As another advantage, peas can be harvested by July 1 and a crop of late Irish potatoes or buckwheat planted on the same land.

The value of domestic animals has shown a slow but steady increase. In 1880 the value of live stock, according to the census figures for that year, was $3,342,930; in 1890 it was $3,422,690; in 1900, $3,822,963; and in 1910, $5,296,830. The pronounced increase in the last 10 years is due to the introduction of improved breeds of dairy cattle. There are some herds of purebred Holstein, Jersey, and Guernsey cattle in the county. The majority of the dairy animals, however, are Holstein grades.

Dairying has developed, owing to the increased demand for milk and the facilities for disposing of it, into the chief live-stock industry. In 1879 about 13,830,404 gallons of milk were produced; in 1889, 20,062,176 gallons; in 1899, 25,331,557; and in 1909, 16,381,694. In the early years a large part of the dairy output was in the form of butter and cheese, but there has been a decline in these products in recent years. According to the census figures for 1869, 5,049,037 pounds of butter and 773,830 pounds of cheese were manufactured on farms; in 1879, 5,122,756 pounds of butter and 355,634 pounds

of cheese; in 1889, 2,986,738 pounds of butter and 323,541 pounds of cheese; in 1899, 2,277,762 pounds of butter and 290,163 pounds of cheese; and in 1909 only 482,765 pounds of butter and 5,476 pounds of cheese. The practice now is to sell the milk to condenseries, creameries or cheese factories, or to dispose of it directly as market milk in Buffalo, Dunkirk, Jamestown, and other places. Although there has been a falling off in milk production in the last 10 years of 8,949,863 gallons, the total value of the dairy products sold has increased in these same years from $1,598,995 to $2,034,455. This is due not only to the fact that higher prices are prevalent but also to the production of milk with a higher percentage of butter fat.

The number of cattle kept on the farms increased from 65,971 in 1870 to 83,927 in 1880. In 1890 there were only 67,549. In 1900 there were 103,572 cattle and in 1910, 88,202. The receipts from the sale of animals for the year 1909 were $1,126,255, and, in addition, $355,164 worth were slaughtered on farms.

Horse raising has never been given much attention in Chautauqua County.

Of late years the poultry business has developed considerably. According to the census the value of poultry and eggs produced in 1909 was $693,977.

As reported in the census, in 1870 there were 13,429 hogs in the county; in 1880, 13,120; in 1890, 21,630; in 1900, 16,357; and in 1910, 20,757. The number of hogs has varied considerably in these 40 years and reached its climax at the time most of the milk was made into dairy products locally, in other words, when more skim milk was available. In the last 10 years hog raising has gained new impetus.

The sheep industry was quite prominent in the early agriculture of the county, but steadily declined. In 1870 there were 40,404 sheep, producing 193,891 pounds of wool, but since then the number has decreased to 14,294 in 1910, with 7,740 fleeces shorn. There is still much steep and broken land in the county that would furnish good grazing for sheep.

Although fruit, mainly apples, is grown in the uplands, the lake plain has always been the fruit section of Chautauqua County. This region, because of the preponderance of grape production over other fruits, has come to be known as the Chautauqua grape belt. This is the largest and most important area producing native grapes in America. It comprises a strip of land extending along the southern shore of Lake Erie from Derby, Erie County, N. Y., to Erie, Erie County, Pa. The grape industry, however, is mainly centered and included in Chautauqua County. This belt has a width of 2 to 5 miles, or from the present lake bluff to the top of the

escarpment, which rises 500 to 700 feet above the plain and 500 to 1,000 feet above the lake.

The following paragraph on the grape industry in Chautauqua County is from a bulletin of the New York Agricultural Experiment Station:[1]

The sale of grapevines was begun in 1834 by Lincoln Fay. Few were sold, for in 1859 there were only 20 acres of bearing vines in the town of Portland. In the decade following the Concord was introduced, and in 1870 there were about 600 acres devoted to grape culture in Chautauqua County. The first carload of grapes was shipped from Chautauqua County in 1880, the shipment being made to Philadelphia by Jones Martin. In 1900 the shipment reached 8,000 carloads and in 1906, 5,634 carloads. This apparent decrease is accounted for by the large quantities used locally for wine and grape juice. According to a canvass made by this station in the preparation of "The Grapes of New York," the acreage of the district was, in 1906 to 1907, distributed approximately as follows: Portland Township, 9,500; Westfield Township, 5,700; Ripley Township, 5,700; Pomfret Township, 4,600; Hanover Township, 1,950; Sheridan Township, 1,950; and Dunkirk Township, 600, making a total of about 30,000 acres of grapes. According to the figures gathered, 90 per cent of this acreage was set to Concord, 3 per cent to Niagara, 2 per cent to Worden, and 1 per cent to Moore Early and Catawba, with the remainder made up of a dozen or more varieties, of which the Delaware leads.

In the following table, published by the "Grape Belt,"[2] the grape production throughout the region for the last 14 years is shown:

Estimated production of grapes in the Chautauqua belt, 1900–1913.

Year.	Production.	Year.	Production.
	Carloads.		*Carloads.*
1900	8,000	1908	4,323
1901	6,669	1909	7,561
1902	5,062	1910	5,700
1903	2,952	1911	8,100
1904	7,479	1912	7,528
1905	5,362	1913	3,957
1906	5,364		
1907	5,186	Total	83,243

It is estimated that the acreage devoted to grapes has increased from 30,000 acres in 1906 to 35,000 in 1913. The total production, however, in the last seven years has increased by only 1,467 cars over that in 1900–1906, an advance of only 3½ per cent.

Similar facts are true of the average yield per acre. A number of factors have been responsible for this low proportional increase in yields. There has been a tendency to establish plantings on soils ill suited to grape production, as on the thin droughty soils of the

[1] Bul. 315, N. Y. Agr. Expt. Sta., Geneva, N. Y., by M. J. Dorsey: The Grape Districts of New York and Table of Varieties.

[2] A semiweekly paper published at Dunkirk.

escarpment or the heavy, wetter soils of the lake plain, or at too high altitudes, where frosts decrease the yields.

From the apparent thrift of the vines grown on the lighter, more friable soils it would seem that the grape prefers these to the heavier types. In some instances, however, these light soils need the addition of organic matter to insure against drought. These lighter soils are of small extent and consequently it becomes necessary to improve the heavier soils by the application of manure and green manuring crops, and by cultivation and subsoiling and draining, so as to render them more suitable for grape growing.

The gross returns to the grape growers vary with the supply and demand. In the fall of 1914 a minimum price of $35 a ton was set by one of the grape-juice factories. The crops are generally contracted for in advance by the buyer and a grower may gain or lose by so selling, according to the character of the yield for that particular year. Only a small part of the crop is made into wine. A large proportion is sold in baskets for immediate consumption, at 1½ to 2 cents a pound, depending on the quality and the supply. The grapes are packed by either the grower or the purchaser. The shipment charges are met by the buyers, unless an individual grower markets his own product. The estimated value of the grape crop of Chautauqua County for 1910 was $1,980,449, and the production was 132,029,939 pounds.

There has been some increase in the production of other fruits in Chautauqua County. In 1889, only 17 bushels of peaches were produced; in 1899, 2,785 bushels; and in 1909, 15,486 bushels. Pears yielded in 1889, 2,601 bushels; in 1899, 10,472 bushels; and in 1909, 13,633 bushels. The cherry crop in 1889 amounted to 410 bushels; in 1899, 5,838 bushels; and in 1909, 12,630 bushels. The production of apples has varied from 175,704 bushels in 1889 to 825,633 bushels in 1899 and 646,269 bushels in 1909. Many of the apple orchards have been neglected in the last 10 years, and consequently there has been a falling off in production. According to the 1910 census, the production of strawberries in 1909 was 551,125 quarts, and of raspberries and loganberries 709,987 quarts. In 1899 the production of strawberries was 387,910 quarts and raspberries 465,300 quarts. The value of vegetables produced in the county in 1909 was $615,102.

The nursery business, especially the growing of grape and small-fruit stocks, has grown to large proportions. This industry is mainly developed in the vicinity of Fredonia and Silver Creek.

Several scattered areas of Muck throughout the county are devoted to truck crops with good returns. The uncleared areas bring some returns to the owners through the sale of timber for cooperage purposes. The demand for baskets and barrels in the fruit section is great, and most of the supply comes from lumber cut in the county.

In addition to these products, maple sugar and sirup are important. Chautauqua County stands tenth among the counties of New York in the production of these commodities, the last census reporting an output of 96,686 gallons of sirup and 157,844 pounds of sugar.

The general adaptation of soils to crops and agricultural industries is well understood in Chautauqua County. The fruit and vegetable industries are centralized on the lake plain, where the climatic conditions are most favorable and where the soils are in some cases lighter in texture and structure. On the other hand, the upland soils, lying at a higher altitude and well back from the tempering influences of Lake Erie, are devoted to general farming and dairying. In the upland region the valley soils and the more poorly drained areas are given over largely to grass and permanent pasture, while the higher tracts are devoted to corn, oats, hay, potatoes, buckwheat, etc. The rougher hill slopes are usually forested and are used to a greater or less extent for pasture.

Owing to the fact that grape and small-fruit culture prohibits the rotation of crops, little opportunity is afforded the farmers of the lake plain for pursuing systematic rotations, although cover crops of rye, vetch, mammoth clover, and, for heavy soils, turnips are grown between the vines by a great number of vineyardists. Regular cultivation is practiced every two weeks throughout the summer up to the time of seeding cover crops early in the fall. On land not devoted to vineyards and vegetables the usual rotation is corn one year, oats or wheat one year, and hay. A very small proportion of the lake plain, however, is devoted to general farm crops. The equipment in use on these grape farms is generally adequate and modern. A more or less effective crop rotation is used by the upland farmers, but it is far from systematic, generally being followed only when convenient. The common rotation is corn one year, oats one year, seeding to grass four to five years, buckwheat or potatoes one year, then back to corn. This system of cropping is entirely suited to the region if adhered to strictly, except that it would be better in most cases if the land were not left so long in grass. Timothy and clover hay is grown and after the first year, or two years at the most, this stand is displaced by a large number of wild grasses, among them barnyard millet, whitetop, and wire grass. Hay cut from such lands is of decidedly poor quality and when the weeds get a foothold they show up in the succeeding crops. In the uplands barnyard manure, of which there is generally an abundance on the dairy farms, is practically the only form of fertilizer used. In many cases a large part of its value is lost through exposure. Few farmers apply it to the land soon enough after it is produced.

Fall plowing is a practice not generally followed. By fall plowing, land which is naturally late in getting in condition for handling

in the spring, owing to its poor drainage, can be prepared and seeded earlier.

According to census figures, the value of fertilizer consumed in the county more than doubled between 1899 and 1909, being $215,817 in the latter year. While some of this fertilizer was used by the farmers in the uplands, the greater part of it was bought by the grape growers, as commercial fertilizers meet with little approval by the farmers of the plateau soils. Manure is used only sparingly by the vineyardists as a fertilizer, as few cattle are kept in the lake-plain region.

Labor in the plateau section of the county is scarce. From $20 to $35 a month and board is paid for ordinary farm labor. At present the demand for farm hands is largely supplied from local sources. A great many of the farmers cooperate during harvest. In the fruit belt no great trouble is experienced in getting labor in the rush season, as many people from the neighboring towns seek employment. Many Italians, Hungarians, and Austrians are brought from Buffalo and Erie. The price paid for labor in the fruit section is $1.50 a day, without board, for the men and women, children getting less, depending on their efficiency. The expenditure for labor in Chautauqua County in 1909 reached $969,761.

In the more remote parts of the uplands there are farms where the buildings are dilapidated and the land has been allowed to grow up to weeds and wild grasses. On most of the farms, however, especially in the fruit belt, the improvements are modern and the land is in a high state of cultivation. There is an increasing tendency to operate the farms on a more businesslike basis. However, there are quite a number of farmers who lack the necessary capital to improve their methods. Lately there has been considerable immigration of farmers from the Western States into the county.

According to the census of 1900, the total number of acres in farms was 614,303, of which 434,246 acres were improved. In 1910 there were only 613,000 acres in farms and 400,723 improved. Between 1900 and 1910 the average size of farms decreased from 83 to 81.7 acres. The percentage of farms operated by owners increased in the same decade from 79 per cent to 83.3 per cent.

Land values throughout the county vary considerably. In the upland section prices range from $10 to $60 or more an acre. The average price is probably about $30 an acre. In the lake plain and the better localities values range from $100 up to $200 or more for farms with bearing vineyards. The average price is about $150 an acre.

The farmers of Chautauqua County are comparatively well organized. There are 34 active granges organized, with 8,000 members. Their activities are mainly along social and educational lines, but some of them have taken up cooperative purchasing.

SOILS.

In the soil survey of Chautauqua County there are recognized 9 series, which include 23 distinct types, and in addition 3 miscellaneous types. A soil type includes all occurrences of soil having the same color, texture, structure, drainage conditions, topography, apparent organic-matter content, origin, and mode of formation to the depth of 3 feet. The types are grouped in series, each including all the types that have been subject to the same formative influence and that have the same color and character of materials. The types, or members of the series, differ only in texture.

The soils of Chautauqua County do not differ much in the source of their material. They have been derived mainly from sandstones and shales of Devonian age, belonging to the Portage and Chemung groups, though there has been an unimportant addition of igneous and metamorphic rocks brought from Canada by the ice. Primarily the soils have been derived from glacial drift resulting from glaciation of the country rocks above mentioned and the modifying of this drift by various agencies.

Although the soil materials of the county have had a common source, they differ widely from place to place in the processes by which they were accumulated, and a broad grouping may be made on this basis, the materials falling into six divisions as follows: (1) glacial, (2) glacio-residual, (3) glacial-lake or mixed glacial-lake and glacial, (4) residual, (5) water-laid, and (6) cumulose soils.

The soils from deep glacial material are represented by one series, the Wooster. The soils in this series have been formed from a thick mantle of glacial till laid down over the country rock by the continental ice sheet.

The glacio-residual soils are included in the Volusia series, and owe their formation to a thin mantle of glacial débris left by the ice on the bedrock. In some instances this layer of till is so thin that the soil has been influenced to a marked degree by the underlying rock formation, so that in a measure the forces of weathering have influenced the formation of these soils.

The Dunkirk and Clyde series embrace the soils that have been influenced by lake waters. The lake plain of Chautauqua County was at one time under lake influence, as is evidenced by the remains of two distinct beach lines, representing the shore lines of old glacial lakes Warren and Whittlesey. The Dunkirk series includes till deposits reworked by lake water and added to and influenced by lake sediments, and the gravelly types of the series represent old beach lines. The Clyde soils have been formed in much the same manner

as the Dunkirk, but have subsequently been under poor drainage conditions. These two groups of soils include practically the whole lake plain north of the escarpment.

The residual soil is embraced in one series, the Lordstown, with only one type, the shale loam. The soil is developed in the Erie plain and is derived from the weathered outcrop of the thin-bedded Portage shale.

The water-laid soils are grouped in the Chenango, Tyler, Genesee, and Papakating series, and some of the Wooster types as mapped contain some of this class of soil, though only where there has been very imperfect assortment of the material in areas of morainic topography. The Chenango series includes water-rounded and water-deposited material that occurs on stream terraces and as delta formations extending into old lake plains. The Tyler, Genesee, and Papakating series include soils developed in the present stream bottoms and in some cases are even now accumulating sediments at times of high water. The Tyler soils represent older and deeper alluvial sediments than the Genesee, and they are characterized by gray surface soils. The surface soils of the Genesee series are brown or grayish brown. The Papakating series is made up of black surface soils, which seem to have been influenced by standing water of local lakes.

The cumulose soil has been formed in low, poorly drained positions by the decay of organic matter or vegetation, and is mapped as Muck.

In addition, two miscellaneous separations are made, Meadow and Rough stony land.

The table below gives the name and the actual and relative extent of each type shown on the map accompanying this report:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Volusia silt loam	260,480		Dunkirk very fine sandy loam	6,784	1.0
Deep phase	94,464	58.1	Meadow	6,528	1.0
Steep phase	31,744		Papakating clay loam	5,696	.8
Smooth phase	10,688		Chenango fine sandy loam	3,648	.5
Wooster silt loam	69,888	10.2	Wooster fine sandy loam	3,520	.5
Dunkirk silty clay loam	27,648	4.0	Dunkirk gravel	3,072	.4
Volusia clay loam	26,880	3.9	Tyler clay loam	2,816	.4
Tyler silt loam	19,648	2.9	Genesee loam	2,688	.4
Genesee silt loam	17,408	2.5	Rough stony land	2,624	.4
Chenango gravelly loam	17,024	2.5	Tyler fine sandy loam	1,984	.3
Dunkirk clay	14,144	2.1	Papakating fine sandy loam	1,984	.3
Chenango silt loam	14,144	2.1	Lordstown shale loam	1,216	.2
Wooster gravelly loam	10,816	1.6	Clyde loam	1,088	.2
Dunkirk loam	8,960	1.3	Total	684,160	
Dunkirk gravelly loam	8,832	1.3			
Muck	7,744	1.1			

VOLUSIA SERIES.

The Volusia series is characterized by light grayish brown to brownish-gray or yellowish-gray surface soils and gray, yellow, and brown mottled, heavier, and more compact subsoils. In the lighter members of the series the upper subsoil may be yellowish, without any distinct mottling until a depth of 12 to 18 inches is reached, while in the heavier types mottling usually begins immediately below the surface soil. The topography ranges from undulating to rolling and hilly. Drainage is imperfect. In origin these soils are derived from ice-laid deposits consisting of sandstone and shale material with but slight limestone influence, and have their typical development where the glacial till bears a close relation to the underlying rock.

Two types of the Volusia series occur in Chautauqua County, the silt loam, with three phases, and the clay loam.

VOLUSIA SILT LOAM.

The top soil of the typical Volusia silt loam to a depth of 6 or 8 inches is a mellow, grayish-brown to brownish-gray silt loam. When dry it has a light-gray appearance. The upper subsoil to about 18 inches is a light-yellow or yellowish-brown silt loam. Below this there occurs a light-yellow or yellowish-brown, compact, heavy silt loam or silty clay loam, invariably mottled with gray, drab, olive, and rusty brown. Throughout the soil and subsoil appear numerous shale and fine-grained sandstone fragments, varying in size from small chips to blocks 8 or 10 inches in diameter. In places, generally where the topography is rough and broken, it is impossible to bore deeper than a foot or so with the soil auger, on account of the high stone content. On the other hand, there are areas where comparatively few stones are found in the 3-foot soil section.

A marked characteristic of the Volusia silt loam is the presence at any depth from 8 inches downward of a layer somewhat in the nature of a hardpan which retards the movement of water either upward or downward and renders the type either droughty or poorly drained and aerated. The nearer this hardpan is to the surface the less room the plant roots have to feed in, as they rarely can penetrate it. When examined in road cuts this compacted layer appears made up of sand, silt, and rock fragments or chips cemented with clay. Subsoil construction such as described above occurs more or less throughout the whole extent of the type, and is found typically developed north of Jamestown in the towns of Ellington, Cherry Creek, Charlotte, Villenova, Arkwright, and Ellicott and in the eastern part of Ellery. In forested tracts this hardpan may be absent, owing to the fact that the tree roots tend to

prevent its formation. From this it might be concluded that this peculiar physical structure of the subsoil is due to continued cropping and growing of shallow-rooted crops or to shallow cultivation for many years. In forested tracts of the Volusia silt loam and in areas which have been cleared but not put under cultivation there occur mounds or ridges of a light-brown, well-drained, and well-aerated soil, with no tendency to hardpan. These are locally termed "hemlock knolls." They are of small extent and of low productiveness. This hardpan feature of the Volusia silt loam contributes largely to the low productiveness of the type, for to it, even though the surface features indicate good drainage, can be traced its uniformly poor state of drainage. Deeper plowing—not subsoiling—to incorporate gradually the hardpan material with surface soil so as to enlarge the root zone has given good results.

The Volusia silt loam is by far the most extensive type of soil in the county. It occurs in the upland area from the escarpment south to the county and State line. It occupies the highest elevations in the county, ranging from 900 feet in the town of Portland to 2,200 feet in the town of Carroll in the extreme southeastern corner of the county. With this great range in elevation the surface is rugged, embracing high hills with rolling slopes and lower, benchlike areas with even surface.

The original tree growth over most of the Volusia silt loam was sugar maple, white pine, chestnut, beech, birch, wild cherry, and white oak. Most of the first-growth timber has been removed and the wooded areas now standing are largely of second growth. The rougher portions of the type are for the most part forested. North of Jamestown and west of Cherry Creek and east of Sinclairville and Gerry there was originally an extensive pine forest.

The typical Volusia silt loam is almost entirely devoted to dairying and general farming. There are a few orchards located on this soil, and judging from their thrifty appearance it would seem that under proper care apple growing could be much more extensively developed.

In the hay lands and pastures on this soil all the common weeds make a vigorous growth and the custom of allowing sod to remain for 6 or 8 years or more enables these weeds to choke out the timothy and clover. The root borer attacks clover, though improved drainage and the use of lime extend the life of this legume.

Of all crops, the Volusia silt loam is best suited to the production of hay. Mixed timothy and clover hay yields 1 ton to 1½ tons per acre, and in some cases 2 to 3 tons, especially where lime has been applied. Alsike clover, which does best on a wet, acid soil, is largely grown. In the pastures the prevailing grass is Canada bluegrass.

Corn is grown mainly for ensilage and fodder, as owing to the elevation and the shortness of the season the crop may not mature before frost. Eight to ten tons of silage corn is the usual yield per acre on this type, according to farmers' reports. Oats yield on an average 30 to 40 bushels to the acre, and 50 bushels have been produced in good years. Buckwheat produces 25 to 30 bushels per acre and is quite extensively grown. Occasionally millet is grown as a soiling crop and rye for the grain or as a green manure. Late Irish potatoes are an important cash crop, yielding ordinarily 75 to 150 bushels per acre, with a maximum of 200 bushels or more on the best farms. Potatoes are grown very successfully on a commercial scale on this type of soil elsewhere in New York State. Peas and corn for canning are grown on this type with fair results in the vicinity of Sherman and Cherry Creek. In several instances forestry and the growing of locust trees for fence posts are being developed and some of the rougher areas of this soil are well suited to these uses.

On the whole, the agricultural conditions over most of the typical Volusia silt loam are poor, judging from the appearance of the fields and farm improvements, and it is on this type of soil that the neglected farms, already mentioned, are mainly situated. The land ranges in value from $10 to $20 an acre for the poorer tracts and those more remote from markets to $50 for the best located and improved land.

Volusia silt loam, steep phase.—In color, texture, and structure of the soil material the steep phase does not differ materially from the typical Volusia silt loam. Stone is more plentiful on the surface and through the soil section, and in places the entire 3-foot section is very stony. The distinction, however, is one of topography solely.

The steep phase is widely distributed through the upland. Its greatest development is in the rough hilly country along the eastern and southern boundaries of the county.

Very little of the phase is under cultivation, but a large proportion is cleared or partially cleared and used for pastures. In many areas the phase is well suited to orcharding, especially apple growing, and to forestry.

Volusia silt loam, deep phase.—To a depth of 12 to 15 inches the soil of the Volusia silt loam, deep phase, is a friable, grayish-brown silt loam, containing a few angular shale chips. When dry it has a rather light brownish gray cast. The upper subsoil to 24 inches is a lighter grayish brown or yellowish-brown silty loam, containing slightly more sand. This part of the subsoil is mottled with gray and rusty brown. At 24 inches the subsoil generally passes into a darker grayish brown, heavy silt loam, containing shale chips and

showing some light mottlings of yellow and gray. In places the subsoil approaches a loam in texture and has more than the usual content of gravel. There are relatively few stones in the surface soil.

The phase is characterized by its depth of top soil, seldom having less than 1 foot. The subsoil has a somewhat higher stone content than the surface soil, consisting of angular and subangular shale and sandstone fragments. In this phase the usual hardpan characteristics that are encountered in the typical Volusia silt loam are absent. Along the escarpment slope the phase contains considerably more shale and sandstone fragments on the surface than is typical and the whole soil section inclines toward a silty loam in texture. Nevertheless, owing to its depth, this material was included with the deep phase of the silt loam.

As in the typical Volusia silt loam, there occur in this phase "hemlock knolls." These are knobs or ridges, of small extent, of light-brown or yellow silt loam, containing little organic matter. They are found in forested or pastured areas and are covered usually with ferns and sumac. They are generally unproductive. The lower subsoil and substratum often effervesce with hydrochloric acid, showing the occurrence of lime in some form.

The Volusia silt loam, deep phase, is closely associated with the typical Volusia silt loam and the Wooster silt loam, representing a gradation between the two. In the town of Hanover, east of Forestville, quite a large body of this soil occurs. It is also encountered on the east and west sides of Chautauqua Lake and in the towns of Busti, Harmony, Chautauqua, Ellery, Ellicott, and Stockton. In these areas its topography is gently rolling. From Laona westward along the escarpment front occur several areas of the deep phase whose surface features are more or less broken, owing probably to recent erosion of this slope. Typically this phase is developed largely in the vicinity of Sherman and in the towns of Ripley and Mina. In these localities the topography is more or less drumlinlike, being made up of a series of low, smooth, rounded hills, whose axes run in a southeast and northwest direction.

While this phase as a whole is better drained than the typical Volusia silt loam, the prevailing subsoil is generally rather impervious. In places at the foot of slopes and between ridges where the surface is fairly level and there is more or less seepage from the adjacent higher land, drainage conditions can be permanently improved only by artificial means. Many brooks and natural drainage ways traverse this soil, affording ample drainage outlets.

The Volusia silt loam, deep phase, contains more foreign material than the typical soil, numerous igneous bowlders occurring on the

surface and an appreciable quantity of granitic and crystalline rock fragments here and there appearing throughout the soil section.

The deep phase originally supported a growth of pine, hemlock, and chestnut. In the forested areas now existing is found a second growth of beech, birch, white oak, and sugar maple. Only the rougher portions of the type are forested.

This phase is exclusively a general-purpose and dairying soil. The milk from the dairies is manufactured into cheese and condensed milk. Much of the capital of the farmers is invested in dairy stock. Some income is received annually from the sale of veal calves and yearlings. Some hogs are raised. From the character of the farming, hay is naturally one of the main crops and actual yields of 2 or 3 tons are obtained on the most highly developed lands of the type. Most of the hay is clover and timothy mixed. Many of the dairy farms are equipped with silos. The yield of silage corn ranges from 10 to 12 tons per acre.

Buckwheat yields 20 to 30 bushels per acre. Wheat has produced 30 bushels to the acre. Oats yield from 35 to 45 bushels. Nearly every farmer on this phase grows 5 or 6 acres of late Irish potatoes, which are an important money crop. Yields of 125 to 200 bushels per acre are not uncommon.

In the vicinity of Sherman peas for canning bring a return of $50 to $60 an acre. Sweet corn and pumpkins are also produced for canning, the former yielding 1 to 1½ tons per acre. Rye, barley, and millet are occasionally grown and give fair results. On selected areas of this phase excellent stands of alfalfa have been obtained, with the use of lime and with careful preparation of the seed bed.

Some of the best apple orchards in the county are located on this soil, and along the escarpment front grapes are grown, yielding 1 to 1¾ tons to the acre.

In general the agricultural conditions on the deep phase of the Volusia silt loam are much better than on the typical soil. A large proportion of the phase is under cultivation and it includes some of the best soil in the uplands of Chautauqua County. The crops grown seem particularly suited to the soil and to the region, but some improvement could be made in farm methods. Most farmers have no fixed crop rotation.

Farm improvements are above the average of those on the typical soil. Land values range from $30 to $60 an acre, depending on location with reference to shipping facilities, milk routes, and good roads, as well as on the character of improvements and state of cultivation.

Volusia silt loam, smooth phase.—The smooth phase of the Volusia silt loam is a light-brown to light brownish gray, mellow silt loam to a depth of 7 to 10 inches. The subsoil is a light yellowish brown,

heavy silt loam, mottled with gray and dark or rusty brown. The subsoil generally overlies at no great depth the country rock—arenaceous shales and sandstones—which tends to render the subsoil lighter than that of the typical Volusia clay loam, which rests immediately upon the Portage shales. There is almost an entire freedom from fragmental rock. The soil of the phase has a distinctly light color and inert appearance, due to the lack of organic matter, to poor drainage, and to the fact that it has been cropped continually for years. This probably was the first upland soil to be cleared and farmed, on account of its desirable surface features.

On this phase there are small areas of hemlock land or ridges. The soil here is a brown silt loam, changing in the subsoil to lighter brown. These ridges lie 2 or 3 feet higher than the surrounding ground, and the difference in color of the soil is due to better drainage and aeration. However, these higher, ridgy areas are of low productiveness, owing probably to lack of humus.

The smooth phase occurs on some of the broad, flat hilltops, principally in the towns of Charlotte, Cherry Creek, Ellery, Ellicott, Carroll, and Poland.

The topography of this phase is level to flat, and in places rolling. The natural drainage is poor, owing to the relatively heavy nature of the subsoil and the nearness of bedrock. On this account water often stands on the surface for two or three days after heavy rains.

The Volusia silt loam, smooth phase, is not extensive. The soil seems to be best suited to the production of hay and to pasture, although buckwheat and potatoes give fair yields. The same agricultural conditions exist on this phase as on the typical soil. Some of the abandoned farms of the county are located on it.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the smooth phase of the Volusia silt loam:

Mechanical analyses of Volusia silt loam, smooth phase.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162002	Soil	1.6	2.5	1.0	4.0	15.0	59.7	15.9
162003	Subsoil	3.0	3.0	1.2	4.8	17.9	54.0	15.7

VOLUSIA CLAY LOAM.

The surface soil of the Volusia clay loam to a depth of 4 to 8 inches is a silt loam, grayish brown to light brownish gray when dry, and containing some angular shale fragments varying in size from 3 or 4 inches in diameter to fine chips. The stone content is

not so high as in the Volusia silt loam. The subsoil is a stiff, heavy clay or clay loam with a greasy feel and a light-gray or drab basic color, mottled with orange, yellowish brown, and rusty brown. In places there appear black mottlings, which are caused by fragments of shale in the process of decomposition. The subsoil is relatively free from stone and generally rests at 2 or 3 feet on shale and flagstone, or more rarely on sandstone and arenaceous shale. The two rocks first named account for its heavy character.

Large and small areas of the Volusia clay loam are distributed throughout the county. They are typically developed along the escarpment front in the towns of Hanover, Sheridan, Pomfret, Portland, and Westfield. In these areas the topography varies from rolling or flat on the benchlike projections along the escarpment to rough and broken on the steeper slopes. South of Prospect Station and at the head of Chautauqua Lake an area is encountered where the surface is rolling and in which kettle holes occur. This area seems to be the remains of an old lobe of the escarpment moraine, the surface having been eroded away and the characteristic heavy clays of the deeper morainic deposits left exposed. In railroad cuts through this section of the type blue bowlder clay is seen in the substratum. In this locality there are few stones either in the soil or subsoil and the bedrock lies at a depth of 20 to 30 feet. Several small bodies of Volusia clay loam situated on hill tops or gentle slopes occur in the uplands in the towns of Carroll, Busti, Chautauqua, Harmony, Clymer, Mina, and Sherman. In these areas there is a greater depth of top soil, the clay subsoil rarely reaching within 8 inches of the surface, while in other parts of the type as mapped the clay subsoil is encountered at 4 or 5 inches.

The type ranges in elevation from 900 feet on the escarpment to 2,100 feet in the hills of Carroll Town. With the exception of the one area mentioned, at the head of Chautauqua Lake, the Volusia clay loam has been derived from the weathering of a shallow mantle of glacial till, as evidenced by the occurrence of erratic bowlders here and there over the surface, and also from the weathering and disintegration of the shale and flagstone bedrock underlying the till sheet.

On account of its heavy texture, the type is difficult to handle when either too wet or too dry, especially that part of it occurring on the escarpment slope. Its underdrainage is also poor, on account of the stiff, plastic clay subsoil and the nearness of bedrock. For these reasons it has proved advantageous to tile-drain the areas, to apply lime and manure, and to turn under green manuring crops. Deep fall plowing has also shown good results. This is naturally a strong soil.

The native forest growth consists of sugar maple, chestnut, hemlock, beech, birch, and pine. Much of the original tree growth has been removed, but a large proportion of the soil is now forested with second growth.

The Volusia clay loam in Chautauqua County has not only been developed as a dairying and general-purpose soil, but it is also used considerably on the escarpment slope for grape culture. Grapes yield from 1½ to 2 tons per acre, depending upon the care given. Owing to the higher altitude, the season is shorter on this soil than on the lake plain, but few crops are lost on account of early fall or late spring frosts. By draining and cover cropping the soil can be made warmer and still better suited to grape culture. A large, tough-skinned grape is generally produced on this soil. It is evidently a good soil for the production of apples.

Of the general farm crops, hay is probably the most important. It yields 1 to 1½ tons per acre. Corn yields 8 to 10 tons of ensilage; oats yield 25 to 30 bushels; buckwheat, 25 bushels; and potatoes, 50 to 100 bushels per acre. In some instances wheat has yielded as much as 20 bushels per acre.

Agricultural conditions over this type are much like those on the Volusia silt loam. Land values range from $30 or less an acre in the hills to $100 for the type as a grape soil.

Results of mechanical analyses of samples of soil and subsoil follow:

Mechanical analyses of Volusia clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162044	Soil	0.5	1.9	0.9	4.0	8.6	55.2	28.9
162045	Subsoil	3.2	3.2	1.1	3.7	9.9	49.5	29.2

DUNKIRK SERIES.

The surface soils of the Dunkirk series range in color from brown to brownish gray and the subsoils from yellowish brown in the lighter types to gray and yellowish brown or brown mottled in the heavier members. These soils are level or gently undulating to rolling in topography and have only fair to good drainage. They are derived from water-deposited material laid down on the floor and along the shores of old glacial lakes. They are essentially noncalcareous, the material being largely from sandstones and shales, with some crystalline-rock influence. In Chautauqua County the Dunkirk series is represented by six types—the Dunkirk gravelly loam, gravel, very fine sandy loam, loam, silty clay loam, and clay.

DUNKIRK VERY FINE SANDY LOAM.

The top soil of the Dunkirk very fine sandy loam is a mellow, brown to light-brown very fine sandy loam with a depth of 8 to 10 inches. When dry the material has a grayish-brown color, with here and there browner spots. The top soil as a rule carries a high percentage of silt and very fine sand. The subsoil is a lighter brown fine sandy loam, mottled with gray and rusty brown. The texture generally grows more sandy and coarser with depth, though it contains enough silt and clay to cement the sand particles closely together. It is hard to penetrate, but comes up on the soil auger as a mealy, granular material. The sand particles are well rounded. Variations occur and in some places the surface may be silty, with a sandy subsoil; in others it may be a fine loam underlain by silt and clay.

In this type there are small spots where the vines and crops are stunted or dead. These spots seem to be due to some peculiar physical condition brought about by erosion. Some rounded gravel particles, ranging in size from that of a pea to 1 or 2 inches in diameter, and angular shale chips appear on the surface, but the soil and subsoil are generally quite free from any very coarse material.

As mapped, the Dunkirk very fine sandy loam includes some areas of Dunkirk silty clay loam.

The Dunkirk very fine sandy loam is distributed throughout the lake plain in scattered areas. One of the largest areas is developed to the west and northwest of Brocton.

In general the surface is undulating, with the exception of the two bodies situated immediately south and southeast of Silver Creek, which are hummocky and uneven, and the areas in the neighborhood of Brocton and Portland, which are still rougher. In the latter the surface is made up of a series of knolls and ridges, from which much of the surface soil has been washed, with potholes where the drainage has been obstructed. A factor in part responsible for this erosion in some places is the uninterrupted one-way cultivation necessary in grape culture.

This soil not only has inherent physical properties favoring erosion, but is deficient in organic matter and lime. Applications of organic matter in the form of barnyard and green manures, and of lime, with deeper plowing, will greatly reduce the tendency to wash. Installation of tile drains where practicable will have the same effect.

The timber growth is largely beech, birch, cherry, poplar, walnut, and maple, with some hemlock and pine. The original forest growth has largely been removed, and where the land is not under cultivation it is covered with second-growth trees and underbrush. Considerably more than half the type is farmed.

This type is associated with other Dunkirk soils and sells for about the same price, from $100 to $200 an acre. It is used largely in the production of grapes, but the vines are not so hardy as those on the heavier soils, the berries are smaller, and the bunches do not fill as well. This type is not adapted, especially in the eroded sections, to the continued cultivation necessary for the production of grapes, and the price it brings for grape culture is hardly justified. In the gently rolling areas, however, it is better suited to the production of such small fruits as strawberries, currants, gooseberries, blackberries, and raspberries, and of vegetables, such as tomatoes, beans, peas, sweet corn, and potatoes. It is an early truck soil. Hay yields 1 to 1½ tons, oats 25 to 30 bushels, and wheat 10 to 15 bushels per acre.

In the table below are given the results of mechanical analyses of samples of the soil and subsoil of the Dunkirk very fine sandy loam:

Mechanical analyses of Dunkirk very fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162038	Soil	0.5	0.7	0.2	6.9	45.0	33.4	12.7
162039	Subsoil	.1	.4	.2	6.0	53.6	30.7	8.5

DUNKIRK LOAM.

To a depth of 6 or 8 inches the Dunkirk loam is a grayish-brown to dark brownish gray loam containing a relatively high percentage of fine and very fine sand. The upper subsoil from 8 to 15 inches is a yellowish-brown sandy loam or fine sandy loam, mottled with gray and darker brown. This passes at 15 inches into mottled gray or brown sandy clay, and at 20 to 24 inches into a heavy silt loam, clay loam, or clay of a light grayish brown color with gray and orange or rusty-brown mottlings. There seems to be no marked uniformity in thickness, depth, color, or in the sequence of the various strata in the soil section. There is, however, a stratum of sand or fine sand lying usually immediately below the surface soil. As a whole the type tends toward a heavy, compact loam.

Large quantities of shale and sandstone fragments, with some of igneous origin, occur on the surface and throughout both soil and subsoil. These are generally angular and do not give indication of having been subjected to severe water action. Although the stone content is by no means uniform, there is probably more stone in this type than in any other of the Dunkirk soils, though not sufficient seriously to hinder cultivation. At 3 to 5 feet the substratum contains sufficient lime to effervesce with hydrochloric acid.

The Dunkirk loam is not confined to any particular part of the lake forelands, but occurs in bodies of various size throughout the

whole lake plain. It is developed in the towns of Hanover, Sheridan, Pomfret, Dunkirk, Portland, Westfield, and Ripley. Typical areas lie immediately northeast of Fredonia and at Hanover Center, and between Lamberton and Brocton, just north of the Ridge Road. The body mapped south of Brocton and east of Portland is decidedly stony and seems to have been more or less influenced by the underlying till deposits. A large part of the type is associated with the old beaches, occurring either between them or on the shoreward side.

The surface of most of the Dunkirk loam has little variation, being gently rolling to flat. That part associated with the beaches is likely to be poorly drained, on account of seepage and run-off from the higher ground, and the surface takes on a dark-gray color, approaching the Clyde loam in characteristics. The remainder of the type is also generally poorly drained, as the fine-textured, impervious subsoil keeps the surface soil more or less saturated. Many surface drains have been dug through the type, but these are generally insufficient to drain the areas properly. When the top soil dries it bakes and clods.

The timber growth over this type was originally walnut, elm, poplar, oak, chestnut, beech, and cherry. Little of the type is now forested, most of it being either under cultivation or in pasture, the more poorly drained tracts being put to the latter use.

The Dunkirk loam is largely devoted to the production of grapes, of which the yields range from 1 to 2 tons per acre. A few successful orchards are located on it. Some small fruits are also grown. Tomatoes yield 10 to 15 tons per acre, and this soil seems well suited to tomato growing. Hay cuts 1 to 2 tons per acre, corn yields 40 to 75 bushels, oats 30 to 40 bushels, and potatoes 100 to 150 bushels.

Land values on the Dunkirk loam depend largely on location and state of cultivation. When set in vineyards it sells for $200 or more an acre, while land for general farming purposes brings about $100. Its rather high valuation in the latter case is due to its possibilities as a grape soil and to its usual situation within short distances of shipping points. Most of the land is improved with good buildings.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Dunkirk loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162054	Soil	1.1	3.9	3.4	21.5	12.2	39.6	18.0
162055	Subsoil	1.1	2.8	3.0	17.7	15.7	45.1	14.1

DUNKIRK SILTY CLAY LOAM.

The surface soil of the Dunkirk silty clay loam to a depth of 6 to 10 inches is a dark grayish brown, heavy silt loam to silty clay loam. When dry the predominant color of the surface is a lighter brownish gray. The upper subsoil, between 10 and 24 inches from the surface, is a light grayish brown or yellowish-brown, brittle silty clay loam, generally mottled with gray or rusty brown. Between 24 and 36 inches the subsoil passes usually into a compact silty clay or clay loam of a brownish-gray or grayish-brown color.

The heavier part of the type is associated with the Dunkirk clay, and while the surface soil is generally friable, in the more level and poorly drained areas it is inclined to bake and crack.

This type also includes a lighter variation which occurs in association with the typical Dunkirk very fine sandy loam. The top soil here to 8 or 10 inches is a mellow, grayish-brown silt loam, underlain to 36 inches either by a uniform yellowish-brown, compact silt loam, mottled with gray and rusty brown, or by a mixture of sand, silt, and clay that occurs in pockets and layers. This variation of the type seems very compact, but crushes to a fine powder. It is subject to erosion on even slight slopes. Another variation found in the lighter areas of this type is the occurrence of spots, varying in area from 20 to 50 square feet or more, wholly devoid of vegetation. They occur generally on the sides of hills or slopes and may be due to exposures of the sand, silt, and clay subsoil. Such patches lack lime and organic matter and are compact and droughty.

The lighter areas of this type are generally rather stone free, but contain some shale chips and rounded gravel, while the heavier areas carry some larger fragments of shale and sandstone, as well as some large erratic bowlders, the latter mainly on the surface. This is especially true of an area between Brocton and Westfield and of that part of the type extending from the vicinity of Forsyth westward to the county line. While the soil and upper subsoil are deficient in lime, the material at lower depths effervesces with hydrochloric acid.

The Dunkirk silty clay loam is the most extensive type in the lake plain of Chautauqua County. The heavier parts as a rule are encountered from the vicinity of Brocton and Lamberton eastward to Silver Creek and Irving and in the neighborhood of Westfield, while the lighter soil is developed around Brocton in association with the Dunkirk very fine sandy loam and westward toward Forsyth, following along the immediate shore line.

The topography varies from level or rolling in the areas of heavier soil, where drainage is generally fair or poor, to hummocky and eroded in areas of the lighter soil. Owing to the generally level surface of most of the type and its retentive nature, it is easily saturated.

Some difficulty is experienced in plowing and cultivating it, owing to its tendency to puddle and clod. In many cases tile drains have been installed and have given excellent results. Liming, applying barnyard manure, turning under green manuring crops, and deep plowing are the means used to improve this soil.

A forest of elm, white oak, beech, walnut, hard maple, and poplar originally covered areas of this soil. Very little of this remains at the present time.

The Dunkirk silty clay loam is largely in vineyards, and where properly handled has proved one of the best soils in the grape belt of Chautauqua County. The average yield of grapes at present on this type is 1½ to 2½ tons per acre. This soil is not so early as the more gravelly soils in the same locality, but with proper methods of management its season for ripening fruit and for cultural operations can be lengthened somewhat. The grapes produced on this type tend to have thicker and tougher skins than those grown on the gravelly or lighter soils, and consequently stand shipping better. There is no marked difference, however, in the quality, flavor, or sugar content of the fruit grown on the heavy and on the light soils.

In addition to grapes, an important crop is tomatoes, which yield 10 to 15 tons per acre. In dry years the better Dunkirk silty clay loam land is more to be desired than the gravelly soils for this vegetable. Apples do well on this type where the soil has fair natural drainage. On the lighter variation raspberries, blackberries, currants, and gooseberries bring good returns. Of the general farm crops hay yields 1½ to 2 tons, corn 50 to 75 bushels, oats 30 to 40 bushels, rye 30 bushels, and potatoes 100 to 150 bushels per acre. Peas and corn are grown to some extent for canning purposes and are considered good money crops. Fertilizer is occasionally used on this soil by grape growers.

The agricultural conditions existing over the Dunkirk silty clay loam are good. The farm buildings are in good repair and most of the type is near towns, trolley lines, and railroads. The average farm contains from 50 to 60 acres, and the value ranges from $100 to $200 an acre. Soil of this type in bearing vineyards brings much more than the above, depending on the bearing records of the vines.

Mechanical analyses of samples of soil and subsoil gave the following results:

Mechanical analyses of Dunkirk silty clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162049a	Soil	2.2	4.8	2.5	9.9	7.1	47.9	25.4
162049b	Subsoil	2.8	5.2	2.8	13.8	10.9	43.2	21.1

DUNKIRK CLAY.

The surface soil of the Dunkirk clay, to a depth of 8 to 12 inches, is a dull brownish gray, rather silty clay loam to silty clay. The subsoil is a stiff, heavy clay or silty clay containing little or no grit. It is generally gray or drab in color and strongly mottled in most instances with yellow or orange and rusty brown. In places it is more or less evenly mottled with these colors, no one color predominating. In other places black mottlings, due to the presence of decaying shale chips, occur. In some areas the lower subsoil is a silt, silt loam, or heavy loam instead of a clay.

A few flat shale and sandstone fragments and chips are sometimes present in the soil and subsoil, especially in areas where the underlying glacial till or bedrock has not been covered to any great depth by the later lake sediments. In the lower depths the subsoil is more or less calcareous.

The Dunkirk clay is extensively developed in the lake plain. The larger areas occur in the vicinity of Dunkirk and eastward to Cattaraugus Creek in the towns of Dunkirk, Sheridan, and Hanover. There are several smaller areas in the towns of Portland, Westfield, and Ripley.

The surface of the type varies from gently rolling to flat, which, with the relatively impervious subsoil, causes poor drainage. Water collecting on the surface has little opportunity to escape, except by evaporation, the natural drainage ways being few. Fall plowing, allowing the soil to be acted upon by the elements through the winter and spring, generally gives good tilth, but the only permanent and really efficient means of overcoming the droughty character of this soil in dry weather is artificial drainage. This fact has been realized by many of the farmers and underdrainage systems have been installed in many of the fields. The effects on the condition of the crops and on the yields have more than justified the cost of this improvement.

The type has a low organic-matter content, and some of the grape growers recognize the advantage of adding barnyard manure and plowing under green manuring crops. The addition of lime also has a granulating effect on this heavy clay soil and is a valuable aid in improving its physical condition.

The Dunkirk clay, like the Volusia clay loam, is one of the most difficult soils in the county to handle. If plowed or cultivated when the soil is either too wet or too dry clodding results. When the soil has been put in this condition it is almost impossible by any amount of subsequent cultivation during the season to obtain a good tilth. The heat of the sun causes large cracks in the surface and allows excessive evaporation even when the soil is not cultivated. At times it becomes necessary to allow vineyards to go through a whole season

without cultivation because plowing could not be done at the proper time.

The original forest growth has practically all been removed. It consists of white oak, elm, beech, walnut, butternut, wild cherry, and ash. Most of the type has been put under cultivation and the remainder is either in pasture or second-growth timber.

The Dunkirk clay in Chautauqua County is suited to a variety of crops, but is mainly used for the production of grapes. The grapes grown on this type are of better shipping quality than those grown on any other type in the county, being firmer and thicker skinned. The yield is 1 to 2½ tons per acre.

Mixed timothy and clover hay yields 1½ to 2 tons per acre. Corn yields 50 to 60 bushels, rye 20 to 30 bushels, and oats 30 to 35 bushels. Occasional crops of tomatoes, cabbage, and buckwheat are grown, and peas and corn for canning. Practically no dairy cattle are maintained on this type, only enough milk being produced for home consumption. Some sheep are kept.

The price of land on the Dunkirk clay ranges from $75 to $100 an acre for uncleared tracts to $150 or $200 for land used as vineyards and having fair improvements. The farms usually range around 60 acres in size. All of the type is well situated with reference to markets and shipping points.

DUNKIRK GRAVEL.

The Dunkirk gravel consists of a dark grayish brown gravel with an admixture of sand of the different grades, silt, and clay. There is no appreciable change in texture through the 3-foot section, except that in the lower part the gravel tends to become finer and the proportion of sand increases. The gravel varies from fine particles to fragments 5 or 6 inches in diameter. Most of the gravel is well rounded, but some is angular. It comes largely from shale and sandstone rocks.

The type is of relatively small extent, representing the coarser part of old beach deposits that have undergone little change through weathering. It is found, as a rule, either on the north slope or just on the crest of the old beaches.

The Dunkirk gravel has about the same agricultural value as the Dunkirk gravelly loam, but is more droughty, as it has much less interstitial material than the latter. An irrigation system exists on this type. All kinds of fruit, especially grapes, and vegetables are grown with pronounced success in favorable years. The fruits rarely suffer from lack of moisture, except possibly strawberries, but vegetable yields are likely to be low when the seasonal rainfall is scant.

A mechanical analysis of a sample of soil of the Dunkirk gravel gave the following results:

Mechanical analysis of Dunkirk gravel.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162034	Soil	28.1	19.6	6.2	7.0	5.2	24.6	9.0

DUNKIRK GRAVELLY LOAM.

The surface soil of the Dunkirk gravelly loam to a depth of 6 to 10 inches is a brown to grayish-brown gravelly loam, containing a relatively large percentage of silt and sand. This is underlain by a lighter brown gravelly loam having enough fine material to bake on exposure. At 1½ to 2 feet the subsoil grades into a coarse sand and gravel and the substratum is made up of imperfectly stratified sand and gravel of various grades. The gravel ranges in size from small rounded pebbles to fragments 3 or 4 inches in diameter and consists largely of shale and sandstone. Some angular rock fragments are mixed with the rounded gravel. This soil in most places is decidedly loamy and includes considerable organic matter, at least in the surface soil. This gives it good moisture-holding properties.

This type of soil is confined entirely to the lake plain, and is typically and rather extensively developed between Fredonia and Silver Creek. It occurs in smaller bodies from Fredonia westward to Westfield and Ripley. It has been formed in narrow strips or ridges, and the areas are small, except around Sheridan.

The topography of this type is uniform and easily distinguished, being characterized by low ridges, with flat tops, rising 10 to 30 feet above the surrounding country. The slopes from these level tops are short and abrupt. In places the ridges merely rise to a crest; in other places they form continuous level or rolling areas, as around Sheridan. In general, however, the type exists in two parallel ridges about 1½ or 2 miles back from the present lake shore and about one-fourth mile apart. In the vicinity of Ripley there are three separate ridges of this type. In places the areas are cut by draws or local drainage channels, giving some parts of the type a more broken topography.

Some of the most valuable land in the county is included in this type, and where planted to grapes $500 to $600 an acre is asked for it. On account of its texture and structure, it is a warm and early soil, easily cultivated and retentive of moisture. For these reasons it is highly prized for the production of fruits of all kinds

and of vegetables. It is too valuable a soil to be used for general farming, and so is devoted almost entirely to specialized farming. There are many nurseries on this soil.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Dunkirk gravelly loam:

Mechanical analyses of Dunkirk gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162036	Soil	9.7	17.4	8.1	14.9	7.8	30.0	11.9
162037	Subsoil	13.6	21.2	11.0	20.1	5.9	20.2	7.6

CLYDE SERIES.

The Clyde soils are prevailingly black in the surface section, but vary to dark gray or dark brown, the strength of color being related to the quantity of organic matter present. The subsoils are gray, yellowish gray, and mottled gray and yellow, and are usually heavier than the soils. The Clyde types occur in flat or depressed, poorly drained areas distributed throughout the northeastern quarter of the United States. They are derived from materials of mixed origin, either water-laid deposits in lakes or ice-laid deposits that have been subjected to conditions of deficient drainage. This series is represented in Chautauqua County by only one type, the Clyde loam.

CLYDE LOAM.

The soil of the Clyde loam, which has a depth of 8 or 10 inches, is a dark-gray to black silty loam, containing a relatively large quantity of sand. In some places the surface is covered with 3 or 4 inches of muck. The upper subsoil is made up of a gray sandy loam or fine sandy loam. At 15 inches this passes into a gray sandy clay mottled with brown, which extends to a depth of 24 inches. From 24 to 36 inches the material is generally gray to yellowish-brown, water-soaked gravel and sand, but in places this saturated stratum is not reached within the 3-foot section. Some other variations exist in the depth at which the various materials are encountered in the soil section.

This type of soil is of small extent in the county and occurs in the lake plain, usually in narrow strips on the north side of the old beaches or between them. In such places it is quite typically developed. Most of the areas are too small to admit of accurate mapping. The type as shown includes some areas of the Dunkirk loam. East of Sheridan and south of the Ridge Road the largest areas of this type

are mapped, and here the subsoil is characterized by a heavier texture than is typical.

The type is situated in low, flat positions and depressions, usually lying 5 to 10 feet or more below the surrounding country. As a consequence it is subject to seepage and is poorly drained. Unless drained by artificial means the type has no agricultural value.

With the exception of the larger areas already mentioned the type has been largely cleared. The native timber growth consists principally of elm, ash, and soft maple. The more wet and swampy areas are covered with a growth of willow, sedge, and other water-loving plants.

This type is highly prized for the production of truck crops and vegetables, and most of it has been put under cultivation. Tomatoes are probably the main crop grown. The crop seldom suffers from drought, as it does in some seasons on the adjacent more gravelly soils. Tomatoes yield 15 to 20 tons per acre. Onions, cabbage, cauliflower, lettuce, and parsnips all yield well. Corn yields 80 to 100 bushels per acre. Some parts of the type are in pasture or hay land. Hay yields 1½ to 2½ tons per acre.

On account of the relatively small area of this type of soil and its value for trucking, which combines well with fruit culture, the selling price is high, ranging from $100 to $150 an acre.

Lordstown Series.

The soils of the Lordstown series are brownish gray to light brown, and the subsoils, which are of about the same texture as the soils, are yellowish brown or brownish yellow, resting upon sandstone and shale bedrock at a depth of 12 to 30 inches. The soil material is residual from the underlying formations but partly glacial from the same and near-by formations. The Lordstown soils occur on slopes, ridges, knolls, and more level stretches associated with the Volusia and other series of glacial soils of sandstone and shale origin, being confined to such areas as have only a thin veneering of soil material over the bedrock. They are naturally well drained, and on account of the shallow depth of the soil rather droughty. In Chautauqua County the series is represented by one type, the shale loam.

Lordstown shale loam.

The Lordstown shale loam consists of 1½ to 2 feet of a shale loam resting on bedrock. The interstitial material varies from a silt loam to a silty loam, and is often heavy enough in texture to bake on drying. It is dark brown in color when wet and lighter grayish brown when dry. There is no line of demarcation between the top and the lower soil. A large quantity of angular shale chips, ranging in size up to 2 or 3 inches in diameter, is mixed with the soil, and in

some places the surface is completely covered with such coarse material. Owing to its shallow depth and the large proportion of rock fragments, the type is droughty.

The Lordstown shale loam is not extensively developed in the county. It occurs only in the lake plain east of Dunkirk and around Silver Creek, where it is associated with the Dunkirk clay and silty clay loam as winding ridges only slightly raised above the surrounding soils or as knobs and the tops of small hills. Some small areas of the type could not be shown on the map.

The soil is not extensive in the county, and therefore has little influence on the agriculture. It is best suited to the production of grapes, although the vines do not winter so well on this soil as on some others. Some small fruits are grown, as well as potatoes, corn, beans, and tomatoes, but it is not particularly adapted to them. Grass does not do well.

The Lordstown shale loam occurs in such intimate association with the Dunkirk soils that it is valued with them, and the price ranges around $100 an acre.

Below are given the results of a mechanical analysis of a sample of this type of soil:

Mechanical analysis of Lordstown shale loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162035	Soil	9.0	7.0	1.9	5.1	5.2	47.9	23.6

WOOSTER SERIES.

The soils of the Wooster series are yellowish brown to light brown in color. The subsoils are yellow to brownish yellow, showing often a faint reddish cast, and are friable and free from mottling, all members of the series being naturally well drained. They occupy upland areas throughout the glacial region, usually where glaciation has been heavy and the till deep, and vary from smoothly rolling to irregularly morainic in topography. They are derived very largely from sandstone and shale. In comparison with the Volusia soils, with which they are often associated, they are better drained and considered much the better agriculturally. In Chautauqua County three types are mapped—the gravelly loam, fine sandy loam, and silt loam.

WOOSTER GRAVELLY LOAM.

The surface soil of the Wooster gravelly loam is a brown, heavy gravelly loam, containing a relatively high percentage of silt, and having a depth of 8 inches. The subsoil to a depth of 20 inches is a gravelly loam of a lighter yellowish brown color. From 20 to 36

inches it consists of gravel and sand of all grades, unstratified except in spots. The gravel is largely shale and sandstone, with some igneous rock intermixed. The fragments range in size from small pebbles to stones 5 or 6 inches in diameter. All the fragments are waterworn and rounded. Occasionally foreign bowlders are scattered over the surface.

The type occurs only in rather small areas associated with other Wooster soils and with Volusia soils. It is scattered rather generally over the upland section of the county. Two comparatively large areas are situated in the high hill country in the southeastern corner of the county and another is found south of Ripley, on the escarpment. It is also typically developed in the vicinity of Jamestown and in the town of Mina, just west of Sherman.

The topography is generally characterized by knobs, knolls, and ridges, intermingled with pits and kettle holes, though in some places along Chautauqua Lake and the larger valleys the surface is terracelike and comparatively level.

Throughout this type drainage is adequate or excessive. Both the soil and substratum are extremely porous and permit the ready movement of water. In times of dry weather the soil is apt to be droughty. It is deficient in organic matter, the addition of which in the form of barnyard manure and green manuring crops improves the soil by increasing its power to retain moisture.

An original forest of pine, hemlock, and beech covered this soil, but most of the type has been cleared and at present is under cultivation. It is an easily cultivated, early soil, but lacks organic matter. Hay and corn give only moderate yields. Potatoes produce 200 to 250 bushels to the acre and oats 30 to 40 bushels. This is a good truck and vegetable soil and it is also adapted to small fruits. Under proper management and care it could be used in growing alfalfa. It ranges in value, depending on location and improvements, from $50 to $75 or more an acre.

Results of mechanical analyses of samples of soil and subsoil follow:

Mechanical analyses of Wooster fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162024	Soil	5.0	6.6	2.4	4.6	14.8	57.4	9.0
162025	Subsoil	13.4	17.4	6.2	7.7	10.7	38.3	6.1

WOOSTER FINE SANDY LOAM.

The soil of the Wooster fine sandy loam consists of 6 or 8 inches of dark-brown to brown, fine to very fine sandy loam. Scattered on

the surface are small, angular shale chips and some gravel composed of various rocks. The subsoil is a light-brown fine sandy loam, which becomes slightly coarser with depth, resting on unstratified gravel within the 3-foot section. Locally this gravel substratum may be assorted and bedded. In the two areas occurring east and west of Poland Center the surface soil is a very fine sandy loam to silt loam and the subsoil is finer in texture and more coherent than is usual with the type.

Comparatively little Wooster fine sandy loam occurs in the county. It is associated with the silt loam of the same series in the upland section, being most extensively developed on the east side of the Cassadaga Valley from Sinclairville south to Gerry. It also occurs east of Levant and south of Kennedy. Several smaller areas are scattered through the county.

The surface varies from rolling and undulating country pitted with kettle holes, as in those areas in the Conewango Valley, to gently sloping or slightly broken country, as along the east slope of the Cassadaga Valley. The area south of Kennedy is flat and bench-like.

The natural drainage is good to excessive. The open and porous substratum allows the free passage of water. As a result most areas are likely to lack sufficient moisture to carry crops through dry years. The areas along the valley slopes are better in this respect, owing to the fact that seepage from the higher land generally keeps the soil moist.

Originally a forest of pine, hemlock, maple, and beech covered this soil. This has largely been cut and the land put under cultivation. It presents no difficulty in cultivation and can be worked soon after a rain. It is a desirable truck, small fruit, and vegetable soil, producing good yields of such crops. Especially good results are had with cabbage, and potatoes often yield 200 to 300 bushels to the acre. Hay is only a fair crop on this soil and corn brings only moderate returns. Oats yield 40 to 50 bushels. This type is apparently a good alfalfa soil. Land of this type of soil ranges in value from $50 to $75 an acre.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

Mechanical analyses of Wooster fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162016	Soil	0.4	1.4	0.4	19.0	38.8	34.3	5.7
162017	Subsoil	.1	.2	.2	31.3	42.4	22.1	3.4

WOOSTER SILT LOAM.

The surface soil of the Wooster silt loam consists of 8 inches of brown, friable silt loam, comparatively high in organic matter. The subsoil is a compact, yellowish-brown silt loam, which on exposure, as in road cuts, breaks down into granular form. No mottling occurs in the subsoil, as is the case in the associated Volusia soils. Few stones occur in either the soil or subsoil, except for some rounded gravel here and there. Occasionally some foreign igneous or metamorphic bowlders appear on the surface. In places the soil approaches a loam in texture, containing much fine and very fine sand. It is not uncommon to find a silty surface soil and a loamy or even sandy loam subsoil. The substratum is made up of locally stratified coarse material. In places this shows the presence of lime. The depth to bedrock is 50 to 60 feet or more.

This type of soil is developed in irregular areas throughout the county and covers a comparatively large total area. The soil is found all along the escarpment crest, around Bear Lake, and in the towns of Pomfret, Arkwright, and Hanover. It also occurs on the slopes of the Conewango and Cassadaga Valleys and around Jamestown, as well as along the south shore of Lake Chautauqua and in the vicinity of Watts Flats, Clymer, Findley Lake, and Sherman.

The surface varies from undulating to hummocky and knobby, and is generally marked by numerous kettle holes. As a result, some difficulty is experienced in farming the rougher areas. That portion of the type occurring in the towns of Hanover and Arkwright, as well as the areas along the valley slopes, is smoother in topography, having a gently rolling surface.

The drainage of this type is good to excessive. The slope is always sufficient to promote good drainage in the top soil, and the deep, porous substratum gives thorough underdrainage. There is no evidence of the existence of the hardpan associated with the Volusia silt loam.

The native timber growth is pine, hemlock, beech, and maple, and a large proportion of this type, especially in the rougher areas, is forested at the present time.

The Wooster silt loam is a strong soil and physically is in the best condition of any soil in the county. Corn yields 60 to 80 bushels per acre, oats about 40 bushels, hay 2 tons, and potatoes 200 to 250 bushels. Buckwheat also does well. Alfalfa apparently would do well on this soil, owing to its open structure and good drainage, and the slightly calcareous nature of the substratum. Cabbage and other vegetables and also small fruits give good yields.

Land of this type is valued at $30 to $75 an acre, depending on the location, state of cultivation, and farm improvements.

Mechanical analyses of samples of the soil and subsoil gave the following results:

Mechanical analyses of Wooster silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162018	Soil	0.5	1.0	0.4	2.0	18.6	68.4	9.2
162019	Subsoil	.4	1.0	.6	3.3	25.7	60.7	8.0

Chenango Series.

The soils of the Chenango series are prevailingly brown, ranging to reddish brown. The subsoils are brown to reddish brown or yellowish. The occurrence of stratified gravel and coarse sand at a depth of 3 feet or more is characteristic of the series. These soils occur in the Northeastern and Central States. They are developed along the streams in those sections of the glaciated region in which the upland soils result from the glacial grinding of shale and fine-grained sandstone, with an admixture of small quantities of material from areas of igneous and metamorphic rocks. Three members of the Chenango series are encountered in Chautauqua County. These are the gravelly loam, the fine sandy loam, and the silt loam.

Chenango gravelly loam.

To a depth of about 6 inches the soil of the Chenango gravelly loam is a dark-brown gravelly loam, generally carrying a rather large quantity of sand and fine to large, rounded gravel. This coarse material occurs both on the surface and scattered through the soil section. The subsoil is a light-brown or yellowish-brown gravelly loam to a depth of 36 inches or more. In places the interstitial material of the type is quite silty, and in others it approaches a sandy loam, as in the area mapped southwest of Hanover Center. In this locality the surface soil is in places underlain by strata of sand, silt, and gravel. Most of the type is underlain at a depth of 3 feet or more by stratified gravel and sand. In the areas around Hanover Center bedrock is found at 10 or 12 feet. Here the soil is less leachy than over much of its extent.

This is a comparatively extensive soil throughout the valley regions of the uplands, and it also occurs to some extent in the lake plain. In the latter the largest two areas lie near Hanover Center and Fredonia. Typical areas in the upland are mapped in the heads of the Conewango, Cassadaga, and Bear Lake Valleys and east of Jamestown and around Frewsburg. It occurs also in smaller areas along the shores of Chautauqua Lake as high terraces.

The topography is flat to rolling, the type occurring as terraces or benchlike areas. Owing to the presence generally of a porous substratum, the drainage is good.

The original forest growth was hemlock, pine, chestnut, and oak. Most of the land has been cleared and is under cultivation. In several areas the type is low in organic matter and as a result is subject to drought, but on the whole this is one of the most highly valued soils in the county. It is a good alfalfa soil, and though not extensively utilized for this legume at present, good yields are obtained from some areas in the lake plain. In the latter section a large part of the type is devoted to growing nursery stock. It is well suited to the production of small fruits and truck crops. It is also a good general-crop soil, yielding 60 bushels of oats, as much as 15 tons of corn for ensilage, 2 or 3 tons of hay, and 150 to 200 bushels of potatoes to the acre. The soil is easily plowed and is in condition for cultivation early in the spring. The stone content is not sufficient to interfere with cultural operations.

Land values on this type range from $60 an acre upward, depending mainly on the location.

CHENANGO FINE SANDY LOAM.

The soil of the Chenango fine sandy loam is a dark-brown fine sandy loam, 8 to 10 inches deep, containing at the immediate surface a relatively high percentage of organic matter. From 10 to 36 inches the subsoil is a light-brown fine sandy loam to sandy loam, the texture becoming coarser with depth. Rounded gravel and waterworn stones, varying in size from pebbles to 3 or 4 inches in diameter, occur on the surface and throughout the soil and subsoil.

In some places the type approaches a sand or sandy loam. In other places it has more nearly the texture of fine sand or loamy fine sand. At about 3 feet it is underlain by stratified gravel and sand.

This type is of small extent in the county and occurs in scattered areas. It is typically developed in the vicinity of Watts Flats and Brokenstraw and on the east side of the Cassadaga Valley, where it is associated with the Wooster fine sandy loam.

The topography is level and in most cases terracelike. The areas lie from 3 to 15 feet above the first-bottom soils. Those in the Cassadaga Valley are small, semialluvial fans only slightly elevated above the streams that have formed them, though well above the main stream. In such places the surface is flat, with a gentle slope toward the valley bottom.

A mixed forest of pine, hemlock, beech, and maple formerly covered this soil. Little timber has been left standing.

The Chenango fine sandy loam is a relatively light and more or less droughty soil. It is largely used for the production of hay, but brings only small yields of rather poor quality. It should be a good soil for strawberries and other small fruits and for early potatoes, cabbage, and other vegetables.

This type is usually sold in connection with other types and in such case brings from $40 to $60 an acre.

CHENANGO SILT LOAM.

The soil of the Chenango silt loam to a depth of 8 inches is a dark-brown silt loam, relatively free from stone and coarse gravel, but containing some small pebbles on the surface and through the soil. The top soil is mellow and friable and easily worked, and is well supplied with organic matter. The subsoil is a uniform, light-brown silt loam to heavy silt loam, containing a relatively large percentage of gravel. The substratum at 3 feet, and sometimes less, is stratified gravel and sand.

This type is scattered throughout the valleys of the county in fair-sized areas. The largest occur in the Conewango Valley at Balcom, in the Cassadaga Valley south of Sinclairville, in the French Creek valley south of Sherman, around French Creek settlement, and in the vicinity of Clymer.

Most of the areas are terracelike, with level surfaces; other bodies of the type have the appearance of alluvial fans, not showing distinct terrace peculiarities, but lying along minor streams and having a gentle slope toward the center of the valley. As a rule the drainage is thorough, and in some instances excessive, especially where the substratum of gravel lies rather close to the surface.

The original forest growth was pine, maple, hemlock, chestnut, beech, and cherry. This is one of the best agricultural soils of the county, and it is largely under cultivation. It is in condition for plowing or planting earlier in the spring than most of the other soils. Judging from the fields examined during the soil survey, the type is well adapted to alfalfa. It is also a good small-fruit and vegetable soil. Corn yields 60 to 75 bushels of grain or 10 or more tons of ensilage per acre. Hay cuts 1½ to 3 tons to the acre. Oats produce 50 to 60 bushels to the acre, and 1 ton to 2 tons of Canada field peas is the normal yield. Potatoes yield 150 to 250 bushels per acre.

Land values on this type range from $60 to $75 or more an acre.

TYLER SERIES.

The surface soils of the Tyler series are gray to grayish brown. The subsoils are yellowish to mottled yellow and gray and of rather compact and slightly plastic structure. The series is developed on

second terraces of streams in that part of the Appalachian region in which sandstone and shale soils largely predominate over limestone soils. Usually drainage is not good. In Chautauqua County the Tyler series is represented by the fine sandy loam, silt loam, and clay loam types.

TYLER FINE SANDY LOAM.

The Tyler fine sandy loam consists of a grayish-brown to gray fine sandy loam, underlain at 5 to 15 inches by a light grayish brown or yellowish-brown fine sandy loam, which in turn rests at 30 inches on a mottled gray or greenish-gray and brown clay. There is some variation in the subsoil; for instance, the sandy clay may not be reached within the 3-foot soil section, and strata of different grades of sand and silt and clay are encountered in some places.

Only a small total area of the Tyler fine sandy loam is found in the county. It is developed in the Conewango Valley in the vicinity of Cherry Creek, and in the Cassadaga Valley northeast of South Stockton and just north of Levant.

The surface features are flat, with here and there "tree mounds" giving in places a hummocky topography. The type is generally poorly drained, especially the subsoil. It occurs in first-bottom positions and is subject to overflow by stream and seepage waters.

The type is of alluvial origin. The sediments are composed of wash from the sandstone and shale débris brought down by glacial waters, the type probably originating as bars or local deltas formed by these streams.

A forest of ash, poplar, hemlock, and pine formerly covered the areas of the Tyler fine sandy loam. This has largely been removed, and at the present time the soil supports second-growth trees and underbrush.

Most of the Tyler fine sandy loam has little value except as pasture and hay land. Little of it is cleared. Part of the large area northeast of Cherry Creek is farmed, being used in the production of peas, tomatoes, and other crops for canning. Where protected from floods the type makes a good truck soil. It is held at $20 to $30 an acre.

Mechanical analyses of samples of the soil and subsoil of the Tyler fine sandy loam gave the following results:

Mechanical analyses of Tyler fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162028	Soil	0.2	1.1	2.5	55.7	14.5	13.9	11.6
162029	Subsoil	.2	.6	2.2	48.3	20.1	20.2	8.2

TYLER SILT LOAM.

The Tyler silt loam is characterized by its gray surface soil and highly mottled subsoil. The soil to 6 or 8 inches is a mellow silt loam, gray in color, with occasionally a slight brownish tinge. The surface soil generally carries a rather high percentage of organic matter. The subsoil from about 8 to 36 inches is a gray or drab, compact, heavy silt loam mottled with rusty brown, yellow, and yellowish brown, and growing heavier with increase in depth. There is very little stone and gravel either on the surface or in the soil mass.

Some minor variations occur in this type. While the surface soil is invariably a silt or silty loam, in low, permanently saturated areas the predominating color is dark gray or black and the subsoil shows a maximum of yellow and rusty-brown mottling. The soil here is in reality Papakating, but of insufficient importance to warrant separate mapping. On the other hand, on slight elevations or near stream courses, at least along the larger ones, the color of the surface soil is more grayish brown and the proportion of mottling in the subsoil is less than usual.

The Tyler silt loam occurs in most of the stream valleys in the county, especially the larger ones. It is typically and extensively developed in the Conewango, Cassadaga, and Bear Lake Outlet Valleys and in the bottoms northeast of Brokenstraw and along Beaver Meadow Brook. There is a comparatively large area west of Mayville.

In general the topography is level to flat, but in detail the surface is decidedly uneven. In places through the areas there occur "hemlock knolls." In clearing this land for cultivation it is necessary to use a leveler on these hillocks.

The Tyler silt loam is an alluvial first-bottom soil, subject to overflow in seasons of high water. This, with the seepage and run-off waters from the uplands and the level surface, gives the soil poor drainage, and for a large part of the year much of it is continually saturated. The fine-textured substratum, which is practically impervious to water movement is also a factor in keeping this soil in a permanently wet condition. Drainage is necessary before the land can be farmed.

A forest of black ash, elm, poplar, cottonwood, and beech, with pine and hemlock in places, formerly covered this soil. At present a large part of the type consists of logged-off land grown up with underbrush and smaller water-loving plants and grasses.

Except where cleared and producing hay, this type of soil has a low value, selling for $20 to $30 an acre. The hay grown is largely timothy, which yields as much as 2 or 3 tons an acre. On account of the early frosts in the valleys and the cold, poorly drained condition

of the soil, the growing seasons are short and the type in its present state is suited only to the production of hay, though when adequately drianed and properly farmed it gives good yields of ensilage corn and oats.

TYLER CLAY LOAM.

The Tyler clay loam consists of a dark-gray or drab heavy silt loam, 3 or 4 inches deep, resting on a subsoil of stiff, plastic silty clay, of drab or blue color, mottled with light brown. The texture of the lower subsoil is heavier and the mottlings more varied. The base color becomes gray and the mottlings range from brown to yellowish brown, yellow, and orange.

In places this type as mapped includes small areas of the Papakating clay loam, distinguished from the Tyler by the color of the surface soil. Such areas were not of importance sufficient to warrant separate mapping.

This soil is developed in the upland part of the county, in the Conewango, Cassadaga, and Beaver Meadow Valleys and in numerous small patches here and there along streams throughout the upland section. It has no great extent.

The topography of the Tyler clay loam in general is flat. The type is a first-bottom soil. It lies back from the streams at a slightly lower level than the land immediately along the channels, and water stands on the surface for some time during periods of flood. It is also subject to flooding by the run-off and seepage from the surrounding hills, and as a result is poorly drained.

At the present time this type of soil is largely covered with second-growth timber and underbrush. The original forest growth was elm, black ash, poplar, cottonwood, and beech, with some pine. Sedges, reeds, and water-loving grasses are abundant.

Most of the land has little agricultural value in its present state, but is held at $20 to $30 an acre. When drained and reclaimed by proper methods of agriculture it should be one of the most productive soils in the county for oats, hay, and corn for ensilage. A comparatively extensive area of this type of land is being reclaimed near Cutting, in the southwestern part of the county.

Mechanical analyses of samples of the soil and subsoil follow:

Mechanical analyses of Tyler clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
162026	Soil	0.3	1.4	0.6	2.6	9.7	60.3	25.1
162027	Subsoil	.0	.0	.1	.5	11.0	67.3	21.0

PAPAKATING SERIES.

The soils of the Papakating series are dark brown to black, with grayish, drab, or mottled yellow and gray subsoils. They occur along streams in the glaciated region and the sediments are the wash from upland soils of glacial but not of loessial origin. The soils contain, however, no appreciable amount of stratified gravel, either in the subsoil or substratum. They are subject to overflow and are usually poorly drained. They are darker in color than the soils of the Genesee or Ondawa series and differ from the latter also in the absence of a gravel substratum. This series is the eastern representative of the Wabash. In Chautauqua County the series is represented by the fine sandy loam and clay loam members.

PAPAKATING FINE SANDY LOAM.

To a depth of 4 to 6 inches the soil of the Papakating fine sandy loam is a black fine sand or loamy fine sand, containing a high percentage of organic matter. The subsoil is a gray to grayish-brown fine sandy loam, growing coarser with depth and mottled with steel gray or rusty brown. In places the subsoil may be either a yellowish-brown or gray, water-soaked sand. In other places the lower subsoil tends toward sandy clay of gray color mottled with brown. A shallow layer of muck covers the surface of some areas.

The Papakating fine sandy loam is of small extent in the county. It occurs in the Cassadaga Valley from a point east of Redbird to Ross Mills. Another area is situated just west of Poland Center, and it is also developed in several places along the immediate shore line of Lake Chautauqua.

The surface of this type is flat and the drainage is poor. The subsoil is invariably saturated with water and capillary rise of moisture tends to keep the upper soil wet. This is especially true of the areas along Chautauqua Lake. Those areas lying in the Cassadaga Valley are probably kept saturated by seepage water from the hills.

The original timber growth was pine, hemlock, black ash, and poplar. The land is now grown up largely with second-growth timber and underbrush. Little of the type is cleared and farmed.

At present the Papakating fine sandy loam has little agricultural value, but it is used as pastures and occasionally for hay production. Where reclaimed it makes a good trucking soil. Its selling value at present is from $20 to $30 an acre.

PAPAKATING CLAY LOAM.

The surface soil of the Papakating clay loam to 6 or 8 inches is a dark-gray to black silt loam, the shade of the color depending upon the content of organic matter. The subsoil consists of a dense and

plastic clay loam to silty clay loam. It has a gray or drab basic color and is mottled to a greater or less degree with rusty brown, yellowish brown, and orange. Owing to the fineness of the texture and the compactness of the structure, the subsoil is almost impermeable to water. No stone whatever occurs in the type and it is not underlain by a substratum of gravel near the surface.

The Papakating clay loam is most extensively developed in the Conewango Valley in the vicinity of Frewsburg. Comparatively large areas occur in the Cassadaga Valley east of Towerville Corners and in the Little Brokenstraw Valley west of Grant, and several areas are encountered along Alder Bottom Creek south of Sherman, in the valley of the West Branch of French Creek north of Findley Lake, and north of Mayville and Hartfield. Smaller patches are scattered throughout the uplands.

The topography is level and the drainage poor. The areas in the Conewango Valley and in the bottoms of the West Branch of French Creek are not only inundated in times of high water but also receive seepage waters from the hills. After periods of high water this type, lying a little lower than the land immediately adjoining the streams, remains flooded for long periods. The other areas along streams and those in depressions between the hills are subject to overflow in flood seasons. The soil, not only because of the topographic position but also on account of the heavy, impervious subsoil, is usually water-logged.

The forest growth on this type is black ash, elm, soft maple, linden, beech, cottonwood, poplar, and alder, with some pine and hemlock. In places it supports a growth of sedges, flags, rushes, and other water-loving plants.

The Papakating clay loam when reclaimed and put under cultivation makes a good soil for ensilage corn, oats, and hay. At the present time it is nearly all in virgin or second-growth forest or in pasture.

Genesee Series.

The Genesee soils range in color from dark brown to grayish brown. They occur along the major streams and their tributaries throughout the northeastern glaciated region, particularly where the Dunkirk, Volusia, Miami, and Ontario series constitute the principal upland soils. These soils are subject to annual or seasonal overflows. Two members of the Genesee series—the loam and silt loam—are mapped in Chautauqua County.

GENESEE LOAM.

The top soil of the Genesee loam to a depth of 8 inches is a dark grayish brown silt loam, containing quite a high percentage of the

various grades of sand, especially fine and very fine sand. From 8 to 24 inches the subsoil is a light-brown sandy clay mottled with gray and yellowish brown. At 24 inches it grades, as a rule, into water-soaked gray sand. Some fine gravel occurs throughout the soil section, but few larger stone fragments are present. The type is extremely variable in color and texture throughout.

The Genesee loam is an unimportant type and is of small occurrence in the county. It is developed entirely along the streams in the upland region. Two large areas occur in the Cassadaga and Bear Lake Outlet Valleys, and it is encountered rather extensively at the northern end of Lake Chautauqua. It is also mapped in several places in the southwestern part of the county.

This type of soil is flat and poorly drained and has little agricultural value at present. Most of it is overgrown with second-growth timber and underbrush. Its uses, where cleared, are for hay land and pasture.

GENESEE SILT LOAM.

The surface soil of the Genesee silt loam is a dark grayish brown to brown, mellow silt loam, which on drying becomes somewhat grayer. It is, however, distinguished from the Tyler soils by being dark rather than light colored, and brown rather than gray on the surface. The top soil extends to a depth of 8 to 10 inches and is often indistinguishable from the upper subsoil, except that it may be a shade darker in color. At 24 to 28 inches the subsoil becomes a silty clay, or a clay generally heavier in texture, and is light gray or grayish brown mottled with darker or rusty brown. The mottlings are less abundant and not so pronounced as those occurring in the Tyler silt loam. There are practically no stones present throughout the soil section, but the substratum is generally composed of stratified gravel and sand, so that, as a rule, the underdrainage is good.

The Genesee silt loam is of small extent in the county. Typical areas lie along Cattaraugus and Canadaway Creeks, as well as along a few of the smaller streams in the lake plain. In the hill region it is found along the immediate course of Stillwater Creek from Busti to the junction of Stillwater and Conewango Creeks, along Little Brokenstraw Creek, Brownell Branch, and French Creek, and, in addition, in numerous small stream bottoms or swales where at the present time there is not much stream action, but where some local wash occurs. That part of the type mapped along French Creek is quite typical. The stream bottoms in which this type occurs are narrow and confined, so that the Genesee silt loam does not exist in broad, expansive areas, as does the silt loam of the Tyler series. The surface is level and the type occurs in first-bottom positions.

Much of this type is uncleared, being overgrown with alder, willows, and bushes of various kinds, with here and there some trees of ash, elm, poplar, and beech.

Owing to its liability to inundation at more or less regular periods, little of the land is under cultivation and its chief use is for pasture. Along Cattaraugus Creek near Irving it is highly valued as a trucking soil. This indicates a development possible on the remainder of the type. Where damage by flood can be avoided, corn, beets, peas, tomatoes, potatoes, and oats give excellent yields. Clover hay gives two good cuttings a year. The land is valued at $60 or more an acre, depending on the locality and on the character of surrounding soils.

Miscellaneous Material.

MEADOW.

The surface material of the type mapped as Meadow varies widely, ranging from a silt loam to a loam or sandy loam. Some areas are quite mucky, or the surface may simply be covered with a thin layer of vegetable matter, partially decayed. The subsoil varies in texture as much as does the surface soil, and may be a heavy silt or clay loam or grade toward a gravelly loam. The soil and subsoil are usually of a gray or dark color throughout, especially where the drainage is poor, but may be lighter in color. Also in depth of soil and subsoil there is quite a variation, although the surface soil is generally quite shallow.

A characteristic feature of Meadow as mapped in Chautauqua County is its stony character. The stones range in size from small gravel to rounded fragments 5 to 6 inches in diameter. Large, flat and angular shale and sandstone fragments are also of common occurrence. In places the land is too stony even for pasture.

Meadow comprises low-lying areas situated along the smaller streams, and in some instances it is poorly drained. It is of small extent in any particular locality, but is found scattered irregularly throughout the upland section of the county in long, narrow strips following small drainage ways, and is often mapped along stream bottoms where no distinct soil types can be identified.

The agricultural value of Meadow is low. At the present time about its only value is for pasture. On account of its limited extent in any particular locality, reclamation would in most places be unprofitable.

MUCK.

Muck consists of black, finely divided organic matter, with some mineral matter, existing naturally under poor conditions of drainage. With increase in depth it generally takes on a browner color and

becomes more fibrous. In depth the Muck ranges from 9 inches to 3 feet or more. The character of the underlying material ranges from clay, as in the larger areas occurring in the Conewango and tributary valleys, to sand and gravel as in the smaller ones. Some marl is found underneath the Muck in areas below Cassadaga.

Scattered areas of Muck occur throughout the county both in the uplands and in the lake plain. The largest areas are encountered in the Conewango Valley east of Cherry Creek. In this section there are indications that at one time the Muck was deeper and more extensive. Fires have in recent years consumed a large part of it, so that in places the depth to the clay is only 1 or 2 feet and in others the muck has been burned off completely. Large bodies lie southwest of Frewsburg in the Conewango Valley; at the foot of Chautauqua Lake along the Chadakoin River; north, west, and south of Sherman, northeast and south of Findley Lake; and in the vicinity of Bear, Cassadaga, Mud, and East Mud Lakes. The Muck layer in the four localities last named is 3 feet or more in depth.

The topography of the Muck is level. The areas occupy the lower and more poorly drained positions in their particular locality. In most instances the land is in a swampy condition the year round.

The vegetation consists of elm, ash, cedar, tamarack, hemlock, swamp maple, and alder, with rushes, sedges, ferns, and a great variety of other water-loving and aquatic plants.

Only two of the larger areas of Muck in Chautauqua County have been reclaimed, one east of Cherry Creek and one just outside of Jamestown on the Chadakoin River. Here lettuce, celery, onions, and potatoes are grown with excellent results. In the Cherry Creek section crops on Muck are likely to suffer in dry seasons on account of the shallowness of the organic stratum. Hay yields 2 to 3 tons or more per acre. Several of the other larger areas where the soil is deep could be drained and used for the crops mentioned. When reclaimed this is a valuable type of soil, being held at $200 or more an acre. In the natural state it sells for $30 or less an acre.

ROUGH STONY LAND.

A few small areas of Rough stony land are shown on the soil map. One of these is at Panama Rocks, where, covering an area of about 5 acres, there are exposures of the Panama conglomerate, which is made up of quartz pebbles embedded in sandstone. Another outcrop of these rocks occurs about 2 miles west of Open Meadows. On the summit of the hill north of Blockville these rocks also outcrop, but not in sufficient area to map. In no case do these rocks influence the surrounding soil. The outcrops of shale and sandstone in the gorges of Silver, Walnut, and Chautauqua Creeks are also included in this classification.

LIME.[1]

The presence in the soil of free lime carbonate or of sufficient basic constituents to produce a neutral reaction is of fundamental importance in the production of many of the common farm crops. Especially is the presence of a small amount of free lime carbonate necessary for the production of leguminous plants, which are so useful in the maintenance of organic matter and the upbuilding of fertility. In this respect much of the soil in Chautauqua County is deficient. The surface soil of practically all of the types recognized has a very low content of lime. Some of the soils have a large quantity of lime in the deeper subsoil, as noted in the type descriptions.

The soils in which the need of lime is most pronounced are those occurring in the higher hill lands and belonging especially to the Volusia series. These soils have been formed largely from the local shale rock, which is naturally deficient in lime. They are deficient in lime not only in the surface soil but in the subsoil to a considerable depth. Where the glacial formation reaches a depth of many feet, there is frequently a large quantity of lime near the bottom of the section, but it is too deep to be of much use to the crops under the conditions existing in this county. The presence of lime in the upper subsoil is an added reason for the maintenance of thorough subsoil drainage by means of which the plants are able to reach the subsoil and make use of that lime.

The Dunkirk soils on the Lake Erie plain, especially the heavier types, appear to have a rather large stock of lime in the subsoil and effervesce freely with acid. However, even these soils are reported to respond to moderate applications of lime in some form to the top soil where clover, alfalfa, and root crops are produced.

The grape plant, which is extensively grown in that region, is not sensitive to a slight acid condition of the soil, but since the maintenance of organic matter in these soils is an important phase of farm practice and the legumes are grown for that purpose, lime becomes a considerable factor in success. Experiments have demonstrated the value of lime in obtaining a stand of clover. The need of lime is especially to be emphasized on the hill lands of the Volusia, Chenango, and Wooster series.

Any of the available forms of lime may be used. Where the roads are steep and the wagon haul relatively long it may be more advantageous to use the concentrated forms which are caustic, namely, lump lime and hydrate lime. As a rule, however, in this territory some form of lime carbonate is probably the more economical and convenient.

[1] This chapter, and that following, on Drainage, were prepared by Prof. E. O. Fippin, of the College of Agriculture, Cornell University.

The maintenance of free lime carbonate in the soil stands next in importance to drainage as a means of improving the more important types in the county. The quantity to be used depends on the form, upon the nature of the soil, and upon the kind of crop to be grown. In general from 1,000 to 2,000 pounds of effective lime per acre should be used once in 5 or 6 years on the heavy soils. On the lighter soils two-thirds of this quantity will generally be adequate.

DRAINAGE.

Adequate drainage of the soil and subsoil is the first requisite of good farming. Without reasonable drainage all efforts at good tillage and the use of lime, manure, and fertilizers are of little avail.

In spite of the fact that the surface of Chautauqua County is largely rolling and often quite hilly, a large part of the area is occupied by types of soil that need some artificial drainage.

Twenty types of soil, having an aggregate area of 79.6 per cent of the county, need more or less artificial drainage. The most extensive types have a pronounced general need of drainage, especially underdrainage, for the production of tilled crops.

There are three types of land having defective drainage:

(1) Low areas that receive the surface and subsoil drainage of adjacent lands. This includes most of the types of the Papakating, Clyde, and Genesee series and Muck and Meadow.

(2) Flat land having compact subsoils. This includes all the heavier types of the Dunkirk, Tyler, and Papakating series. The precipitation is retained unduly in the soil, owing to the flat topography and the nature of the soil.

(3) The sloping hill land. This includes the Volusia series. Here the retention of water is due to the combination of a rather loose and absorbent top soil with a compact and quite impervious subsoil. The surface slope of the land has small potency to drain the land in this case, since the removal of water is determined by the rate of percolation through the soil on top of the impervious layer, and this is slow. Consequently such land is soggy, cold, and late, and has a shortened growing season. The hill land generally has this undesirable condition, but it is far less noticeable in the Wooster than in the Volusia series.

The necessary correction for the first class of land is evident. Its improvement is limited by the nature of the soil and the ease and cost with which it can be drained.

The second group of land does not show the need of drainage to the casual observer so readily. It is indicated by the darker soil. the damp spots, and by the pale and mottled color of the subsoil.

The water is retained in the subsoil until late in the season and after rain, to the detriment of crops. It limits the root zone, cuts down the food supply, and makes crops more susceptible to the attack of enemies. Most of this land is on the Lake Erie plain, where values are high, owing to intensive cropping. Therefore the matter of providing better underdrainage should receive careful attention. As noted in the type descriptions, where underdrainage has been tried it is giving excellent results. For the fruit crops systematic work, especially on large-sized areas, gives best satisfaction, and the expenditure necessary is usually warranted.

On the third group of land, the hills, the need of drainage is not evident. The soil section must be examined and the conditions during the year noted. Farmers term this land "springy" and cold. The undesirable conditions may be local or general. It is most pronounced where the silty top soil is 1 or 2 feet deep. Underdrains of tile, stone, or wood will largely correct the condition.

The cost of drainage in proportion to the market value of the land is often urged in opposition to the improvement. Where the soil is valuable only for such hay as it will produce, or for hay and timber, the objection is sound; but where it is being devoted to tilled crops with considerable labor and expense, the improvement brought about may be so great as to warrant considerable expenditure for drainage.

On the denser soils several seasons may be required for the drains to reach full efficiency. Tile and stone drains have recently been installed in a few places in the soils of Chautauqua County.

SUMMARY.

Chautauqua County is situated in the extreme western end of New York, bordering on Lake Erie. It has an area of 1,069 square miles, or 684,160 acres. The county comprises two main physiographic and topographic divisions—the lake plain or Erie forelands and the rolling to hilly upland, which are separated by a north-sloping escarpment 300 to 500 feet high. The elevation of the lake plain is from 573 to 900 feet and of the hill region from 900 to 2,100 feet above sea level.

The drainage of the forelands is by small streams into Lake Erie and the St. Lawrence system, while the drainage of the uplands is southward by the Conewango and French Creeks, through the Ohio system, into the Mississippi River.

Settlement was begun in 1802, and the county with its present boundaries was formed in 1808. Mayville has always been the county seat.

In 1910 the population of the county was 105,126. The majority of the inhabitants are of New England or Pennsylvanian ancestry. Of late years there has been an influx of people from southern

Europe, especially into the fruit belt. Two cities are situated within the county, namely, Dunkirk, with a population of 17,221, and Jamestown, with 31,297 inhabitants.

The mean annual temperature is about 47.2° for both topographic divisions. The normal annual rainfall at Jamestown is 43.55 inches and at Westfield 37.44 inches. The length of the growing season in the uplands is about 148 days and in the lake plain about 170 days. The prevailing winds are from the west and northwest.

There are two types of agriculture in the county. In the lake plain fruit growing and vegetable gardening are the leading interests. The principal and most valuable fruit crop grown is the grape. In the upland dairying and general farming, with some apple growing, are the main branches of agriculture pursued. The general crop rotation followed in the upland region is corn, oats, hay, and potatoes or buckwheat. Owing to the great development of the grape industry, no regular rotation is followed in the lake plain. Fertilizers and green manures are used extensively in the vineyards. In the dairy section manure is the chief fertilizer used, though lime is employed to some extent.

The average size of farms in 1910 was 81.7 acres, and 83.3 per cent of the farms were operated by owners. Of the 613,000 acres in farms, 400,723 acres is improved land. In the upland section land ranges in value from $10 an acre for the poorest ridge land to $60 or more for the best valley land. In the lake plain land values, depending on improvements and location, vary from $100 to $200 or more an acre.

The soils have all been derived from glacial débris, originating largely from the sandstone and shales of the region, but with admixture of some foreign material brought in by the ice.

The Dunkirk soils and part of the Chenango gravelly loam have been subject to glacial-lake action. The lighter textured types of the Dunkirk and Chenango series are the best fruit and truck soils, but the heavier Dunkirk soils are also used for grape and vegetable culture. They are generally in need of organic matter, lime, and drainage.

The Clyde loam and Lordstown shale loam are unimportant types of small extent, associated with the Dunkirk soils.

The upland soils are of glacial or glacio-residual formation. The Volusia silt loam, deep phase, and the members of the Wooster series include the deeper glacial-till and morainic deposits. They form a large proportion of the upland and are generally of rather high agricultural value, being suited to dairying and general farming. The Wooster soils are in addition suited to alfalfa and fruits and vegetables, being well drained, though usually lacking in organic matter.

The Chenango series includes the second-bottom or stream-terrace soils which now lie above overflow. They are among the best soils in the county and are well suited to vegetables, small fruits, and the general farm crops. Alfalfa also does well on them. They are well drained, but are in need of organic matter.

The first-bottom soils are grouped in the Genesee, Papakating, and Tyler series. The Genesee soils are brown and moderately well drained, the Papakating soils are black and poorly drained, and the Tyler soils are gray, with highly mottled subsoils, and poorly drained. When drained these soils are suited for the production of corn for ensilage, oats, and hay. At the present time they are largely forested or in pasture.

Muck is of small extent and but little of it is farmed. It is productive of such crops as celery, onions, and lettuce.

Meadow includes stream wash material occurring along the smaller streams. It is of extremely variable character and of little value for agriculture.

Rough stony land is a small and unimportant separation.

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[PUBLIC RESOLUTION—No 9.]

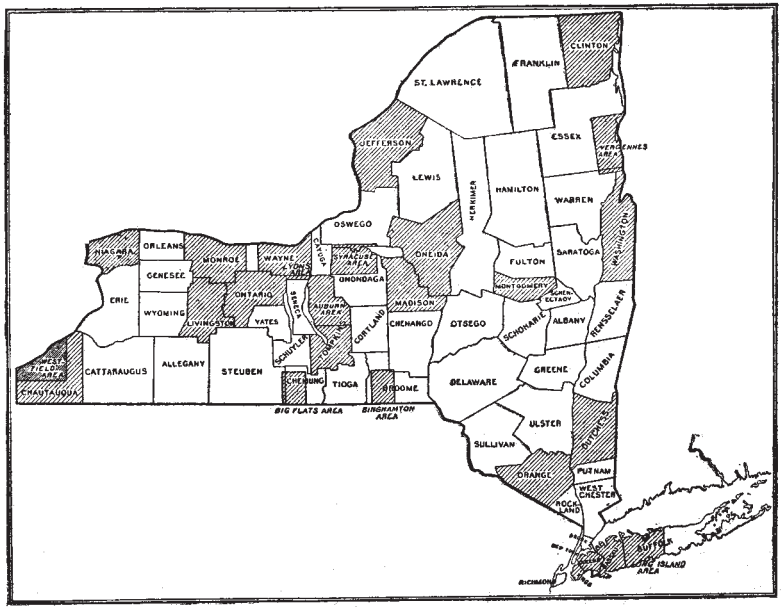
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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

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

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in New York.

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