

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE NEW YORK STATE COLLEGE OF AGRICULTURE,  
CORNELL UNIVERSITY, A. R. MANN, DIRECTOR;  
E. O. FIPPIN, IN CHARGE, SOIL SURVEY.

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SOIL SURVEY OF OSWEGO COUNTY,  
NEW YORK

BY

CHARLES N. MOONEY, IN CHARGE, AND E. T. MAXON, OF THE  
U. S. DEPARTMENT OF AGRICULTURE, AND R. J. MORGAN AND  
J. H. BROMLEY, OF THE NEW YORK STATE  
COLLEGE OF AGRICULTURE.

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W. E. McLENDON, INSPECTOR, NORTHERN DIVISION.

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(Advance Sheets—Field Operations of the Bureau of Soils, 1917.)



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1919.

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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., August 12, 1918.*

SIR: In the extension of the soil survey in the State of New York during the field season of 1917 a survey was undertaken in Oswego County. This work was done in cooperation with the New York State College of Agriculture.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1917, as authorized by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

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

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### FIGURE.

FIG. 1. Sketch map showing location of the Oswego County area, New York..	Page. 5
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### MAP.

Soil map, Oswego County sheet, New York.
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# SOIL SURVEY OF OSWEGO COUNTY, NEW YORK.

By CHARLES N. MOONEY, In Charge, and E. T. MAXON, of the U. S. Department of Agriculture, and R. J. MORGAN and J. H. BROMLEY, of the New York State College of Agriculture.—Area Inspected by W. E. McLENDON.

## DESCRIPTION OF THE AREA.

Oswego County is situated in the north-central part of New York, at the eastern end of Lake Ontario. It is bounded on the north by Lake Ontario and Jefferson County, on the east by Lewis and Oneida Counties, on the south by Onondaga County, and on the west by Cayuga County and Lake Ontario. Part of the south boundary follows the Oneida River from its junction with the Seneca east to Oneida Lake and the south shore of the lake to the eastern county boundary. The county includes a land area of 948 square miles, or 606,720 acres.

The topography of the county varies from rolling or undulating to hilly. During the glacial period this region was probably covered by several advances and retreats of the ice. The glaciation resulted in smoothing the hills and depositing their debris of earth, stone, and gravel in irregular masses in the existing valleys or depressions. The deposits in places obstructed drainage and lakes were formed into which great quantities of fine material were carried by the glacial streams. The southern part of the county, composed of such lake-deposited materials, was probably left as a more or less flat plain, but erosion has modified it into a rolling country, with isolated ridges and hills of till or gravel. The general level of this southern section is about 350 to 400 feet above tide level, or about 150 feet above Lake Ontario. The western part of the county, in Oswego and north Hannibal Towns,<sup>1</sup> is smoother, the ridges and hills being of even outline and occasionally drumlin shaped. Some of the lower slopes are rough and bumpy, of morainic character. East of the Oswego River the country consists in part of long smooth ridges and in part of areas of very irregu-

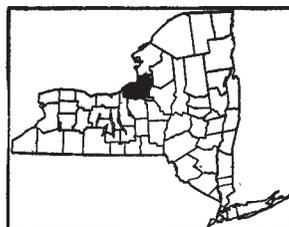


FIG. 1.—Sketch map showing location of the Oswego County area, New York.

<sup>1</sup>The word "town," as used in New York, is synonymous with "township."

lar morainic topography, the latter being most prominent in the towns of Scriba and New Haven.

The eastern side of the county is more broken and hilly than the western part, though in part smooth. Extending from Orwell through Williamstown there is an old partly-filled valley formed of very irregular, high, gravelly hills, but to the eastward these give way to a series of gravelly terraces and sand plains. To the south the uplands rise rather abruptly and also to the north to the valley of Salmon River in Redfield. The elevation of this hilly region ranges from 500 feet, a short distance from Oneida Lake, to above 1,000 feet in Redfield south of the Salmon River. North of Salmon River the country rises to a dome-shaped highland dissected by streams. The elevation reaches 1,750 feet above sea level in the extreme northeast corner of the county. To the west it falls off into bumpy, hilly slopes, then to old gravelly and sandy lake beaches at an elevation of about 600 feet, and these give way to a series of smooth ridges of east and west trend dropping off rather abruptly to the marshes bordering Lake Ontario. While the east and northeast parts of the county are high and hilly, none of it can be described as rugged, except in the gorges of the Salmon River.

The drainage of the county is into Lake Ontario. The lake receives the drainage of the northern, north-central, and western parts of the county through the Salmon River and numerous creeks. The Oswego River flows in a northerly direction across the county through the west-central part, and drains a considerable area on each side. It is formed by the junction of the Seneca and Oneida Rivers on the south boundary. The Seneca is the outlet of the "finger lakes" in the counties to the south, and the Oneida River is the outlet of Oneida Lake, which is partly included in the county. Streams reach all parts of the county and only small scattered areas have poorly established drainage. Practically all the streams are cutting their channels and have formed only narrow flood plains. Some of the drainage ways like the Oswego and Salmon Rivers have no flood plains at all or only small developments in bends. In the central and southern part of the county the ridges average 20 to 40 feet above the stream courses and some rise 100 feet above. In the northwest and north-central parts the valleys are narrow, and the streams have cut 100 to 200 feet below the ridge crests. In the rougher eastern part of the county the channels are 150 to 200 feet below the ridges. Most of the streams are rapid flowing. The Salmon River has numerous rapids, some of which in the lower course, especially at Pulaski, are used for power. This river flows through a number of gorges, and in the town of Orwell has a precipitate waterfall of about 100 feet. Above the falls a dam has been constructed which forms a high reservoir in its valley reaching eastward

beyond the village of Redfield. Power developed here is used to generate electricity, which is sent over high-transmission lines to Syracuse and numerous villages. Some farm houses are supplied with light and power from this source. The Oswego River has a series of rapids at Fulton, Minetto, and Oswego, and water power developed at these points supports large manufacturing industries of various kinds.

In the central and eastern parts of the county there are areas of bog and series of partly filled ponds, the outlets to which are more or less obstructed, causing swampy conditions. The largest of these, Lake Neatahwanta, a roughly circular body of water more than 1 mile across, lies southwest of Fulton.

As early as 1721 the English established a trading post at the mouth of the Oswego and a few years later built a fort on the site of the present Fort Ontario. Permanent settlement did not begin until the close of the Revolutionary War, when the soldiers were given grants of land in this region. The pioneers settled in the eastern part of the county, at the mouth of the Salmon River or Port Ontario, near the village of Redfield, at Constantia on Lake Oneida, and on Frenchman Islands on Lake Oneida. The settlers were from eastern New York and from New England, Connecticut, and Massachusetts. The present rural population and a large proportion of the village population are descended from the early settlers. In the manufacturing towns of Oswego and Fulton there have been accessions of foreigners, largely Italians, Greeks, and French Canadians.

The eastern, more hilly, and remote part of the county is sparsely settled. Otherwise the population is well distributed. The 1910 census reports 75,929 inhabitants in the county, of which about one-half are located in Oswego and Fulton. The county seat, Oswego, situated on Lake Ontario at the mouth of the Oswego River, had a population in 1910 of 25,426. It has been from the earliest days one of the most important lake ports and it is an important manufacturing center, the result of its good water power. Fulton is the second largest city. It is situated 12 miles up the river from Oswego, where water power is developed, and has large manufacturing establishments. Its population in 1910 is given as 11,138. Towns of more than 1,000 inhabitants are Pulaski, Phoenix, and Mexico. Villages of less than 1,000 population include Sandy Creek, Lacona, Richland, Central Square, and Williamstown, all on railroads.

The railroad facilities of the county are exceptionally good. Several branches of the New York Central system traverse the county, and the Delaware, Lackawanna & Western has a terminus at Oswego. There is an electric line between Oswego and Syracuse, the largest city in this part of the State. Water transportation is maintained on

Lake Ontario. The Oswego River has been made navigable with dams and locks at the rapids, and it connects with the Erie Canal system or the new barge canal up the Seneca River to Syracuse and thence west to Buffalo or east via the Oneida River and Oneida Lake to Albany and the Hudson River.

The public roads are numerous and kept in generally good condition. There are a number of fine State roads, limestone-macadam, asphalt-bound highways. In addition, the county has constructed some main roads of water-bound sandstone macadam.

The principal farm products of Oswego County are those of the dairy, mainly milk, the markets for which are Syracuse and New York City. The cheese and butter find local markets in the near-by towns and cities or are shipped to outside points.

#### CLIMATE.

Oswego County has a temperate climate, subject to considerable extremes of heat and cold. Climatic conditions vary somewhat over the county, those sections along the lake having milder conditions, while inland and eastward in the higher sections of the county more extreme conditions prevail.

The mean annual temperature at Oswego is 46.8° F. The winters are rather long and cold and attended by heavy snowfall. During the months of December, January, February, and March the mean temperature is below the freezing point, and in all these months the absolute minimum lies below zero. January is the coldest month, with an absolute minimum of -21°. The summers are pleasant but rather short, with moderate heat, and only short periods in July and August when the thermometer may register 95° F. or over. There is generally some hot weather in June and September.

The average date of the last killing frost in the spring at Oswego is given as April 20, and that of the first in the fall October 29. Frosts have been recorded as late in the spring as May 4 and as early in the fall as October 13. The period between frosts is shorter to the south of Oswego and in the valleys of the higher uplands in the eastern part of the county. This difference in frost occurrence makes the sections along the lake much more desirable for fruit growing.

The mean annual precipitation, as recorded at Oswego, is 36.18 inches. The rainfall is fairly evenly distributed throughout the year, being highest in March, April, and May. There is a range in the yearly precipitation from 28.33 inches to 40.56 inches. The average total snowfall is 86.25 inches. It is generally considered that the northeast and eastern parts of the county have the greatest precipitation, owing to the moist westerly winds over Lake Ontario, being chilled upon coming in contact with the elevated lands at the

eastern end, and precipitating this moisture as rain or snow. As a rule, only short periods of drought occur. The growing season is apparently of sufficient length to mature all crops, but it is shortened by cool, wet weather in the spring and cool weather in fall, so that it is difficult to mature corn unless the season is favorable.

The appended table gives the normal monthly, seasonal, and annual temperature and precipitation as recorded by the Weather Bureau Station at Oswego:

*Normal monthly, seasonal, and annual temperature and precipitation at Oswego.*

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1916).	Total amount for the wettest year (1912).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	29.2	61	- 9	3.59	1.91	2.37
January.....	23.9	61	-21	3.16	2.95	5.04
February.....	24.0	58	-14	2.57	2.32	4.71
Winter.....	25.7	61	-21	9.32	7.18	12.12
March.....	31.4	78	- 2	2.84	1.16	2.20
April.....	43.2	85	20	2.26	1.58	2.92
May.....	54.7	91	30	2.85	4.60	7.38
Spring.....	43.1	91	- 2	7.95	7.24	12.50
June.....	63.8	89	42	3.43	5.85	1.01
July.....	69.6	97	46	3.23	1.05	2.49
August.....	68.8	97	46	2.69	1.21	2.81
Summer.....	67.4	97	42	9.35	8.11	6.31
September.....	62.7	90	35	2.81	1.98	4.50
October.....	51.2	82	28	3.34	2.16	1.70
November.....	39.1	75	12	3.41	1.56	3.43
Fall.....	51.6	90	12	9.56	5.70	9.63
Year.....	46.8	97	-21	36.18	28.33	40.56

#### AGRICULTURE.

For a considerable period the settlers in this region, as in all new and remote communities, grew subsistence crops only, planting in their first clearings corn and vegetables, wheat, rye, and oats. From this beginning the region gradually developed into a grain-growing section, with Oswego an important commercial center and port. In 1826 the Erie Canal had been completed and in 1828 the Oswego Canal, connecting the former with Lake Ontario, was opened, followed in 1830 by the Welland Canal. For a time the only effect of

these means of transportation on agriculture, was to stimulate agriculture, but as the Ohio country to the west, which could grow wheat to better advantage, now had an outlet to the eastern markets, competition soon compelled Western New York to give up the growing of wheat on an extensive scale. Dairying, which had been increasing in importance all the time, now became established as the leading industry. The product, largely cheese, was shipped to outside markets, and with the advent of railroads dairying developed to still greater proportions. Fruit growing also gradually developed as an important phase of the agriculture.

In 1880 practically 81 per cent of the total area of the county was in farms and 71.29 per cent of all farm land was improved. At that time hay occupied a larger acreage than all other crops combined. There were 95,064 acres in hay, producing 122,092 tons. Of the grain crops oats ranked first, with an area of 22,907 acres and a production of 702,706 bushels. Corn followed with 20,620 acres and a production of 615,105 bushels. The area in wheat was 7,004 acres, producing 88,691 bushels; in rye, 3,116 acres, producing 35,771 bushels; and in barley, 1,587 acres, with a production of 37,109 bushels. Buckwheat was an important crop, the acreage being somewhat less than that of wheat, or 6,008 acres, and the production 86,313 bushels. There was a production of 5,384 bushels of beans. The area in potatoes is given as 9,956 acres and the production as 902,079 bushels. Hops were grown on 622 acres, with a production of 198,309 pounds. Tobacco occupied 256 acres and produced 312,341 pounds. The population in 1880 numbered 46,853 rural and 31,058 urban.

By 1890 the population had decreased to 44,006 rural and 27,877 urban. There was practically no increase in the percentage of improved land in farms. The area in hay and forage crops had increased to 108,316 acres, and that in oats to 26,955 acres. The acreage in wheat and rye had decreased over one-half and the area in corn had fallen to 12,781 acres.

In 1900 the acreage in corn was about the same as in 1880, or 20,876 acres. Oats occupied 23,886 acres, wheat, 3,082 acres; rye, 2,285 acres; barley, 337 acres; and buckwheat, 4,843 acres. Beans were grown on 158 acres. Hay and forage crops still led all other crops, occupying approximately 105,000 acres. Potatoes were grown on 8,804 acres, and tobacco on 1,079 acres. Apples and pears were the most important tree fruits. Strawberries occupied 800 acres, blackberries 62 acres, and raspberries 166 acres. The value of animals sold or slaughtered was \$550,216; of dairy products, excluding those used in the home, \$927,147; and of poultry, \$144,109.

By 1910 the area in corn had fallen to 14,411 acres, producing 491,706 bushels. Oats still maintained the lead of the small grains,

occupying 20,591 acres and producing 504,314 bushels. The other small grains—wheat, rye, and barley—showed a decided decrease, falling to 330 acres, 524 acres, and 182 acres, respectively. The area in buckwheat was 3,808 acres and the production 71,394 bushels. The value of all cereals produced in 1909 was \$630,762. The area devoted to hay and forage crops showed little change. Timothy and clover together were grown on 78,577 acres, timothy alone on 11,550 acres, and clover alone on 823 acres. The total value of all hay and forage crops amounted to \$1,709,608. Potatoes were grown on 7,507 acres, producing 997,874 bushels. Tobacco occupied 284 acres, producing 340,041 pounds. Vegetable crops were grown on 3,126 acres, and the value of all vegetables produced was \$612,473.

Dairying has been an important industry for a comparatively long time. The use of special refrigerator cars and fast trains makes it possible to ship raw milk to New York City. The milk ordinarily is hauled to a shipping station either by the individual producer or by a few neighbors cooperating, each taking his turn in hauling for a specified period. There are some persons engaged in collecting the milk on regular routes by means of auto trucks or teams and wagons, delivering to the shipping point for a stated consideration based on weight.

There are few farmers that are not engaged in dairying to some extent, though on some farms dairying has been given up because of lack of labor and in some of the more remote sections because of the expense of marketing. In such cases the farmers do general farming, producing staple crops for their own use and selling the surplus. The principal sale crop usually consists of hay, which is baled on the farm, is nonperishable, and easily transported.

In general, the crops grown are largely those that support dairying, and a large part of the farm is in grass for both hay and permanent pasture. Hay and forage crops occupy more than one-half the land in farms. Timothy and clover are the main hay crops, usually grown together. Oats are generally grown because they succeed better than other small grains, and can be used as a nurse crop for grasses. The production of corn has largely changed to the silage varieties, and comparatively little corn is grown for the grain. Practically every farm has a silo. Vetch is being introduced and seeded in oats to increase the yield of forage. As not much grain is produced dairy farmers buy most of the grain ration for their stock.

The high cost of feed has made it necessary to select good dairy cows. Purebred and grade Holsteins are preferred on most of the dairy farms. There are also some Jersey and Guernsey cattle and grades of these breeds. The census reports the total value of dairy products in 1909 as \$1,950,833, which is the largest revenue from any agricultural source.

Besides field corn for grain and silage considerable sweet corn is grown for sale on the local markets or to canning factories. Peas also are grown quite extensively for canning in some sections, especially in the western part of the county. Potatoes are grown on every farm to supply home requirements, and in some sections for market. In the town of Williamstown there has developed an important potato-growing section on the sandy and gravelly terrace soils. The crop is grown under inspection and the product is certified by the State, being sold for seed at a price somewhat higher than that received for ordinary potatoes.

Tobacco is confined to the southwest corner of the county, and the fields are an extension from a tobacco-growing section in the county to the south. From 1900 to 1910 the acreage in tobacco decreased by nearly 80 per cent, owing to low prices. In former years there was a considerable acreage in the central part of the county as well as in the southern part. With the present high prices farmers are planning to grow tobacco more extensively again. The tobacco is manufactured into the cheaper cigars and cheroots. Yields range from 1,000 to 1,500 pounds per acre.

Truck farming has been important for some time, and the acreage devoted to it is now being extended. Trucking is done entirely on the areas of mucky soils and has been confined to areas in the vicinity of Oswego and Fulton, but the industry is now becoming important in more distant sections with the extension of good roads and the use of auto trucks. The main crops are lettuce and onions, but celery, beets, and carrots also are grown. The lettuce is packed in crates and shipped to outside markets. It is said that the Fulton lettuce commands the top price on the New York City market. Large yields of onions and other crops are obtained. The principal drawback to trucking in recent years has been the prevalence of plant diseases and the scarcity and high cost of labor. The use of the Muck areas entails high expense for drainage, and developments are made by companies rather than individuals.

Strawberries are an important crop in the section around Oswego. The product is widely known in the market and commands a good price. Strawberries are grown on the glacial upland soils. Blackberries and raspberries are also produced in quantities for shipment.

While some apples and other tree fruits are grown on practically every farm, commercial orcharding is confined to those towns along Lake Ontario, especially Oswego, Scriba, and New Haven. The leading varieties are Baldwin, which grows to perfection in this county; Rhode Island Greening, Northern Spy, and King. Pears also are produced commercially, a number of varieties from early to late being grown. There are no large peach or plum orchards, but the production of plums is considerable.

Poultry forms a considerable source of income on practically all farms, the revenue being largely derived from the sale of eggs. The value of poultry and eggs produced in 1909 is given by the census as \$518,137.

The adaptation of certain soils to the different crops is recognized mainly in truck farming, where the mucky lands are used exclusively for this purpose. It is recognized that the heavy silty soils are best for hay production, and such soils as the Dunkirk silty clay loam for oats. Farmers realize that the silty or very fine sandy loams are the most desirable for tobacco, and these soils were used most extensively when tobacco growing was at its height.

Wherever possible, machinery is used in the production of crops, and as only a comparatively small acreage of the farms is in tilled crops these are given good cultivation. A general practice is to plow the land, especially sod land, in the fall. This is particularly necessary when the soil is expected to be wet in the spring, and also on the heavy silty soils. The latter practically requires fall plowing to produce a suitable seed bed.

The farms generally are well equipped. The farm dwellings are, as a rule, large, and the barns ample for the accommodation of the dairy animals and other stock and for storing the hay.

A three-course rotation covering a period of 5 to 7 years is followed by most farmers. It consists of corn, planted on sod land plowed the preceding fall; oats, with which is sowed timothy and clover; and the use of the field for hay as long as it is productive, with pasture a year or two before it is returned to corn.

All the available barnyard manure is used, mainly for corn or on the hay lands. In conjunction with manure commercial fertilizers are generally used. In 1909, according to the census, 50 per cent of all the farms in the county used fertilizer, with a total expenditure of \$128,321, or an average of \$40.54 per farm. At present the fertilizer used is largely in the form of high-grade rock phosphate. On corn from 400 to 600 pounds per acre is used, on oats 250 to 300 pounds, and on potatoes from 400 to 1,000 pounds. It is considered desirable to have potash in the fertilizer for potatoes, but under present conditions this ingredient is either not obtainable or is too expensive to warrant liberal application. On hay lands some farmers apply about 200 pounds of phosphate per acre and, until the recent high prices of nitrate of soda, 150 to 200 pounds of the latter. Liming has been found beneficial on all the soils. The lime is generally used in the form of finely ground limestone, and about 1 ton per acre is applied on the land in oats. Experiment shows that with this application large increase in the yield of hay may be expected. On the truck farms larger quantities of fertilizer are used, the application rarely being less than 1,000 pounds per acre.

Farm labor is scarce but efficient and commands wages equal to that paid ordinary laborers in the towns. Wages by the day are about \$2 and by the month \$25 to \$40. On the truck farms \$12 to \$15 a week is the usual price.

The average size of farms in 1910 was 77.9 acres, of which 49.2 acres was improved land. The farms vary from a few acres to 200 acres or more. There are no very large farms, but there are some large holdings of land, mostly forested tracts.

The census of 1910 shows that 85.6 per cent of the farms are operated by owners, 13.7 per cent by tenants, and 0.7 per cent by managers. Farms generally are rented on shares, the owner furnishing the land, seed, and half the fertilizers and the tenant the labor, stock, and tools.

Land values vary from a few dollars an acre to about \$75 to \$100 for average farms. The general selling price is from \$40 to \$50 an acre, orchards being higher priced according to the age of the trees and other conditions. Raw, uncleared mucky lands near railroad stations are held at about \$100 an acre, but when these have been cleared and cultivated for some time and their value proved they are greatly enhanced in price.

#### SOILS.

On the basis of origin and mode of formation the soils of Oswego County fall into three groups, viz, glacial-drift soils, water-deposited soils, and cumulose soils. The rock formations underlying the county are all of sedimentary origin, consisting of gray shales, mostly thick-bedded and arenaceous, and thin-bedded sandstones, all of Lower Silurian age. The shales are most largely represented in the Salmon River gorge and in the northeast highlands of the county. The sandstones are gray and red. The gray Oswego sandstones are the most extensive. The red sandstone is largely confined to the southeastern part of the county, though it outcrops in the Oswego River Valley. Here it represents the Medina sandstones; associated with it is some conglomerate rock of the Oneida formation.

During the glacial period this region was probably covered by repeated advances and retreats of the ice sheets, which left a deep mass of glacial till over the upland. On some of the ridges and hills the surface was left smooth, while in other places the material was probably plowed up by the ice in different advances and covered by more detritus, leaving a very broken or morainic topography. That this till is of local origin and has not been moved far is indicated by the character of the embedded stones, which consist mainly of the known underlying formations and by their largely angular shape, the fragments showing little abrasion or rounding. That a small

part of the till is of foreign source is shown by the occasional presence of igneous cobbles and boulders that must have come from regions farther to the north.

The glacial-drift soils are all closely related and are much the same texturally, being derived from similar sandy formations and differing very little in agricultural value, except as influenced by surface relief, drainage, and degree of stoniness. The soils of this group are separated into two series, the Ontario and the Worth. The Ontario occupies the smooth drumlinoidal hills in the north-central and western part of the county. The series is characterized by a light-brown surface soil, a brownish-yellow to yellow subsurface layer, and a brownish-gray, compact subsoil, all carrying considerable stone. The chief characteristic separating this series from the Worth is that the material at some point within the 3-foot section or below is calcareous, effervescing strongly when an acid is applied. The till is evidently derived in fact from some calcareous or limestone formation.

The Worth is the most extensive series in the county. It is characterized by a light-brown surface soil and a yellowish-brown subsoil, which in the smoother types becomes grayish and compact, similar to the Ontario subsoil except that it is noncalcareous. The silt loam of this series is confined to the northeast corner of the county and forms the highest uplands, reaching an elevation of 1,750 feet above sea level. The stony fine sandy loam is a widely distributed type characterized by a broken, bumpy, or morainic topography. The gravelly fine sandy loam consists of kame-kettle and esker deposits, the latter deposited by swiftly moving streams within the ice mass, and in places also including old gravelly lake beaches.

At the close of the glacial period a great lake, Lake Iroquois, was formed. This lake covered most of Oswego County, or all of it below what is now the 600-foot contour, although the lake itself did not reach this level. In post-glacial time there has been a tilting of the land, this being indicated by the upper limit of the lake beaches. The levels as found by geologists are 484 feet at Cleveland on the hill slopes near Oneida, 489 feet near the village of Constantia, 563 feet at Richland, and 657 feet at Adams Center, in Jefferson County. This former lake extended over the low country beyond the present Oneida Lake to the slopes of the high hills to the south. Into it the glacial streams poured their waters and their burdens of detritus, the finer materials being carried farthest and deposited in quiet waters and the coarse particles nearer the shore and in moving waters. These water-deposited or glacial lake and terrace soils, consisting of modified glacial drift, are classed in six series.

Of these the Dunkirk is most extensive and important agriculturally. The sandy members of this series are characterized by light

or grayish-brown surface soils and light-yellow subsoils that may become somewhat grayish or mottled yellow and gray in the lower subsoil. The heavier members have a brownish to drabish-gray surface soil, a yellow to mottled yellow and gray subsurface layer, and a brown or indistinctly mottled brown, yellow, gray, and drab subsoil. The Dunkirk silty clay loam and silt loam and part of the very fine sandy loam are distinctly lacustrine soils; the very fine sandy loam is also a stream-delta soil occurring extensively along slopes of stream valleys entering the old lake proper. The fine sand consists of delta and stream deposits and in large part of the sandy beach formation.

The Chenango soils occupy outwash or delta plains and terraces of streams above the former lake level. They are characterized by dark to light brown surface soils and yellowish-brown subsoils, and the sandy members usually rest at varying depths upon a gravelly substratum. The gravel fragments in these soils are derived from the sandstone glacial drift, modified or reworked by water.

The Otisville series in this county consists of two types, the gravelly fine sandy loam and the fine sand. The former, occupying rough areas or steep, gravelly hills, is, in part at least, ice laid, a kame-kettle formation, and in part waterlaid or reworked, being deposited by very swift, heavily laden waters. The fine sand is a delta or beach deposit formed very much like the present Beach sand along Lake Ontario, brought up by waves and molded into dunes by the wind.

The Saugatuck series is represented by one type, which is variable in color and characterized by a brown hardpan layer. It is flat to hummocky or slightly undulating in topography, and poorly drained.

The Caneadea series is represented by the silty clay loam. This consists of lacustrine material similar to the Dunkirk silty clay loam, but poorly drained. It lies at low elevations, usually along or near stream courses, and some areas are subject to overflow. The series is characterized by light-gray or drabish-gray surface soils with a light-gray mottled or iron streaked subsurface layer and a gray to drab, mottled subsoil. It represents the same stage of soil development in the glacial lake soils of sandstone and shale origin as do the Homer soils in the lake plains farther west where the material is, in part at least, from limestone.

Only one soil is mapped of the Granby series, the fine sandy loam. It occurs along streams and in depressions, and is poorly drained. Typically it is derived from lake sediments, but as mapped it includes some areas that are influenced by recent alluvium.

Muck is a cumulose soil representing the accumulation of decomposed and decaying vegetable matter in the presence of water. It occupies depressed marshy and swampy areas.

Meadow includes areas of alluvial soils existing under poor drainage conditions and of no present agricultural use except for pasture.

Beach sand represents material along the lake shore thrown up by wave action and drifted by the winds into a dunelike ridge.

The following table gives the name and actual and relative extent of the several types mapped:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Worth stony fine sandy loam.....	192, 512	} 37. 1	Saugatuck fine sand.....	13, 440	2. 2
Poorly drained phase.....	33, 216		Caneadea silty clay loam.....	13, 248	2. 2
Ontario loam.....	47, 296	7. 8	Worth stony loam.....	12, 480	2. 1
Muck.....	44, 416	7. 3	Chenango stony gravelly loam.....	11, 328	1. 9
Meadow.....	33, 408	5. 5	Dunkirk silt loam.....	11, 200	1. 9
Worth silt loam.....	32, 768	5. 4	Otisville fine sand.....	4, 032	. 7
Dunkirk fine sand.....	31, 616	5. 2	Chenango sandy loam.....	2, 496	. 4
Dunkirk silty clay loam.....	31, 552	5. 2	Chenango gravelly sandy loam.....	2, 496	. 4
Worth gravelly fine sandy loam.....	24, 960	4. 1	Chenango fine sand.....	1, 152	. 2
Otisville gravelly fine sandy loam..	24, 320	4. 0	Beach sand.....	448	. 1
Dunkirk very fine sandy loam.....	21, 440	3. 5			
Granby fine sandy loam.....	16, 896	2. 8	Total.....	606, 720	

WORTH STONY FINE SANDY LOAM.

The Worth stony fine sandy loam, to depths ranging from 5 to 8 inches, consists of a light-brown or grayish-brown to slightly reddish brown fine to very fine sandy loam. It has, especially when moist, a loamy feel, due to the organic matter it holds, the quantity being sufficient in places to make it somewhat light or fluffy. The subsoil consists of yellow, fine, to very fine sandy loam that usually becomes more sandy in the lower part of the 3-foot section. The yellow color in most places gives way to yellowish gray or gray below 24 inches, but the yellow may persist, as is seen in road cuts, to depths of more than 36 inches. In places through the eastern part of the county where the soil has a slightly reddish shade the subsoil also is tinged red with the red Medina sandstone material. The gray material of the lower subsoil is compact and is generally referred to as "hardpan." In the lower part it may contain some brownish spots or iron stains.

In the western part of the county, where this type is associated with the Ontario loam, the material at depths of 5 to 10 feet is frequently calcareous, effervescing with the application of acid. For the most part, however, it is noncalcareous, the soil being derived entirely from sandstone till.

There is considerable stone on the surface and in the soil mass. In uncleared areas stones are very conspicuous in contrast to cultivated fields from which the larger fragments have been removed. Usually there has been sufficient stone to build the fences that inclose the small fields, usually only a few acres in extent. The stones vary in size from small fragments to slabs several inches in diameter. They are largely angular, but there also are some subangular blocks and rounded cobbles, as well as deposits of rounded waterworn gravel. The fragments consist mostly of gray sandstone and to some extent of red sandstone, but there is some sandy shale, especially in the vicinity of Pulaski and toward the village of Mexico. The gravel also is mostly of sandstone, but igneous gravel of foreign origin is present to a slight extent. Before any of this land can be cultivated considerable stone must be removed.

The Worth stony fine sandy loam is the most extensive and widely distributed type in the county. It is mapped in practically all the towns, but the largest areas occur in the northern part of the county above the level of the old lake deposits. One of the largest developments is the belt that extends through the towns of Williamstown, Redfield, Boylston, and Sandy Creek. The next largest occurrence is in New Haven. Throughout the eastern part of the county the areas are comparatively small, following narrow ridges or occupying lower, bumpy slopes around smooth hill areas.

The type occupies ridges and hills of morainic formation. There are minor inequalities caused by the accumulation of stone and intermediate slight depressions, resulting in an uneven surface, but where the areas are cleared, the stones largely removed, and the land more or less leveled by plowing and cultivation, the fields are smooth except for the larger knolls and depressions.

The elevation and sloping surface of this type favor the run-off, but, as in the case of all glacial-till soils, the depressions, no matter how small, are wet, supporting a growth of rushes, sedges, and other moisture-loving plants. Hence fields have a very spotted appearance. The larger draws and seepage slopes on improved farms have been more or less completely drained by means of blind ditches made with stone. These are effective but expensive to construct, although their use has the advantage of removing stones from the surface. Practically all the type except the sharper knolls requires underdrainage.

Because of its large extent and wide distribution, this is an important soil type. The larger part of it is cleared and under cultivation to grass, cultivated crops, and fruit. Much, however, is in permanent pasture, especially the more stony and rougher areas. Some of the areas in the eastern part of the county are mostly in timber, and their value is based largely on the timber growth. The most important crop is hay, consisting of timothy and clover, either

separate or combined, mainly grown to feed dairy cows. Considerable timothy hay is sold. Silage corn also is grown for dairy feed. Some oats are grown, and buckwheat, which gives good yields, is an important crop. Potatoes are grown on all the farms and give fair yields. Beans are an important special and, with the current prices, a profitable crop. Diseases difficult of control reduce the yields. Near Lake Ontario a considerable area is in apple and pear orchards, especially in the town of New Haven. The orchards give good yields of fruit of good quality.

As dairying is followed on most farms large quantities of barnyard manure are produced. This is all saved and applied to the land. Commercial fertilizer, mostly high-grade acid phosphate, is also used. From 200 to 300 pounds per acre is the ordinary application for oats, and from 400 to 600 pounds for corn. Acid phosphate is also applied to hay land, the customary application being 200 pounds per acre. Some nitrate of soda is used also. The use of finely ground limestone is becoming more general and has proved very beneficial. The average yield of hay without liming is about 1 ton per acre.

Land values on the typical Worth stony fine sandy loam vary greatly, depending upon the condition of the fields, the buildings, and the location as to roads and towns. Prices show a wide range, general farming land bringing from \$10 to \$100 an acre. Land in bearing orchards, especially on desirable locations near the lake, is held at much higher prices.

*Worth stony fine sandy loam, poorly drained phase.*—The poorly drained phase of the Worth stony fine sandy loam is a variable soil in color and to some extent in texture. The surface soil ranges from light grayish to black and the subsoil from yellow or brownish yellow to gray or drab or mottled yellow, gray, or drab, depending upon the drainage. The apparently flat surface is made up of low, stony to gravelly hummocks a few inches or a foot or two high, with corresponding wet depressions between. In the former the soil consists of 4 to 7 inches of light or grayish brown fine or very fine sandy loam, underlain by an inch or two of yellowish or orange-colored material, similar in texture to the soil, grading into a yellow and gray, mottled, fine or very fine sandy loam. This may become somewhat heavier in the lower depths, or, as is usually the case, more sandy, in some places the texture being a fine or very fine sand. The phase contains a large percentage of rock fragments of all sizes strewn over the surface and in the soil mass. This stone is mostly gray sandstone, but there is some red sandstone and occasionally some igneous rocks of foreign origin. Some rounded waterworn gravel also is present, and frequently the hummocks are composed almost wholly of gravelly material. A variation occurs where the

soil is reddish brown, with a purplish-red subsoil. The depressions are occupied by a dark-gray to black fine or very fine sandy loam, underlain by gray to drab fine sandy loam or fine sand. In places, however, the material may become somewhat heavier, containing enough clay or silt to make it sticky. Some of these depressions are mucky for a few inches, underlain by gray to drab fine sandy loam or fine sand. This subsoil is compact and wet and generally full of stone.

The flat areas of this phase occur scattered over most of the towns containing glacial till, but their largest development is in those towns in which contact occurs between the lake-deposited material and the till deposits. These areas frequently are bounded by old gravelly beaches or deposits of gravel. The flat areas were probably under water, but where there was no or at most only slight deposition of lake material. The largest areas of the phase are in Hannibal, Granby, Volney, Scriba, Richland, and Sandy Creek Towns.

This soil occurs almost entirely on ridge crests, but few areas extend down gentle slopes to stream-way depressions. Some narrow strips also are mapped in troughs between ridges. The areas are flat and poorly drained, the slight depressions between the hummocks supporting an aquatic vegetation, largely rushes and sedges. The only means of drainage is by percolation to lower depths, as there is practically no run-off.

The Worth stony fine sandy loam, poorly drained phase, while rather extensive, is of little importance agriculturally. Where cleared of forest growth it is devoted to permanent pasture, being too rough and stony to mow. Occasional small patches have been improved and are cultivated to corn, oats, buckwheat, and hay. The timber growth consists of maple, elm, ash, birch, hemlock, and some other trees in less abundance. The selling value of this land is low where the timber growth has been removed.

#### WORTH STONY LOAM.

The Worth stony loam, to a depth of 5 to 7 inches, consists of a dark-brown to light-brown, light, friable, gritty loam or fine sandy loam. In newly plowed and moist fields the color shows a reddish tinge. The subsoil is an orange-yellow fine sandy loam changing in the lower depths to a grayish-yellow color and a compact texture. While the type characteristically has a reddish tinge, the color varies within short distances, and as seen in road cuts alternates in places to the lighter brown soil and the lighter yellow subsoil. Considerable quantities of stone are strewn on the surface and mingled in the soil mass, the content increasing with depth. The stone consists mostly of red sandstone, but there is some gray sandstone. The

stones range from angular to subangular. The reddish color observed in many places through this type is derived from the red Medina sandstone and is not a soil color due to oxidation of the soil material.

The Worth stony loam is confined mostly to the towns of Constantia, Amboy, Albion, Williamstown, and Redfield. Small areas occur in adjacent towns. The type occupies smooth, rounded, glaciated hills. The slopes are rarely steep, and with removal of the stone all the land is capable of cultivation. The type has good surface and internal drainage, although there are seepage places on ridge crests and slopes where underdrainage would be beneficial.

This type represents the desirable smooth hill land of the sections of the county it occupies, and all of it is cleared and under cultivation. Dairying for milk production is the main occupation, and consequently most of the type is in grass. Some corn, oats, and buckwheat are grown. The yield of hay is about the average for the county, approximately 1 ton per acre. Oats yield 20 to 40 bushels per acre. Potatoes do well on this soil. Fertilizers are generally used, in rather small applications, to supplement barnyard manure.

The Worth stony loam areas lie for the most part some distance from railroads, and, without the advantage of favorable location, values do not run high. Most of the farms are not highly improved as to buildings. About \$20 to \$40 an acre is the ordinary price of farms on this soil.

#### WORTH GRAVELLY FINE SANDY LOAM.

The Worth gravelly fine sandy loam, to depths ranging from 5 to 8 inches, consists of a light-brown to yellowish-brown fine sandy loam, containing a large amount of gravel. The subsoil, especially below 15 inches, is largely gravel, the earthy material consisting of yellow fine sandy loam. Gravel completely covers the surface. It consists largely of waterworn sandstone, with a small amount of igneous origin. The fragments vary in size from fine gravel to cobbles. In places there are some larger blocks of rounded or subangular sandstone, both gray and red.

The depth of this gravelly formation is unknown. Exposures in gravel pits indicate that it is of considerable depth and also show more or less stratification, in places distinct, in others indistinct and indeterminate.

The Worth gravelly fine sandy loam occurs in almost all the towns in the county where the elevation does not rise more than 600 feet above sea level. The largest occurrence is in the southwest part of the county, in Granby and Volney Towns. It is generally associated with lake-deposited soils, especially along the glacial-till uplands. The areas as a rule are not large.

The surface is ridgy to hummocky, depending upon the mode of formation. Much of the type, especially at the western foot of the highlands, occupies gravelly lake beaches, with a surface varying from flat or sloping to ridgy and somewhat bumpy. In Granby Town and along the Oswego River part of the type has a typical kame-kettle topography, consisting of steep-sided, rounded gravel knolls, with intervening kettle-hole depressions lacking drainage outlets. It also occupies gravel knolls and narrow low ridges in the central and southern parts of the county, where it is associated with lower lying lake-deposited material. A few areas are included that are evidently esker material carried and deposited by swift streams within ice masses. In some places the type occurs as gravel deposits on slopes of glacial-till ridges and hills. In the southern and central part of the county such areas are encountered up to an elevation of 500 feet, but in the northern part, especially in Sandy Creek Town, the altitude is slightly over 600 feet above sea level or about 350 feet above the present level of Lake Ontario. The gravel content permits of the ready passage of water through this soil, and the type is inclined to be droughty.

Practically all of this soil is cleared and devoted to some agricultural use. The original timber growth was mostly chestnut and oak. Grass, either for hay or pasturage, is the most important crop. The more irregular areas are used as permanent pastures. Corn, potatoes, and buckwheat are grown. The yield of hay varies, but about 1 ton per acre is considered a good average. With applications of finely ground limestone the yield has been increased to 2 or more tons per acre. When lime is used clover succeeds on this soil. The better areas of the type grow corn successfully, as the soil is well drained and consequently "early." Sweet corn is one of the successful crops. Potatoes do well, especially in seasons of normal rainfall.

#### WORTH SILT LOAM.

The soil of the Worth silt loam consists of 4 to 8 inches of light-brown or grayish-brown to yellowish-brown, light silt loam or silty loam of rather fluffy structure. The upper subsoil is a brownish or light-yellow material of texture similar to the soil, continuing to a depth of 12 to 15 inches, and in some places to a depth of more than 2 feet. Below this the color becomes grayish and the texture decidedly more sandy, the material becoming a fine or very fine sandy loam. There is considerable stone on the surface and in the subsoil, and the content usually increases with depth, so that it is difficult to penetrate with the soil auger more than 15 inches. The stone consists mainly of slabby pieces of gray sandstone and of rather thick bedded sandy shales. It ranges from pieces small enough to make the soil only

"gravelly" to slabs several inches across. The stones are for the most part angular, but some have rounded corners or edges. In places some igneous boulders of foreign origin are present. With the removal of the larger stones the land is capable of cultivation, though even then it is rather stony.

The Worth silt loam is confined to the northeastern corner of the county in the towns of Boylston and Redfield. It occupies approximately one-half of the latter town. It occurs in one large area interrupted only by the wet strip of Meadow along the streams. The type occupies the highest elevations in the county, the highest altitude, about 1,750 feet above sea level, being in the northeast corner of Redfield Town. It occupies the highest hilly section of the county, rising from the North Branch of Salmon River in long slopes, seldom very steep, but in places somewhat bumpy. The higher levels have the aspect of an uneven plateau, relieved by slight elevations or knolls. Into these high, level sections the streams have cut back numerous narrow valleys, and some of the lower slopes are very steep.

The streams afford ready run-off, but wet seepage places on slopes are common and slight, poorly drained depressions occur in the more level upland. Despite the stoniness the compactness in the subsoil not far beneath the surface (at a depth of 15 to 24 inches) retards drainage and tends to maintain the supply of moisture in the soil.

While the Worth silt loam is comparatively extensive, it is of little importance from an agricultural standpoint. Most of the type is in forest, owned or controlled by lumber and wood-pulp companies. The principal tree growth is beech and birch, with hemlock and spruce in the ravines.

This soil is not naturally strong, but with good cultural methods and the application of large quantities of barnyard manure it gives splendid yields of the general farm crops. The season is rather short for corn, except for ensilage, and varieties suited to this use are grown on the few farms where dairying is carried on. Irish potatoes yield 50 to 150 bushels per acre. Buckwheat is grown and does well. Much of the cleared land is devoted to grass for hay and pasturage, and the rougher and more stony areas are used for permanent pasture.

The selling value of this land is low, largely because of its distance from towns and railroads.

#### ONTARIO LOAM.

The surface soil of the Ontario loam varies in depth from 4 to 10 inches, averaging 6 inches, and consists of a brown to yellowish-brown, mellow fine loam, relatively sandy, i. e., approaching a fine or very fine sandy loam in texture. It contains enough organic matter to impart a mellow loaminess. The upper subsoil consists of a brownish-yellow to yellow or yellowish-gray, fine-textured loam texturally

like the soil. This extends to a depth ranging from 10 to 18 inches, where it rests upon a brownish-gray fine sandy loam which extends to a depth of more than 36 inches. This lower subsoil varies somewhat in color and texture. Frequently the upper part is mottled with yellow and brown, the latter color being due to iron stains or iron crusts resulting from insufficient drainage and aeration.<sup>1</sup> The material may become more sandy and coarse textured, or, as is often the case, there may be lenses or layers of more sticky or clayey material. In small spots a silt loam surface soil is encountered, with a correspondingly heavier subsoil, at least for a few inches if not throughout the 3-foot section. The gray color of the subsoil is due to the fact that the material has not been completely weathered. The subsoil is very compact, and though not cemented acts like a hardpan, by which name it is known locally. At depths ranging from 3 to 8 feet the underlying material is calcareous, but there are apparently no limestone fragments in this lower till. Sweet clover (*melilotus*) grows profusely in exposures of this lower till along the roadsides. This is not the case with other subsoils of the county.

The Ontario loam is quite stony. Most of the stones, especially the larger ones, have been removed from the surface and used to build the fences inclosing the fields. The cleared land consequently does not have the appearance of being very stony, although there is enough stone left to interfere more or less with cultivation. The fragments consist almost entirely of sandstone, there being only occasionally a boulder of igneous rock. The stones vary in size from small fragments to occasional large boulders. Most of the stones are less than 1 foot in diameter, and angular to subangular in outline. There are in places some rounded cobbles.

The Ontario loam is confined to the western, northern, and northwestern parts of the county. It occurs in all the towns west of the Oswego River, being most extensive in Oswego Town and other towns around the lake. The type occupies ridges and hills with a general trend at right angles to the shores of Lake Ontario. The slopes are smooth, and steep only in some places near stream courses. There is consequently very little waste land in this type. The hills rise 50 to 200 feet above Lake Ontario.

The surface relief affords good run-off, and, owing to the shallow depths to the compacted subsoil, the type holds a comparatively small supply of moisture. During long-continued rainfall the soil in places becomes very wet and mortarlike, and compacts and hardens upon drying. Seepage spots are common on slopes and wet areas occur on the crests wherever there is the slightest depression. These

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<sup>1</sup> The poorly drained areas with a mottled subsoil do not belong in the Ontario series, but are included on account of their small extent.

surface inequalities are readily eliminated by continued plowing and cultivation. This soil is invariably improved by underdrainage, which has been provided in many places by means of blind ditches filled with stones.

The Ontario loam is an important soil, and the greater part of it has been cleared and improved. The original forest growth was comparatively heavy, and consisted largely of maple, beech, birch, and elm, with hemlock abundant in the ravines. All the common crops are grown on the Ontario loam, but its principal uses are for dairying and fruit growing, frequently carried on together. A large part of the farms is in grass for hay and pasturage. The hay crop consists of timothy and clover, grown either separately or together. Much timothy hay is baled and sold. Clovers succeed on this soil, especially with applications of lime. Silage corn is the main tilled crop. Considerable sweet corn is grown and sold for consumption fresh or for canning. Oats are the principal small-grain crop. Oats are grown as a step in the rotation and as a nurse crop for grass, especially clover. Beans occupy a considerable acreage. Buckwheat is a common crop, and potatoes are grown on all farms, but only on an acreage large enough to supply the home needs.

Most of the commercial fruit growing in the county is on the Ontario loam. The fruit is mainly apples and pears, with some plums and peaches. The desirableness of this soil for fruit growing is largely due to its location near the lake. Berries are an important special crop. The strawberries produced on this soil have a reputation for excellent quality, size, and appearance. Raspberries, both black and red, and also blackberries, are grown to some extent.

The yield of hay averages a little more than 1 ton per acre, but where liberal applications of barnyard manure and acid phosphate are used it is considerably greater. Silage corn yields heavily. Oats yield 25 to 50 bushels per acre, and potatoes average about 90 bushels, with larger yields under good management in favorable seasons. Navy beans yield from 10 to 20 bushels per acre, and at present prices are a very profitable crop.

Except for stoniness this soil is easily handled. Much of the plowing is done in the fall. Fertilizers are in general use, in addition to barnyard manure. The application of lime in the hydrated form or in the form of finely ground limestone is gradually extending, as its use results in increased yields of hay.

Some of the best farms in the county are on the Ontario loam. This soil has the advantage of location near the main towns, railroads, and lake. The lowest priced land of this type brings from \$40 to \$50 an acre. Farms including bearing orchards are held at much higher prices.

## DUNKIRK FINE SAND.

To an average depth of 6 inches the Dunkirk fine sand consists of a light-brown or grayish-brown, rather loose fine sand, generally containing enough organic matter to impart a loamy feel. The subsoil consists of yellow fine sand continuing to a depth of more than 36 inches or else grading into a compact fine sand of a yellowish-gray color or yellow with gray mottling. The lighter colored subsoil usually occurs in the flatter areas, while the yellow subsoil is encountered on knolls or slopes. On knolls it frequently develops an orange-yellow color, and here there is sometimes a slightly brownish layer similar to hardpan, only an inch or two thick, and usually lying near the surface. Occasional gravel pockets occur in the type, and some areas have a small quantity of rounded gravel on the surface and throughout the 3-foot section. In places the texture of the soil approaches a medium sand, a notable instance being near the village of Lacona.

This type has a wider distribution than any of the other Dunkirk or associated glacial-lake soils. It is mapped in practically all the towns in the county except those in the higher eastern part, as it does not occur above the 600-foot level. The areas are numerous and vary in size from patches barely large enough to map to tracts 2 or 3 square miles in extent. The largest bodies are in the southern part of the county in the towns of Granby, Schroepfel, and Hastings.

The surface of this soil varies from flat or undulating to somewhat hilly. Some of the areas are terracelike, consisting of old sandy lake beaches or plains. In places the type occupies slopes to stream valleys, and has a somewhat billowy or hummocky surface. In a few places the type is marked by sand "blows," forming sand knolls a few feet high. In this characteristic the type resembles the Otisville fine sand, of which it may be considered a smoother equivalent lying at a lower elevation.

The type has good drainage. As it is somewhat loose and porous water sinks into it readily. The land tends to be rather droughty, though. The rather compact lower subsoil, however, aids somewhat in maintaining the supply of moisture in the large area south of Fulton. There are several springs, one of which supplies a well-known mineral water.

The Dunkirk fine sand is comparatively extensive and widely distributed. Most of the type is cleared and farmed. The timber growth consists of chestnut, oak, and white pine on the better drained areas and hemlock in the depressions. Chestnut is common in fields, the trees being preserved for the crop of nuts. This soil is devoted to the cropping systems prevailing on other soils used for dairying. Where it is not too loose and droughty potatoes do well.

A large proportion of this type is in grass for hay and pasturage. It gives a few good cuttings but after two years the yield decreases. The pastures are good and, on account of thorough drainage, earlier than on most of the other soils. The type does fairly well with corn, but the yield of oats is usually light. It is an easily cultivated soil, much desired in the early days because of the ease of working and lack of stones. The type is fertilized in the same way as the other soils, barnyard manure being supplemented with commercial fertilizer. This now necessarily consists mainly of acid phosphate, although potash would be desirable also.

Some of this land has the appearance of being abandoned, growing up to weeds and briars, but there are some fair farms on the type, especially on the smoother areas and on the lower slopes where moisture conditions are better. Land prices are low to medium, ranging from \$15 to \$30 or \$40 an acre, depending upon the improvements and nearness to towns or main roads.

Much of this type could well be reforested to white pine, as is being done to some extent on the large body containing the springs mentioned previously. In handling this soil care should be taken to increase and maintain the supply of organic matter, which would incidentally increase the power of the soil to hold moisture. Legumes should be more generally grown as cover and green-manuring crops. When the spring season is not too late watermelons and cantaloupes would succeed on this soil and probably be profitable.

#### DUNKIRK VERY FINE SANDY LOAM.

The surface soil of the Dunkirk very fine sandy loam consists of 6 to 10 inches of light-brown or grayish-brown very fine sandy loam, containing enough organic matter to have a loamy feel. The subsoil is a compact yellow very fine sandy loam, in most places becoming grayish yellow at 15 to 20 inches. The type contains considerable silt, especially in those areas bordering the Dunkirk silt loam, so that it is sometimes quite difficult to separate this soil from the silt loam type. Some included areas are really the Dunkirk very fine sand, but they are not extensive enough to map as a separate type. In such places the soil is a brown, very fine sand and the subsoil is a brownish-yellow very fine sand to a depth of 20 to 24 inches, changing below to a grayish very fine sand.

The Dunkirk very fine sandy loam is one of the most widely distributed glacial-lake soils in the county. It occurs in a considerable number of areas in the southern and central parts, especially in Hannibal, Granby, and Volney Towns. The most important of the fine sand areas occur on the ridge at Daysville and southwest of South Granby.

The surface of the Dunkirk very fine sandy loam is in part rolling. Some areas occupy the lower slopes of hills and valleys, and the surface is broken by the channels of small streams and by low knolls. The areas of this soil generally follow the stream courses into the hilly country, especially in the town of Hannibal. Practically the entire type is capable of cultivation, as the slopes are nowhere very steep, except on the slight escarpment to the stream bottoms.

The type, as well as the included very fine sand areas, has good surface and internal drainage, owing to its position and open structure. The lower subsoil, however, is compact and tends to hold moisture, so that the type is fairly retentive.

The Dunkirk very fine sandy loam is an important soil. It makes good farm land and has a wide crop adaptation. All the type has been cleared and put in cultivation. Originally it supported a variety of deciduous trees and pines. As on the other arable soils, the grass crop is most important, as dairying is the prevailing type of agriculture. Corn and oats are grown in the rotation and some alfalfa is produced. Part of the tobacco grown in this county is produced on this soil and it is apparently adapted to that crop. The cultivated soil of the light sandy areas is easily drifted and these areas generally are kept in grass and pastured.

The yield of hay averages about 1 ton per acre, but under the best management considerably more than this. Corn grown is of silage varieties and gives fair yields. Oats yield 25 to 40 bushels per acre. Ordinarily the yield of tobacco ranges from 1,000 to 1,500 pounds per acre.

This soil is comparatively easy to handle, as it is mellow and free from stones. It is fertilized with barnyard manure and acid phosphate. On some farms applications of finely ground limestone are used. This soil responds to liming, the effect being especially noticeable in the yield of hay crops.

The farms on this type as a whole are above the average in appearance and in improvements. Much of the type lies near towns and railroads, and prices, which depend largely upon the buildings and other improvements, range from \$30 to \$50 or more an acre.

In handling this soil every effort should be made to increase the supply of organic matter. In addition to applying all available barnyard manure green-manuring crops should be grown. The legumes are probably best for this purpose, but rye or buckwheat are valuable.

#### DUNKIRK SILT LOAM.

The soil of the Dunkirk silt loam consists of about 7 inches of light-brown or grayish-brown, friable silt loam. The subsoil has about the same texture as the soil, and there is very little change in texture

within the 3-foot section, except that at or near 36 inches the material in places contains a little more fine sand, the texture grading toward a very fine sandy loam. In a few patches heavy silt, silty clay loam, or silty clay of brownish color is encountered. The lower subsoil is locally called hardpan, on account of its close, compact structure. The color of the subsoil varies to some extent. Usually it continues light yellow to 15 or 20 inches, where it becomes slightly grayish and more compact. The subsurface material for a few inches in the flatter spots may be grayish before it grades into the yellow or brownish material and shows slight mottling of brown, different shades of yellow, and some gray or drab.

The Dunkirk silt loam occurs in numerous areas in the southern and central parts of the county in association with other glacial-lake soils. The surface is flat or gently sloping to gently rolling or undulating, broken by streams and draws. Its highest elevations are 60 to 80 feet above the streams some distance away, the slopes being long and gentle. Drainage on the whole is good, but the flatter areas are benefited by underdrainage.

The Dunkirk silt loam is considered one of the best soils in the county. It is easy to cultivate, has a wide crop adaptation, and is productive. The type is all cleared and in improved farms. Dairying is the prevailing type of farming, and the cropping system is adapted to support this industry. Hay is the principal crop, both timothy and clover being grown. Corn, largely for silage, is the main cultivated crop. Oats are grown to form a step in the rotation and as a cover crop for grass. In the southwest corner of the county, in what is known locally as the Baldwinsville tobacco section, some tobacco is grown.

The yields of hay and silage corn are above the average for the county. Oats yield 25 to 50 bushels and tobacco from 1,000 to 1,500 pounds per acre. The tobacco is used in the manufacture of the cheaper cigars or cheroots.

As dairying is extensively engaged in, considerable quantities of barnyard manure are available. Commercial fertilizers are also used in light applications. At the present time they consist of phosphatic ingredients, especially acidulated rock phosphate. Liming is becoming more general, finely ground limestone being applied at the rate of 1 to 2 tons per acre. Hydrated lime is used to some extent. This soil, like all the other types of the county, responds well to lime, especially in the production of hay. Much of the Dunkirk silt loam is advantageously situated with reference to railroads and towns, the farms as a whole are well improved, and prices range from \$30 to \$75 or more an acre.

## DUNKIRK SILTY CLAY LOAM.

The Dunkirk silty clay loam, to depths ranging from 5 to 9 inches, with an average of 7 inches, consists of a brownish-gray silt loam to silty clay loam varying to dull or drabish gray.<sup>1</sup> This is underlain by yellow, heavy silt loam or silty clay loam, frequently slightly mottled with gray. At depths ranging from 10 to 18 inches the latter material grades into a heavy, silty clay loam to clay of a grayish-brown color, finely streaked with different shades of yellow, gray, and drab. In flat situations the surface is generally drabish gray with a few inches of lighter colored material overlying the heavy, brownish subsoil. In a few places the yellow color with gray mottling continues throughout the 3-foot section. The surface material has a smooth feel when moist, and its content of clay makes it more or less plastic. The subsurface material frequently is largely silt and has the smooth feel of damp wood ashes. The lower subsoil is very plastic and close structured, and when dry it is difficult to bore into or to excavate. On rises and benches on slopes to streams the surface is frequently quite mellow or granular. The type is locally known as "clay" land.

The Dunkirk silty clay loam occurs in the southern part of the county east of Oswego River, the largest development being in the towns of Schroepel and Hastings. The areas are interrupted by ridges of other soils. The type occupies flat to gently undulating areas and slopes. The greater part of it lies below the 430-foot contour. Surface drainage is good except in the flat areas, but internal drainage is slow owing to the close and compact structure of the subsoil. This soil, because of its fine texture, is capable of holding a large water supply, but it absorbs moisture slowly and when it dries shrinks and forms cracks. The type is benefited by underdrainage, but the drains must be close together to be effective.

The Dunkirk silty clay loam is one of the important soils of the county. The original timber growth was largely elm and hickory, but practically all of this type has been cleared and put in cultivation. Owing to its prevailing heavy texture it is not adapted to a wide range of crops, but is considered the strongest grass and small-grain soil in the county, and it is largely used for grass, hay, and oats. The texture is rather heavy for corn. Hay gives a heavier yield than on any other soil in the county, and grass affords good

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<sup>1</sup> The Dunkirk silty clay loam as mapped in Oswego County is made to include a wider range of conditions than is ordinarily allowed in one type of series. The Dunkirk series, as now defined, is to include brown soils with lighter brown or yellowish-brown subsoils, little if any mottled; in Oswego County only the silty clay loam areas where the soil and subsoil have a good brownish color are true Dunkirk silty clay loam. The areas with a very light grayish soil and subsurface layer and a gray mottled subsoil belong in the Caneadea series, while those of intermediate color characteristics, corresponding to the Volusia soils, belong in a new series not yet established.

cuttings of hay and then pasturage for a longer period than on most of the soils of the county. The yield averages  $1\frac{1}{2}$  tons per acre. Usually clover and timothy are grown together, but timothy alone does well. Clover succeeds where the soil is limed. Oats make the highest yield in the county, 50 bushels or more per acre not being uncommon. Silage corn gives good yields, but the soil is hardly "early" enough to mature the grain. Gardens, as a rule, are not as good as on the lighter soils of the county.

This is much harder soil to handle than the sandier types. It must be plowed or cultivated at just the proper time. If too wet when plowed it forms clods which are difficult to break down until they have gone through a winter's freezing and thawing, and if plowed too dry it breaks into big lumps which make it difficult to form a seed bed. The general practice is to plow as late as possible in the fall, since the soil is generally wet in the spring and planting would naturally be delayed. Fall plowing is considered especially desirable for sod land, as it gives an opportunity for the sods to settle and tends to destroy grubs and insects. In seeding oats or grass corn land is merely well disked, as is the case on other soils.

The usual fertilizer practice is followed on this soil, barnyard manure and light applications of acid phosphate being used. Some liming is done, 1 ton or more of finely ground limestone being applied per acre.

The farms on this type are probably better than the average. There are a number with large dwellings and barns, the latter being needed to house the dairy stock and their feed. Those farms on which dairying is not followed derive a considerable income from the sale of hay and oats. The price of land of this type ranges from \$30 to \$60 an acre. Most of the type lies near towns and along the railroads.

Lime should be more generally used on this soil. It would be well to use at least 2 tons of finely ground limestone per acre. This soil responds to liming in increased yields, the benefit being due in part to reinforcement of the physical condition of the soil. All the roughage possible should be plowed under to make the soil more open and friable. The growing of legumes as cover crops and for green manuring would be of much benefit.

#### CHENANGO STONY GRAVELLY LOAM.

The surface soil of the Chenango stony gravelly loam consists of 5 to 10 inches of brown fine loam or fine sandy loam very stony and gravelly containing considerable finely divided organic matter. The fine earth subsoil is a yellow loam or fine sandy loam to a depth of more than 36 inches. The surface is thickly strewn with rounded cobbles and gravel, and, as a matter of fact, the soil and subsoil

largely consist of gravel or cobblestones. The cobbles are 4 to 6 inches in diameter. There are in places some angular sandstone slabs and subangular blocks. The soil is often so stony that after the larger stones and cobbles have been removed to build the field walls enough stones remain on the surface and in the soil to interfere with cultivation. The fragments are almost entirely sandstone.

The Chenango stony gravelly loam is confined to the central and eastern part of the county. The largest areas are in the old partially filled valley now occupied by Fish Creek in the towns of Albion and Williamstown. The type has a flat surface broken only where streams have cut down through it. It occupies glacial terraces or outwash plains, probably more or less reworked into a succession of terraces, as occurrences in the valley above Kasoag indicate. Most of the type lies above the 500-foot level. Drainage is practically everywhere good.

This soil is not extensive, but practically all of it is cleared and cultivated. Chestnut, oak, and white pine made up the original timber growth. Much of the type is used in the production of forage crops to support dairying. Grasses for hay and pasturage occupy the largest acreage. Corn is the principal cultivated crop, and the type is highly desired for corn, as it is well drained and "early" and the crop has the advantage of a comparatively long season. Corn gives good yields of grain and silage. In areas where there are not too many stones potatoes give good results.

There are some fairly good farms on this type, with attractive improvements. The selling value is above that of the hilly lands adjoining.

#### CHENANGO GRAVELLY SANDY LOAM.

The Chenango gravelly sandy loam, to a depth ranging from 6 to 10 inches, consists of a brown or light-brown gravelly sandy loam or fine sandy loam. The subsoil is a yellow, gravelly sandy loam or fine sandy loam extending to 36 inches or more. Rounded waterworn gravel covers the surface and occurs abundantly in the soil mass. It is most abundant in the lower part of the 3-foot section, which is practically a gravel bed with very little interstitial material. The gravel ranges up to an inch or two in size, which distinguishes this type from the Chenango stony gravelly loam, although the two soils grade into each other.

The Chenango gravelly sandy loam occurs in association with the Chenango sandy loam in the towns of Richland, Albion, Williamstown, and Redfield. The areas are rather small and the type is not extensive. Despite its flat surface, which is due to its origin as a terrace or gravelly outwash plain, the drainage is good.

This is a desirable soil, and all of it is cleared and under cultivation. It is used, like all the other soils of the county, mainly for crops to support dairying. Corn and potatoes are the principal cultivated crops. Corn gives good yields and potatoes do exceptionally well. With proper methods extra good yields are obtained, and the product is of superior quality. Some of the best fields of potatoes in the county, in the vicinity of Kasoag, are on this soil or on the gradational areas between it and the sandy loam type of the same series. With the use of green-manuring crops in addition to heavy applications of barnyard manure and the use of some commercial fertilizers, the Chenango gravelly sandy loam is a good farming soil.

The selling value of this land is enhanced by its location near railroads and towns, and ranges from \$30 to \$50 or more an acre, depending upon the improvements.

#### CHENANGO FINE SAND.

To a depth of 8 inches the Chenango fine sand consists of a brown fine sand containing in places sufficient organic matter to impart a loamy feel. The subsoil is a brownish-yellow to yellow fine sand, resting upon a gravelly substratum in the lower part of the 3-foot section or not far below.

The Chenango fine sand occurs in a few small areas in the eastern part of the county. The largest areas are in the towns of Constantia and Albion. The type represents terrace or outwash-plain areas, and has a generally level surface, but drainage tends to be excessive, and the soil is droughty. The various areas are cleared but they are of little agricultural importance.

#### CHENANGO SANDY LOAM.

The Chenango sandy loam typically consists of 6 to 10 inches of light-brown to dark-brown sandy loam, but the texture varies, ranging on one hand to fine sandy loam and on the other to a coarse sandy loam carrying small gravel, and on some low knolls the soil is practically a loose sand with a tendency to drift, as indicated by bare spots in fields. The surface soil typically contains enough organic matter to impart a loamy feel and slight fluffiness. The subsoil is similar in texture to the soil, being a light sandy loam of brownish-yellow to yellow color, which at depths ranging from 15 to 28 inches changes into a fine gravelly substratum. The latter in places extends below the 3-foot section, but in others rests upon a gravel bed. This fine gravelly substratum is made up of particles little larger than the head of a pin, mingled with considerable fine and very fine sand. The color is usually brownish, but in the flatter or more depressed areas, grayish or brownish gray.

Near streams, on slight knolls or gentle ridges, rounded gravel may occur on the surface and in the soil mass. Where such areas are of sufficient size they are separated and included with the Chenango gravelly sandy loam.

The Chenango sandy loam is not an extensive soil. It occurs in a number of areas in the eastern part of the county, the largest being mapped in the valley between Williamstown and Kasoag. Other areas lie in the vicinity of Richland. It occupies outwash plains or terraces, with a surface flat or relieved by only slight undulations. The streams traversing the type flow in narrow, steep-banked channels.

Drainage is good to excessive. Streamway depressions are numerous enough to carry off the drainage, and the sandy texture and open structure of the material, especially of the coarse gravelly substrata, offer easy passage for percolating waters. The cultivation of this type requires measures to conserve the soil moisture.

The Chenango sandy loam is not of much agricultural importance at present. In the early days of the county absence of stone and ease of cultivation made it a desirable soil, and it was all cleared and put under cultivation. The principal tree growths were chestnut and oak. Because of the leachy character and low productivity of the soil it gradually fell into low esteem, but even at present it is all occupied by cultivated crops or by grasses for hay or pasturage. The larger part is devoted to grasses to support the dairy industry. Corn of ensilage varieties is grown to some extent. The most important special crop is potatoes. Some years ago a farmer found that the soil when given liberal applications of commercial fertilizers, in conjunction with barnyard manure and the turning under of cover crops, was especially suited to potatoes. The yield in such case ranges from 100 to 500 bushels per acre, with 200 or more bushels as an average. From 400 to 600 pounds of commercial fertilizer is used per acre. At the present time this consists entirely of high-grade superphosphate. Farmers aim to use a good proportion of potash when this ingredient is available.

All areas of this soil are close to towns and railroad facilities. Present selling values are about \$40 to \$50 an acre.

In using this soil the principal need is to increase the content of organic matter by generous applications of barnyard manure and the turning under of green-manuring crops, especially the legumes like clover and vetches.

#### OTISVILLE GRAVELLY FINE SANDY LOAM.

The Otisville gravelly fine sandy loam, to depths ranging from 4 to 8 inches, consists of a light-brown or grayish-brown to yellowish-brown fine sandy loam containing a large quantity of rounded gravel.

Gravel also covers the surface. The subsoil is a heterogeneous mass of gravel and rounded stones of all sizes mingled with some yellow fine sandy loam. In the lower part of the 3-foot section the interstitial fine-earth material is decidedly more sandy and in some places almost exclusively sand. The type has a compact structure in places, but is loose and somewhat incoherent when disturbed.

The gravel consists almost entirely of rounded, waterworn sandstone, most of it gray but some of it red. The fragments vary in size from small gravel to cobblestones and, occasionally, small boulders. Also, there may be some subangular stones. These are confined mostly to the surface, especially at the point of contact with glacial-till soils.

The Otisville gravelly fine sandy loam is confined to the eastern part of the county. The largest development is in the towns of Albion, Orwell, and Williamstown, with areas extending into Richland, Sandy Creek, Boylston, and Redfield Towns. A number of rather small areas occur in Amboy and Constantia Towns.

The topography is the roughest in the county, consisting of high, irregular hills separated by deep depressions. Most of the slopes are too steep to cultivate. In addition to the rapid run-off, the open gravelly structure favors the rapid internal passage of water, and the type is consequently droughty.

The greater part of this land has been cleared of the original growth of oak and chestnut. On account of its rough surface, most of it is used for permanent pasture. Only the smoother land is mowed for hay, and only a few small areas are used for cultivated crops. The price of land of this type is relatively low.

#### OTISVILLE FINE SAND.

The Otisville fine sand, to a depth of 5 or 6 inches, consists of light-brown to yellowish, loose fine sand. The immediate surface layer is frequently quite loamy from the organic matter it contains. The subsoil is a yellow or orange-yellow fine sand extending to an unknown depth. In the flatter situations the lower part of the 3-foot section may become yellowish gray or grayish, as in the case of the Dunkirk fine sand.

Particularly conspicuous in this type are spots, sometimes covering several acres, where the surface has been denuded of vegetation and is blown by the wind. These "blow-sand" areas are advancing, as is evidenced by the partial covering over of adjacent stony till areas. The Otisville fine sand occurs in the eastern part of the county, mainly in Albion and Richland Towns. There is one area in the vicinity of Altmar, and an area each in Constantia and Redfield Towns. The type occupies hilly areas, and is a delta or lake-beach

formation piled up by the winds. Owing to its porous nature it is well to excessively drained.

This is not an important type agriculturally, although it has all been cleared and put under cultivation. Owing to its tendency to drift when cultivated it is kept in permanent pasture, only small patches in the more level situations being cultivated. This land is not held in high esteem. It would apparently be advisable to forest it with white pine, which originally covered the type more or less completely.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Otisville fine sand:

*Mechanical analyses of Otisville fine sand.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
162625.....	Soil.....	0.0	2.0	4.9	50.0	29.6	8.2	5.2
162626.....	Subsoil.....	.0	1.8	4.9	51.6	32.6	5.5	3.4

SAUGATUCK FINE SAND.

The surface soil of the Saugatuck fine sand consists of dark-gray to light-gray fine sand. At variable depths below 8 inches, but usually within 24 inches of the surface, there is encountered a reddish or rusty-brown, compact layer of fine sand varying from 1 or 2 inches to a foot or more in thickness. This is known as hardpan. It is composed largely of organic matter, with some iron compound cementing the sand grains. Beneath the hardpan is a fine sand ranging in color from brownish yellow to yellow or almost white.

The texture is practically a fine sand throughout the 3-foot section, but in a few places the surface material is a fine sandy loam. There is great variation in color within short distances. Mingled with the areas of darker colored surface are patches of variably colored soil, usually occupying low hummocks. In some of these the material is yellow from the surface down, and the hardpan is merely a darker colored stratum an inch or two thick. In others the soil is purplish or pinkish red at the surface and throughout the 3-foot section, or is a light gray with some brown spots or iron stains. Most fields, especially where freshly plowed, have a very spotted appearance.

The hardpan varies from a few inches to 36 inches or even more below the surface, but it is never far below the 3-foot section. It usually occurs between the depths of 10 and 24 inches.

In the deeper depressions in this soil there are included some areas having a mucky or muck-sand surface layer. This, however, is underlain at a slight depth by the typical light-colored fine sand subsoil.

The Saugatuck fine sand is confined to the eastern part of the county. The largest areas are mapped in the towns of Richland and Albion. The type has been developed in the higher parts of the beds of former glacial lakes, on stream deltas, or outwash plains. The surface is prevailingly flat, or, in only a few places, slightly rolling, but it is marked by hummocks a foot or two high separated by corresponding depressions.

Owing to the hardpan layer and the lack of surface relief, drainage is poor. The depressions are wet and support such water-loving vegetation as rushes and sedges. Since the hardpan layer prevents movement of water up or down the soil is very wet in rainy periods and very dry in periods of ordinary drought.

Although the Saugatuck fine sand is extensive it is of little agricultural importance. Practically all of it has been cleared, but much of it has apparently been abandoned and is now covered with bushes and briars. Birch is the predominant growth, but the trees on a few uncleared areas include birch, elm, beech, hemlock, and maple.

A few areas are under cultivation. Corn is grown to some extent, but seems to give low yields. The type is used principally for pasture, but much of it is unfenced and can not even be pastured. The pasturage, consisting largely of the native grasses, is of only fair value. This land sells for a few dollars an acre, but is not in demand.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Saugatuck fine sand:

*Mechanical analyses of Saugatuck fine sand.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
162605.....	Soil.....	0.2	0.4	0.6	55.2	29.0	10.3	4.1
162606.....	Subsoil.....	.1	.1	.4	73.4	15.9	4.4	5.4

CANEADEA SILTY CLAY LOAM.

The Canadea silty clay loam, to a depth of 6 to 10 inches, ranges in color from drabish gray to brownish gray and in texture from a heavy silt loam to a silty clay loam. Below this lies a zone of light-gray, heavy silt loam a few inches thick, usually grading into a heavier material, a silty clay, which becomes bluish gray in the lower part of the 3-foot section. The subsoil may show some mottlings of yel-

low and brown. In places it is mottled yellow and gray. The surface soil in general has a smooth feel and when moist is plastic.

In some places the Caneadea silty clay loam is lighter textured than typical, the surface soil being a comparatively light silt loam, with a corresponding subsoil. In most areas lenses or layers of different-textured materials occur throughout the 3-foot section, some of these being heavier or more clayey and others sandy.

The Caneadea silty clay loam occurs principally in the south-central part of the county. The largest areas are mapped along the Oneida River and its tributaries. The type also occurs along the streams and in depressions throughout the central part of the county, in association with the heavier lacustrine soils.

This type consists mainly of lake-deposited sediments, although along streams the material has probably been reworked and is alluvial to some extent. The areas are low, flat, and poorly drained, and along streams subject to overflow.

Most of the Caneadea silty clay loam has been cleared, but on account of its more or less wet condition little of it is cultivated. A considerable total area is used in the production of hay, and heavy yields are obtained. Some corn is grown, giving fair yields. A large proportion of the type is devoted to grazing, to which it is well suited. The timbered areas support a variety of trees common to moist soils. Elm and ash are the principal trees, with hickory, maple, and hemlock next in importance. To bring this soil generally under cultivation will require extensive drainage operations.

#### GRANBY FINE SANDY LOAM.

To depths ranging from 4 to 12 inches the Granby fine sandy loam consists of a dark-gray or black fine to very fine sandy loam. The black color is due to the presence of organic matter, the amount of which varies from merely enough to impart a dark color to a quantity sufficient to render the material somewhat mucky. The subsoil consists of light-gray fine or very fine sand which generally grades into light-drab fine sand. The latter is compact and usually water saturated, or at least moist.

While the type as a whole has a dark-colored surface soil, there are necessarily included some areas having a light-gray or light-drab surface soil similar to that of the Caneadea series. The greater part of even these lighter areas, however, have a slight surface veneer of darker material, especially where not cultivated. In some places there is so much organic matter that the surface material is true Muck, though usually shallow, rarely more than a foot in depth. Considerable textural range was allowed in mapping this type. In some areas the soil is a silty loam to silty clay loam, varying from dark to light colored. The subsoil of these areas generally grades

into a nontypical sandy material, but in many places throughout the type silty or clayey lenses may be encountered at different depths. Mottlings of yellow and brown are of quite common occurrence, the brown mottlings representing iron stains or disintegrating iron concretions.

The Granby fine sandy loam occurs scattered over the county wherever there are lake deposits. It is encountered in all except the higher eastern part of the county, not being found above the 600-foot contour.

The type occupies the troughs between ridges and slight draws, depressions where conditions have not been favorable for the formation of Muck, and first bottoms along streams. It primarily represents lacustrine deposits accumulated under poor drainage conditions. Along streams it is to some extent alluvial, consisting of reworked lake materials deposited by stream action.

This is a poorly drained soil supporting such aquatic growths as rushes and sedges, and being in part semiswampy. Some of the areas have been drained by open ditches and are used for growing corn or are cut over for hay. The type is unimportant except for pasturage. The native grasses and sedges make fair grazing. Where the drainage has been more or less improved hay, especially orchard grass, gives good yields. Some areas of better drainage support a growth of elm, ash, beech, maple, and tag elder.

The selling value of this type of soil is low, as it requires considerable expenditure to correct the drainage conditions and fit the land for cultivation.

#### MUCK.

Muck consists of vegetable matter in varying stages of decomposition, mixed with small proportions of sand, silt, and clay washed in by overflow waters or carried by the winds from the surrounding uplands. The vegetable matter represents the remains of plants, more or less preserved by the water through its action in retarding oxidation. Part of the material included with this type really represents Peat. Here decomposition is less advanced, and the material still retains a fibrous character and more or less the identity of the plants from which derived. In the typical Muck areas the material is finely divided and all trace of the original structure of the plants from which it has come has disappeared. Peat is usually brownish in color and Muck jet black. Muck has a slight plasticity due to the more finely divided condition of the material and to the admixture of some mineral soil particles.

The variations from well-decomposed and finely divided organic matter to the coarser, fibrous peaty material occur within short distances rather than in distinct large areas. The various textures are

intermingled on the surface, but below they are rather in layers, the lower material usually being more peaty. Frequently the immediate surface in the case of areas of recent accumulation has not yet become broken down. With cultivation the coarser materials soon change to a more or less finely divided state, but they still retain their brownish color.

The depth of the Muck varies from a few inches on the border of the areas to several feet only a short distance away, and in some areas to depths beyond ordinary means of sounding. Some areas were included where the depth did not exceed 2 feet in any place, but in the main the organic layer is more than 3 feet deep.

Muck occurs in every town in the county, but the larger developments are through the central part, east and west. It occurs in a large number of areas varying in size from a few acres to several square miles. The largest area is that in West Monroe and Constantia Towns along Oneida Lake. The type is most extensive in Hastings and Palermo Towns and the southwest part of Mexico Town, where there is a series of bogs connected by narrow arms.

This soil occupies depressed areas or old filled-in ponds, and small lakes and stream valleys. The areas are frequently the boggy upper courses of streams. They lie at all elevations and can be drained by clearing their outlets and digging ditches. The only exception is the area along Oneida Lake. Here dams constructed to aid navigation raise the water so that the surface of the Muck is barely above the water level. Water stands on the Muck areas a good part of the year, although they are dry as a rule during the summer.

The vegetation is of water-loving species. In places it consists of cat-tails, rushes, sedges, and grasses, with pond lilies and other aquatic plants in the pools of water. The greater part of the type has a growth more characteristic of swamps. Such trees as swamp maple, elm, tamarack, hemlock, spruce, and scrub white pine may be abundant, and there may be a thick undergrowth of shrubs such as alder and high-bush huckleberry. As a rule there is a deep carpet of sphagnum moss. According to the predominant growth the various areas are known as tamarack swamps, huckleberry swamps, alder swamps, etc.

Muck is an important soil in the agriculture of the county, although its utilization is confined to truck gardening. Only a small proportion of the type has been developed. On areas lying near the larger towns, as near Oswego, and, especially, Fulton, trucking has been developed and good markets are available for the products. At the present time more distant areas are being cleared, drained, and developed. Several companies have taken over large bodies of Muck for development.

The principal crops grown are lettuce and onions, with celery, beets, and carrots of somewhat less importance. The yields are good. A number of crops of lettuce are produced in one season, and it is consequently one of the most profitable crops. The variety known as Boston head lettuce is grown exclusively.

The crops are all heavily fertilized with a complete fertilizer, though at present, on account of the shortage of potash, this element is used in very small proportions. From 1,000 to 2,000 pounds of fertilizer is applied per acre. No lime is used. Litmus tests show that the Muck is neutral or at least not acid.

Muck requires drainage to put it in condition for cultivation. Clearing is expensive, and preparing the seed bed is difficult until the land has been cultivated long enough for it to settle. In working this land it is necessary to use a special shoe (muck shoe) on horses to prevent their bogging. Small caterpillar tractors work well and a number are in use.

Muck lands are becoming higher priced as the demand increases. Uncleared and undrained land which a few years ago sold for only a few dollars an acre now brings \$50 to \$100, where situated within reasonable distance of a railroad station. The use of auto trucks has been a large factor in increasing the radius of the area within which this land can be worked profitably. Developed Muck land sells for several hundred dollars an acre. The heavy expense of clearing accounts in part for the high market value.

#### MEADOW.

Meadow is a term applied to low-lying areas that are wet most of the time and in which the soil material is too variable from place to place to be classed as a definite type. As mapped in Oswego County, Meadow includes areas of Caneadea, Granby, and Papakating soils, as well as Muck, but under even more wet conditions, being either swampy or semiswampy. Some areas are covered by cat-tail rushes, with intervening small ponds containing such growths as pond lilies; there may be trees and shrubs here and there or the vegetation may change entirely to trees and shrubs, the growth typical of swamps. The growth is frequently quite thick, and consists of ash, swamp elm, swamp maple, hemlock, spruce, scrub white pine, tamarack, and alder, with willow and swamp huckleberry.

In the towns of Constantia, Amboy, Albion, Williamstown, and Redfield, and to a less extent in other towns, the material is spoken of as "peaty muck" or ooze. It consists of silty material with considerable black Peat and some Muck. This peaty muck mantle varies from a few inches to 24 to 30 inches in depth, and is underlain by gray or drab sand containing stones and boulders. These peaty

muck areas are always very wet and "miry" and do not support the weight of stock or persons. The large area along Oneida River is marshy in places, but in general has a tree and shrub growth. Because of the preponderance of ash this area and similar ones are spoken of as "ash swamps." The soil is largely of the Caneadea series, with mucky or peaty spots included. These peaty muck areas are due to obstructed drainage. Along the Oneida River the poor drainage results from the construction of dams and locks built to aid navigation.

In its present condition Meadow is nonagricultural and of value only for grazing and for the timber growth.

#### BEACH SAND.

Beach sand consists of light-gray to yellowish-gray fine sand, forming a narrow strip along the shore of Lake Ontario in the towns of Sandy Creek and Richland. It occupies bumpy or dunelike ridges, rarely more than one-eighth mile wide and rising 5 to 40 feet above the lake. The sand has been carried and heaped up by the waves and wind, and is still subject to the action of these agencies.

Beach sand is nonagricultural. The natural vegetation is a scrubby growth of pine and some deciduous trees, with shrubs and sand grasses.

#### SUMMARY.

Oswego County is situated in the northern part of New York, at the southeast extremity of Lake Ontario. It comprises a land area of 948 square miles, or 606,720 acres.

The surface varies from undulating to hilly. The range of elevation is from 246 feet above sea level, the level of Lake Ontario, to 1,750 feet in the extreme northeast corner of the county.

The drainage is all into Lake Ontario directly or indirectly. The Salmon and Oswego Rivers, the most important streams, are swift flowing and furnish water power.

Settlement of this county was begun soon after the Revolutionary period by emigrants from the eastern part of the State and from New England. The population in 1910 was 71,709. The rural population slightly exceeds the urban. Oswego, the county seat, had a population of 25,426 in 1910. Fulton is next in size, with 11,138 inhabitants. These cities are situated at water-power sites on the Oswego River, and are important manufacturing centers.

The rail transportation facilities of Oswego County are good. Water transportation is maintained on Lake Ontario. The Oswego River has canals and locks around rapids, and is navigable.

The agricultural products are dairy products, principally milk, hay, corn for silage, fruit, and vegetables. The general farm crops are principally those that support the dairy industry.

The mean annual temperature as recorded at Oswego is 46.8° F., the absolute maximum 97° and the absolute minimum -21°. The annual precipitation is 36.18 inches. The average length of growing season is 190 days. Away from the lake the growing period is somewhat shorter, the season being just long enough in favorable years to mature corn.

The principal crop rotation consists of corn, oats, and grass, the latter being cut a number of seasons and then pastured. Commercial fertilizers are used, in conjunction with the barnyard manure produced on the farm.

Farm labor is scarce and commands high wages.

Farm values range from a few dollars to \$100 or more an acre, depending upon the soil, the improvements, and the nearness to towns. The soils of Oswego County are separated into 21 types. They are classified, according to mode of formation, into three groups, viz, glacial-drift soils, water-deposited soils, and cumulose soils. The soils are formed of glacial till derived mainly from sandstone and sandy shale.

The glacial-drift soils include 7 types, representing two series, the Worth and Ontario. The Ontario differs from the Worth in that the substratum or lower till is calcareous.

The soils derived from glacial lake and terrace deposits and existing as delta formations and old lake beaches, are classed as the Otisville, Chenango, Saugatuck, Dunkirk, Caneadea, and Granby series. Of these, the Dunkirk and Chenango are the most important. The Dunkirk silty clay loam is the heaviest soil in the county. It is a strong grass and small-grain soil. The other Dunkirk types are sandy and have a wide crop adaptation. The Chenango soils are gravelly and sandy. The gravelly sandy loam and sandy loam type are good corn and potato soils.

The Caneadea and Granby series are each represented by one type. These are lacustrine soils more or less reworked by streams.

Meadow is a term used to include areas of wet soils which are too intricately mixed to separate into types.

Beach sand includes the areas of sands thrown up by wave action and winds along the shore of Lake Ontario. It is of dunelike character and nonagricultural.

The cumulose group is represented by Muck. This consists of vegetation in varying degrees of decomposition. Muck is an important soil. The truck gardening of the county has been developed largely upon it.

[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.]



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