
Soil Survey

Seneca County New York

By

C. S. PEARSON, in Charge, R. B. CHILD, W. E. KENNEDY

WARREN HUFF, and C. B. LAWRENCE

Cornell University Agricultural Experiment Station



UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY

In cooperation with the

Cornell University Agricultural Experiment Station

This publication is a contribution from

BUREAU OF PLANT INDUSTRY

E. C. AUGETER, *Chief*

DIVISION OF SOIL SURVEY

CHARLES E. KELLOGG, *Principal Soil Scientist, in Charge*

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

C. E. LADD, *Director*

DEPARTMENT OF AGRONOMY

RICHARD BRADFIELD, *Head*

SOIL SURVEY OF SENECA COUNTY, NEW YORK

By C. S. PEARSON, in Charge, R. B. CHILD, W. E. KENNEDY, WARREN HUFF, and C. B. LAWRENCE, Cornell University Agricultural Experiment Station

Area inspected by W. J. LATIMER, Inspector, District 1, Division of Soil Survey,¹ Bureau of Plant Industry, United States Department of Agriculture

United States Department of Agriculture in cooperation with the
Cornell University Agricultural Experiment Station

CONTENTS

	Page		Page
Introduction	1	Soils—Continued.	
County surveyed	2	Soils of the glacial outwash plains	39
Climate	7	Palmyra gravelly loam	40
Agriculture	8	Chenango gravelly loam	40
Soil-survey methods and definitions	13	Soils of the flood plains	41
Soils	14	Wayland silt loam	41
Soils of the drumlins and drumlinlike hills	17	Alluvial soils, undifferentiated	41
Ontario loam	19	Soils of the glacial lake plain	41
Ontario loam, steep phase	20	Dunkirk fine sandy loam	42
Ontario fine sandy loam	21	Dunkirk silt loam	43
Cazenovia silt loam	22	Dunkirk silt loam, shallow phase	44
Soils of the gravel hills	23	Collamer silt loam	45
Groton gravelly loam	23	Schoharie silt loam	45
Soils of the glacial till plain	23	Schoharie silty clay loam	46
Honeoye silt loam	24	Poygan silty clay loam	47
Honeoye silt loam, eroded phase	26	Toledo silty clay loam	47
Cayuga silt loam	27	Ottawa loamy fine sand	48
Darien silt loam	28	Ottawa loamy fine sand, rolling phase	48
Darien silt loam, slope phase	29	Berrien loamy fine sand	49
Lansing silt loam	29	Granby fine sandy loam	49
Lansing silt loam, shallow phase	30	Soils of the swamps and marshes	50
Lansing silt loam, shallow steep phase	31	Carlisle muck	50
Farmington loam	31	Carlisle muck, shallow phase	51
Ovid silt loam	32	Edwards muck	51
Romulus silty clay loam	33	Walkill silt loam	51
Romulus silty clay loam, shallow phase	34	Miscellaneous land types	52
Kendaia silt loam	34	Rough broken land	52
Lyons silty clay loam	35	Mac'e land	52
Soils of the Appalachian Plateaus, Southern		Productivity ratings	52
New York section	35	Morphology and genesis of soils	61
Wooster gravelly loam	36	Summary	64
Lordstown flaggy silt loam	36	Literature cited	68
Langford silt loam	38	Map	
Erie silt loam	38		
Chippewa silty clay loam	39		

INTRODUCTION

The soil survey map and report of Seneca County, N. Y., are intended to convey information concerning the soils, crops, and agriculture of the county to a wide variety of readers.

Farmers, landowners, prospective purchasers, and tenants ordinarily are interested in some particular locality, farm, or field. They need to know what the soil is like on a certain piece of land, what crops are adapted, what yields may be expected, and what fertilization and other soil-management practices are needed for best results. Many persons

¹The field work for this survey was done while the Division of Soil Survey was a part of the Bureau of Chemistry and Soils.

do not wish to read the entire soil survey report, and they need not do so to obtain much of the information essential to their purpose.

A person interested in a particular piece of land should first locate it on the colored soil map accompanying the report. Then, from the color and symbol, the soil may be identified in the legend on the margin of the map. By using the table of contents, the reader can find the description of the soil type or types. Under each soil type heading is specific information about that particular soil. There is a description of the landscape, including the lay of the land, drainage, stoniness (if any), vegetation, and other external characteristics, and the internal or profile characteristics of the soil—its color, depth, texture, structure, and chemical or mineralogical composition. The description includes information about present land use, crops grown, and yields obtained, and statements concerning possible uses and present and recommended management.

By referring to the section on Productivity Ratings the reader may compare the soil types as to productivity and suitability for the production of crops or for other uses.

For the person unfamiliar with the county or area, there is a general description of the area as a whole in the first part of the report. Geography, physiography, regional drainage, relief, vegetation, climate, population, transportation facilities, and markets are discussed. A brief summary at the end gives a condensed description of the county and important facts concerning the soils and agriculture.

The agricultural economist and the general student of agriculture will be interested in the sections on Agriculture and Productivity Ratings.

Soil specialists, agronomists, experiment station and agricultural extension workers, and students of soils and crops will be interested in the more general discussion of soils in the section on Soils, as well as in the soil type descriptions. They also will be interested in the section on Productivity Ratings.

For the soil scientist, the section on Morphology and Genesis of Soils presents a brief technical discussion of the soils and of the soil-forming processes that have produced them.

COUNTY SURVEYED

Seneca County is near the geographical center of New York State (fig. 1). Ovid, one of the county seats, situated near the south-central part of the county, is 105 miles southeast of Buffalo and 155 miles west of Albany by air line. Waterloo, the other county seat, situated near the north-central part, is 45 miles southeast of Rochester and 40 miles southwest of Syracuse. The county is rectangular in outline, extending 33 miles from north to south and 10 miles from east to west, giving an approximate area of 328 square miles, or 209,920 acres. For much of its north and south distance the county is bounded by Seneca Lake on the west and Cayuga Lake on the east.

That part of the county south of Ovid and marked by the Portage Escarpment is in the Southern New York section of the Appalachian Plateaus province² of the United States. The part of the county

² FENNEMAN, N. M. PHYSIOGRAPHIC DIVISIONS OF THE UNITED STATES. (Map.) United States Geological Survey. 1930.

north of Ovid comprises part of the Erie-Ontario-Mohawk plain (2),³ Seneca is the central county of the Finger Lakes region, so called because of the remarkable series of parallel north and south valleys, many of which are occupied by lakes.

The southern or plateau section consists of a rolling upland only slightly dissected by the small streams and drainageways, except where they notch the steep slopes close to the lakes. The steep slopes immediately adjacent to the lakes are cut up by a succession of steep-walled narrow gorges formed by these small streams cutting down into the interbedded shales and sandstones. The lake shores are marked in many places by bluffs from 50 to 100 feet in height. At distances of $\frac{1}{2}$ to 1 mile from the lakes the slopes become more gentle, and at the divide between the lakes the relief becomes that of a gently rolling or undulating plateau.

The central part of the county from Ovid to Fayette consists of a glacial till plain or a slightly rolling to flat plateau with gradual slopes to the lake shores. In places midway between the lakes the land is so flat as to impede surface runoff, with consequent poor drainage. The streams are small and have developed no distinct valleys, except on the slopes above the lake shores where they have cut narrow V-shaped channels.

The area from Fayette to a point 4 miles north of Waterloo is a flat lake plain with little or no relief aside from the shallow narrow stream valleys. Much of this area is poorly drained; some of it is marshy.

The northern part of the county is a flat plain with numerous high-crowned long narrow hills or drumlins with their long axes extending north and south (pl. 1). East of this area and extending to the county boundary is the Montezuma Marsh, which comprises the flooded lowlands at the northern end of Cayuga Lake.

The elevations, according to the United States Geological Survey topographic maps, range from 381 feet above sea level along the shores of Cayuga Lake and the Seneca River to 1,630 feet at a point midway between the lakes on the southern boundary of the county. The average elevation of the northern part ranges from 400 to 500 feet, with a gradual increase toward the south. Seneca Lake has an elevation of 444 feet (fig. 2), Seneca Falls 465 feet, and Ovid 862 feet.

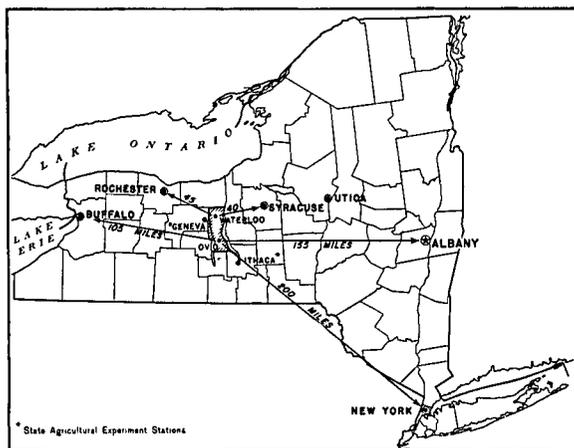


FIGURE 1.—Sketch map showing location of Seneca County, N. Y.

³ Italic numbers in parentheses refer to Literature Cited, p. 68.

The southern part of the county is in the northeastern hardwood forest, and the northern part is in the southern hardwood forest (6). These two areas are typical zones of natural vegetation oc-

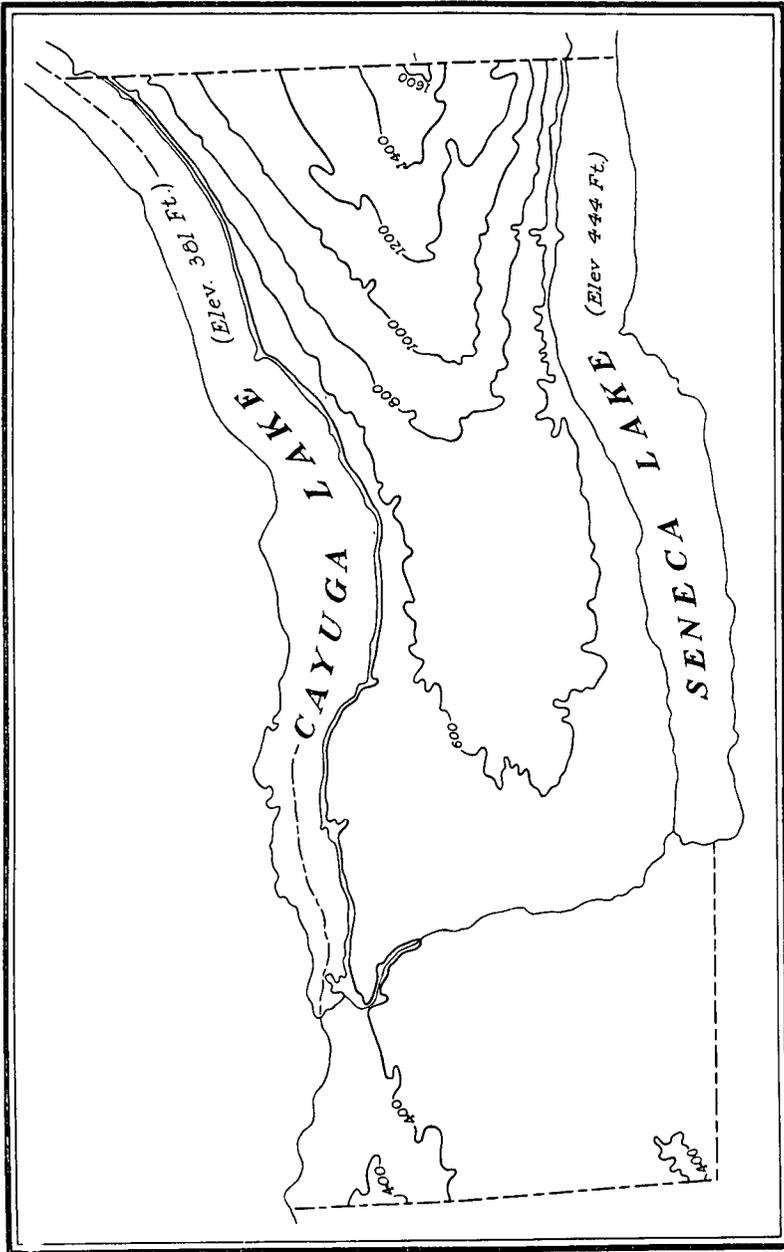


FIGURE 2.—Sketch map of Seneca County, N. Y., showing elevations.

curing in New York State. Beech, maple, birch, and hemlock are the principal trees of the former forest, and oaks are the principal trees of the latter forest, which in these latitudes occur throughout

the Erie-Ontario-Mohawk plain. In addition to the trees mentioned, hickory, ash, basswood, tuliptree (yellow poplar), elm, sycamore, cedar, black walnut, cucumbertree, and black cherry are common in the north, and white pine is common in the south.

The original forests were dense and unbroken, with a tangled undergrowth of brush and briars. The only open areas were those burned by the Indians for their villages and orchards. These great forests were rapidly cleared by the early settlers. At first the timber was burned, but in later years it was made into lumber. The present forests, occurring as farm wood lots, consist of second- and third-growth material of the original species.

The predominant grass of native pastures is Canada bluegrass, which on some of the heavier textured soils makes a dense cover in this locality of rather low rainfall. Bentgrass and fescue, as well as wild white clover, are common on the more calcareous soils. In the extreme southern part of the county on the poor hardpan soils, poverty grass, redtop, and sweet vernalgrass are the more important species.

The expedition of General Sullivan in 1779 marked the end of Indian domination in western New York. The army traveled up the east shore of Seneca Lake and destroyed all the Indian villages, together with the growing crops, great stores of corn, and numerous orchards. It was the observation of the soldiers as to the great promise of the land that first stimulated settlement.

By a treaty in 1788, the Onondaga Indians ceded all the land originally comprising Onondaga County and now divided into Seneca, Onondaga, Cayuga, and Cortland Counties, with parts of Oswego, Wayne, and Tompkins Counties. This land was set apart for bounties to soldiers and became known as the Military Tract. It was surveyed into 25 townships of 60,000 acres each; later the townships were re-surveyed into lots of approximately 600 acres each.

In 1796 a State road was cut through the wilderness from the Mohawk Valley to Geneva by way of Auburn, and in 1800 the famous Cayuga Lake bridge was constructed. This became the highway for western immigration. The first immigrants entitled to military grants came from eastern New York; others were from New England and Pennsylvania.

The first permanent white settlers arrived in 1789 and located at the rapids along the Seneca River, where water power was available for gristmills and sawmills. Settlement once initiated was rapid, and by 1810 the Federal census reported the population of the county as 16,609. In 1860 the population was 28,138; in 1870, 27,823; in 1900, 28,114. By 1930 the population had fallen to 24,983, 10,490 of whom were urban and 14,493 rural. The 1940 census reported a slight increase to 25,732. Most of the present inhabitants are descendants of the original settlers, a considerable number of whom were of German origin. According to Federal census returns for 1930, 88.3 percent of the people are native-born white, 11.1 percent foreign-born white, and the rest Negro. During recent years many people of southern European origin have settled at Seneca Falls and Waterloo, where they are employed in the various manufacturing plants.

Originally Ovid was selected as the county seat; but, owing to the great distance from the northern to the southern parts of the county, Waterloo was designated as a second county seat to care for the north-

ern part. At present county buildings are maintained and court is held in both villages. Besides these two villages, which had populations of 578 and 4,010, respectively, in 1940, Seneca Falls with a population of 6,452, and Interlaken with a population of 661, are the most important villages of the county. A large State institution for the feeble-minded is located at Willard.

The county is served by the main line of the Lehigh Valley Railroad and a branch line of the New York Central. One of the main east-and-west highways of the State, United States Highway No. 20, passes through Seneca Falls and Waterloo. Excellent highways afford very efficient transportation by automobile and motortruck. Seneca and Cayuga Lakes are connected with the Barge Canal by the Seneca River, which has been improved for navigation.

Most of the farm products are utilized locally or sold to local mills and cooperative organizations in or near the county. The excess fruit and wheat are trucked to Syracuse and Buffalo. A large part of the fruit crop, mainly peaches and grapes, is sold at roadside stands.

State and United States highways are maintained in excellent condition. All the county roads are hard-surfaced, as are also a part of the roads through the towns. The other roads are either graveled or covered with materials from local shales, making them passable throughout the year. Of the 1,666 farms in the county in 1930, 215 were located on concrete roads, 311 on asphalt and macadam roads, 181 on gravel and improved dirt roads, and 839 on unimproved dirt roads. There were 1,653 automobiles reported by 1,325 farms and 470 trucks by 426 farms. There were 839 tractors and 135 electric motors doing farm work. Farmhouses with telephones numbered 908, and 351 were lighted by electricity. The school system is well developed. Centralized schools, to and from which the students are transported by busses, are in many of the towns.

A large number of plants located at Seneca Falls and Waterloo manufacture tools, pumps, automobile parts, and woolen goods. The total value of manufactured products in the county for the year 1929 amounted to \$18,320,570, according to the 1930 Federal census of manufacturers. In 1937 the total value of products of 28 establishments was \$6,969,742. This represented a cost of \$3,226,490 for materials, fuel, electric energy, and contract work, leaving a value added by manufacture of \$3,743,252. In these establishments the average number of wage earners for the year was 1,706 and the total cost of wages was \$1,752,965.

EXPLANATORY LEGEND FOR PLATE 1

VERTICAL AERIAL PHOTOGRAPH OF AREA NORTH OF SENECA FALLS AND WEST OF MONTEZUMA MARSH, SENECA COUNTY, N. Y.

- A, Wooded Carlisle muck.
- B, Palmyra gravelly loam.
- C, Ontario fine sandy loam.
- D, Ontario loam on long drumlinlike hills.
- E, Schoharie silt loam, showing dark streaks, which indicate slight depressions that are more poorly drained.
- F, Wayland silt loam, bordering Black Brook.
- G, Ontario loam in long narrow fields following the trend of the drumlinlike hills.
- H, Low wet area of Toledo silty clay loam.
- I, Low poorly drained area of Poygan silty clay loam.



CLIMATE

The climate is prevailingly of the continental type with modification induced by the occurrence of lakes on each side. The diversity of the climate resulting from the varied topography is intensified by the geographical position of the county, which places it in the path of storms that cross the Great Lakes and move down the St. Lawrence Valley (8). The sudden and at times extreme changes brought about by these storms are characteristic of climatic conditions in the Central Lakes region.

Rainfall is distributed rather uniformly over the growing season and is sufficient for the needs of crops commonly grown. The precipitation for this season—May to September, inclusive—averages 15.13 inches. This is one of the driest sections of the State. The spring and summer seasons are generally the wettest.

The bordering lakes seldom freeze over entirely during the winter, and they regulate to some extent the winds that pass over them. The most important climatic influence of these lakes is the extension of the growing season, which is more pronounced on the immediate slopes. Owing to its greater elevation, that part of the county south of Ovid has a growing season about 15 days shorter than that of the northern half. The average length of the frost-free periods of the two sections are 145 and 160 days, respectively, although killing frosts have occurred as late as June 9 and as early as September 10 (5).

The influence of the lakes on the length of the growing season is reflected in the agriculture. Practically all of the fruits grown in the county, such as peaches, apples, and grapes, are produced on the slopes bordering these lakes. Frosts as late in the season as June 9, however, greatly reduce the fruit crop, especially peaches.

The amount of annual precipitation is not always significant, owing to the possibility of below-normal rainfall during the growing season that is not reflected in the total amount for the year. Records for 60 years or more for this section, however, show that the summer period is always the wettest.

Records taken at Ithaca at the southern end of Cayuga Lake over a period of years show the mean precipitation for the growing season to be 16.73 inches (5). Extreme droughts and loss of crops owing to deficient moisture are rare.

Farm work can usually be done as late as the first part of November, at which time the ground freezes, although it is not uncommon to have mild spells during the winter when plowing can be done. Preparation of the seedbed usually starts about April 1 on the lighter textured or gravelly soils and from 2 to 4 weeks later on the heavier, less well drained soils.

The prevailing direction of the wind is northwest. The highest velocity recorded in this general region is 70 miles an hour, but winds of such intensity are rare. Hail may fall once or twice during the summer, but it seldom damages crops.

Table 1, compiled from records of the United States Weather Bureau, gives the normal monthly, seasonal, and annual temperature and precipitation at Romulus.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Romulus, Seneca County, N. Y.

[Elevation, 719 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1909)	Total amount for the wettest year (1902)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December.....	28.8	65	-18	2.01	1.70	4.68	10.9
January.....	24.6	70	-19	2.08	2.22	3.31	11.8
February.....	23.7	65	-17	1.82	1.32	1.53	12.5
Winter.....	25.7	70	-19	5.91	5.24	9.52	35.2
March.....	33.6	84	-5	2.39	1.42	2.17	10.0
April.....	45.4	88	9	2.48	2.19	1.68	4.3
May.....	57.3	93	25	3.34	2.98	3.24	.1
Spring.....	45.4	93	-5	8.21	6.59	7.09	14.4
June.....	66.3	96	35	3.28	2.05	5.95	.0
July.....	71.3	98	41	3.10	2.78	9.25	.0
August.....	69.0	98	37	2.99	1.63	2.43	.0
Summer.....	68.9	98	35	9.37	6.46	17.63	.0
September.....	62.6	97	32	2.42	1.61	3.68	.0
October.....	51.4	88	21	2.85	1.43	3.57	3
November.....	39.3	74	3	2.21	.89	1.71	3.4
Fall.....	51.1	97	3	7.48	3.93	8.96	3.7
Year.....	47.8	98	-19	30.97	22.22	43.20	53.3

AGRICULTURE

As has been stated, at the beginning of settlement the country including Seneca County was covered with dense forests. The only openings were those occupied by Indian villages with their gardens and orchards and the areas periodically burned over to facilitate hunting. The expedition of General Sullivan, sent out to subdue and chastise the Indians for their depredations against settlers of the Mohawk Valley, found an advanced type of agriculture being practiced by these people. Such crops as corn, beans, pumpkins, and fruit were grown in great abundance. In an early history of the county (1) it is stated that the men of Sullivan's army found such an array of fruit trees in one place that they called it Appleton. It is now known as Kendiaia. The destruction of villages, crops, and stored grain by this army, followed by an unusually severe winter, was a blow from which the Indians never fully recovered. Many of them fled to Canada, where their descendants are living today.

Settlement was rapid after the Indian domination was broken. The first agriculture, like that of all newly settled localities, was of a subsistence type, and the crops grown were those that would sustain life in a wilderness. The first task was to remove the timber, which was burned. It was customary to chop out the small timber and underbrush in the winter in order to be able to plant corn the following summer. In the spring fires were set and the brush and logs were burned where they lay. If the weather was favorable, every-

thing would be consumed, leaving the land in good condition to plant. If the season was far advanced and did not allow complete clearing, corn, pumpkins, and turnips were planted among the blackened logs. The uniform rate of pay for chopping was \$5 an acre. Three trees were left standing on each acre. The following extract from a history (1) of Seneca County gives the cost of clearing the land. The contract was entered into October 7, 1805.

To clear off all the timber and brush of every description, to grub it, to plow it three times, the first plowing to be in the spring, to harrow it four times, to enclose the whole in good fences of oak or ash rails, at least 8 rails high and locked, and to furnish what rails shall be necessary to do the same and to have the work completed by October 20, 1806. I am to pay him 95 dollars for 10 acres, to furnish a hand to work at grubbing one week, to furnish necessary teams, drags, plows and grubbing hoes and Griffen to be at the expense of boarding himself and hands.

Prices for food and farm products about this time were as follows: Corn, 37½ cents a bushel; rye, 50 cents; hay, \$6 to \$12 a ton; butter and cheese, 11 to 16 cents a pound; salt pork, \$8 to \$10 a 100 pounds; whisky, 50 to 75 cents a gallon; and sheep, \$2 to \$4 a head. Milk cows brought from \$16 to \$25 a head, oxen \$50 a span, and horses \$100 to \$125 a team. Wages were \$4 to \$5 a month. Prices for products were low because of poor roads and long distances to markets. Wheat, which sold for \$1 a bushel at Bath, brought only 60 cents at Geneva. Nevertheless a large quantity of wheat was transported overland to Albany and Buffalo, much of it in winter by sleighs. Salts from leached ashes at times were the only product that could be sold for cash.

The completion of the Erie Canal in 1825 and the Seneca Lake branch in 1828, which allowed boats to reach the bordering lakes, gave a great impetus to agriculture, as it furnished a cheap method of transportation for the surplus products. Wheat always has been the main staple crop. The soils were early recognized as being very well adapted to the production of this crop, and in 1840, 25 percent of the cultivated land was devoted to its production. Oats, barley, rye, corn, peaches, and apples were grown to a considerable extent in the early agriculture. In 1825, 25 grain mills, 42 sawmills, and 501 looms were in operation.

From the time the canal system was completed to 1900, agriculture was based chiefly on the production of wheat and hay. Seneca County was long famous for its timothy. Although the opening of the western country resulted in a decided drop in the wheat acreage, this crop still retained an important place in the system of farming practiced. With the introduction of automobiles and trucks and the resulting decrease in the number of horses, the market for timothy hay was lost, and the farmers were forced to find a substitute for this crop. A substantial increase in the number of dairy cattle resulted, and the sale of milk assumed a place of greater importance in the agriculture. The acreage of cash grain crops increased materially, and during recent years intertilled crops, such as field beans and cabbage, have become an important source of revenue, as have canning and vegetable crops.

The agriculture has not yet become entirely stabilized, but the trend is toward dairying and the production of cash crops. There are,

however, certain natural climatic and physiographic limitations on the expansion of the dairying industry; the average annual rainfall is low, and pastures are usually short in the late summer; the water supply is not reliable, most of the creeks are intermittent, and springs are rare; moreover, wells do not always furnish a constant supply of water. On the basis of source of 40 percent of farm income or more, the 1,666 farms in 1930 were classified by the census as follows: General, 662; dairy, 286; crop-specialty, 195; poultry, 91; self-sufficing, 82; fruit, 68; cash grain, 48; truck, 21; animal-specialty, 11; and abnormal or unclassified, 202.

At present the most important crop as regards acreage is hay, principally timothy and medium red clover. Alfalfa, introduced around 1900, is increasing fairly rapidly in acreage and no doubt will continue to do so, as many of the soils are highly calcareous. In many parts of the county alfalfa can be seeded with good expectation of success without the use of lime.

Wheat, second in importance as regards acreage, is the most important cash crop grown. It is sometimes used as a nurse crop for new meadow seedings, but more frequently it is grown alone. Most of the grain is sold to local mills. Barley, another cash grain crop, is increasing in acreage. Rye is grown principally for a cover crop and to furnish late fall and early spring grazing. Oats are grown as both a feed crop and a cash crop. Buckwheat is a cash grain crop produced on the imperfectly or poorly drained soils of the central and southern parts of the county. In 1934 a total of 9,805 acres was devoted to corn, of which that from 5,994 acres was harvested for grain and that from 3,811 acres was used as fodder and silage, principally the latter.

Field beans, mainly the Red Kidney variety, and cabbage are important cash crops. The acreage of these is increasing and no doubt will continue to do so, as many of the soils, because of their high lime content, are well adapted to their production.

Clover seed was grown on 2,718 acres and alfalfa seed on 253 acres in 1929. These crops were not reported by the 1935 census.

Vegetable growing has been developed on the reclaimed muck of the Montezuma Marsh. Potatoes, beans, sweet corn, celery, and onions are the principal vegetables grown on these organic soils. Peas for canning are grown on a large acreage of the Ontario soils in the northern part of the county.

The production of fruit has always been an important phase of agriculture in Seneca County. The moderately long frost-free season, owing to the tempering influence of the adjacent lakes, has been the most important factor in the development of fruit growing. Federal census returns for 1935 report 7,455 acres in orchards and vineyards, with a production (in 1934) of 151,398 bushels of apples, 8,113 bushels of cherries, 332 bushels of peaches, 16,590 bushels of pears, and 2,672,536 pounds of grapes. Dry weather and late frosts resulted in a very short peach crop for that year. The town of Lodi leads in the production of peaches with 47 farms reporting 33,157 trees of bearing age in 1935. This town also leads in grapes, with 42 farms reporting 201,240 bearing vines in 1935 and a production of 859,033 pounds in 1934. The town of Covert leads in the production of apples with 138 farms reporting 23,405 apple trees of bearing age during 1935. The total value of fruits (and nuts) in 1929 was \$317,596.

Table 2 gives the acreages of the principal crops in Seneca County from 1879 to 1934, inclusive, and table 3 gives the value of certain crops and livestock products in 1929, according to the Federal census.

TABLE 2.—*Acreage of principal crops in Seneca County, N. Y., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1934
Corn:	<i>Acres</i>	Acres	Acres	Acres	Acres	Acres	Acres
For grain.....	13, 155	9, 301	12, 338	10, 954	7, 621	3, 831	5, 994
Cut for silage and fodder.....	.....	.....	.....	.....	3, 778	4, 080	3, 811
Wheat.....	31, 941	18, 892	26, 664	13, 495	22, 564	11, 569	14, 447
Oats.....	12, 525	13, 486	22, 780	21, 879	12, 478	8, 495	10, 867
Buckwheat.....	1, 238	1, 510	4, 912	5, 085	4, 108	8, 939	.....
Barley.....	17, 768	17, 867	3, 776	2, 358	4, 295	3, 669	4, 383
Rye.....	96	751	257	1, 189	777	108	396
Dry beans.....	.....	.....	1, 156	2, 221	565	4, 174	6, 027
Potatoes.....	3, 564	2, 064	3, 102	2, 833	1, 566	919	1, 819
Vegetables harvested for sale.....	.....	.....	.....	.....	.....	2, 413	2, 872
Cabbage.....	.....	.....	.....	.....	.....	711	946
All hay.....	28, 262	44, 447	43, 296	47, 182	56, 105	37, 256	38, 767
Timothy and timothy and clover mixed.....	.....	.....	.....	42, 950	50, 059	25, 490	27, 563
Clover alone.....	.....	.....	4, 871	3, 155	2, 890	6, 969	3 249
Alfalfa.....	.....	.....	24	317	1, 345	3, 772	7, 483
Other tame hay.....	.....	.....	38, 243	369	1, 294	924	3 3, 472
Wild hay.....	.....	.....	158	391	517	101	.....
Apples ¹	<i>Trees</i>	Trees	Trees	Trees	Trees	Trees	Trees
Peaches ¹	153, 507	156, 922	123, 437	134, 784	110, 412	109, 570	109, 570
Pears ¹	27, 094	82, 538	81, 440	45, 439	40, 718	70, 851	70, 851
Cherries ¹	13, 418	48, 879	29, 468	33, 300	23, 729	33, 311	33, 311
.....	6, 901	17, 746	27, 063	24, 690	17, 541	29, 525	29, 525
Grapes ¹	<i>Vines</i>	Vines	Vines	Vines	Vines	Vines	Vines
.....	.....	.....	932, 406	561, 869	466, 752	660, 531	609, 551

¹ For all purposes other than grain.

² Sweetclover and lespedeza only; other clover included with timothy and timothy and clover mixed.

³ Includes wild grasses.

⁴ Fruit trees and grapevines are for the years 1890, 1900, 1930, and 1935, respectively.

TABLE 3.—*Value of some agricultural products, by classes, in Seneca County, N. Y., in 1929*

Crop	Value	Livestock products	Value
Cereals.....	\$718, 812	Dairy products sold.....	\$713, 752
Other grains and seeds.....	83, 297	Wool shorn.....	23, 398
Hay and forage.....	738, 080	Poultry and eggs produced.....	666, 893
Vegetables (including all potatoes and sweetpotatoes).....	273, 709	Honey produced.....	41, 379
Fruits and nuts.....	317, 596	.....	.....
All other field crops.....	1, 211	.....	.....
Farm garden vegetables (excluding potatoes and sweetpotatoes) for home use only.....	39, 388	.....	.....
Forest products, cut on farms, for home use and for sale.....	84, 862	.....	.....
Nursery, greenhouse, and hothouse products.....	45, 515	.....	.....

Livestock raising and the production of livestock products, although important, never have developed to the degree that they have in the surrounding counties. Dairying has gained since 1900, however, and is increasing to a certain extent each year. In 1929, 6,811 cows and heifers were milked, and the production of milk amounted to 4,268,054 gallons. In 1934, 7,900 cows and heifers were milked and the production amounted to 5,042,910 gallons. Most of the milk is disposed of in fluid form and is either sold locally or handled by cooperative organizations. Holstein-Friesian is the most popular breed of dairy cattle.

Sheep are decreasing in numbers. They are raised mainly in the central and northern parts of the county on farms where alfalfa and beans are grown. Alfalfa hay, cull beans, and bean straw are used to fatten lambs for market.

In 1935, 1,602 farms reported a total of 145,062 chickens over 3 months old. Although the census reports 91 farms devoted to poultry raising, most of the chickens are raised to supply the needs of the farmers' families.

Farm work is done by both horses and tractors. In 1930, 1,306 farms reported 3,969 horses, an average of slightly over 3 to a farm. During the same year there were 839 tractors in operation. In 1935, 3,765 horses were reported on 1,335 farms.

Table 4 gives the number and value of livestock in 1920 and 1930 and the number in 1935.

TABLE 4.—*Number and value of livestock on farms in Seneca County, N. Y., in stated years*

Livestock	1920		1930		1935
	Number	Value	Number	Value	Number ¹
Horses.....	6,905	\$984,241	3,969	\$467,356	3,765
Mules.....	95	14,763	97	11,241	82
Cattle.....	11,383	1,074,653	12,945	877,847	13,185
Sheep.....	8,727	120,791	12,780	116,536	6,814
Goats.....	19	195	109	773	217
Swine.....	10,158	169,890	4,253	64,369	3,525
Chickens.....	² 123,622	² 151,228	135,706	154,705	145,062
Bees.....hives..	2,720	35,005	3,126	17,193	.....

¹ Value not reported.

² All poultry.

The county is supporting a fairly prosperous agriculture, except in areas where the soils are inferior. Farm buildings are substantial and are in a good state of repair. No doubt one reason for the good condition of the farms is the diversity of the agriculture. Rotation is practiced universally, and a large quantity of fertilizer is used. Expenditures for all fertilizers and soil amendments for 1929 amounted to \$105,934, with 1,212 farms, or 72.7 percent of the total number, reporting such purchases. During the same year 3,399 tons of commercial fertilizer were purchased. Superphosphate is usually applied for corn and oats, and complete fertilizers, such as 4-12-4, 2-8-10, or 3-7-9,⁴ are applied for beans, cabbage, wheat, and canning crops. The vegetable growers on the muck soils use large quantities of commercial fertilizer both in single ingredients and in combined form. Some of the extensive growers mix their own fertilizers. Lime is used for clover and alfalfa on certain of the less alkaline soils in the southern part of the county, but it is possible to grow these legumes on many of the soils of the central and northern parts without the use of this amendment. Lime also is used to some extent on the ground where cabbage is grown.

During 1929, 972 farms reported an expenditure of \$389,628 for labor, most of which is recruited locally. Much of the labor is hired,

⁴ Percentages, respectively, of nitrogen, phosphoric acid, and potash.

especially by the fruit growers, by the season, and the supply is apparently sufficient to meet these demands.

The average size of farms in 1935 was 98.5 acres; in 1930 it was 103.7 acres, and in 1920, 101.4 acres. The number of farms increased from 1,666 in 1930 to 1,943 in 1935. In the latter year 616 farms included less than 50 acres, 506 ranged from 50 to 99 acres in size, 549 ranged from 100 to 174 acres, and 183 ranged from 175 to 259 acres. Of the larger farms, 86 ranged from 260 to 999 acres, and 3 included 1,000 acres or more. The present trend is toward a decrease in the acreage of individual farms and an increase in the total number. A trend like this is to be expected in times of industrial depression, when the usual movement of rural people to cities is reversed. The Federal census reports 336 farm operators on January 1, 1935, that were not engaged in agriculture 5 years earlier.

In 1935, 191,420 acres, or 89 percent of the total area of the county, was in farms. Land in farms included 121,403 acres of cropland; 40,692 acres of pasture land, of which 25,655 acres was plowable pasture and 7,591 acres woodland pasture; 13,411 acres in farm woodland, and 15,914 acres used for farmsteads and other purposes. The average value of land and buildings in 1935 was \$4,793 a farm, or \$48.65 an acre. These values represent a considerable reduction since 1930, when the corresponding values were \$7,245 and \$69.89, respectively.

In 1935, 75 percent of the farms were operated by owners or part owners, 23.8 percent by tenants, and 1.2 percent by managers. The total number of tenants according to the 1930 census was 364, 56 of whom were cash tenants; the rest rented on shares, under an arrangement whereby the landlord furnished part of the seed and fertilizer and received one-half of the crop.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers or horizons, called collectively the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil⁵ and its content of lime and salts are determined by simple tests. Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelation of soils and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into mapping units. The three principal ones are (1) series, (2) type, and (3) phase. Areas of land, such as coastal beach or bare

⁵ The reaction of the soil is its degree of acidity or alkalinity, expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

rocky mountainsides, that have no true soil, are called (4) miscellaneous land types.

The most important group is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus, Honeoye, Ontario, Ottawa, Lansing, and Schoharie are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Ontario loam and Ontario fine sandy loam are soil types within the Ontario series. Except for the texture of the surface soil, these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, which differs from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a soil type, certain areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Even though no important differences are observed in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, important differences may exist in respect to the growth of cultivated crops. In such an instance the more shallow or eroded parts of the soil type may be segregated on the map as a shallow or eroded phase. These differences are not necessarily reflected in the character of the soil or in the growth of native plants.

Miscellaneous land types include areas not classified as distinct soil units, such as rough broken land, made land, and alluvial soils, undifferentiated.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

SOILS

The soils of Seneca County vary widely in texture, color, drainage, and relief, all of which have a bearing on the agriculture and productive capacity of the soils. There are loamy sands that have been shifted more or less by wind, heavy tenacious clays laid down in former lakes, and soils of intermediate textures developed from

various kinds of glacial till and outwash deposits. Most, of the soils, however, are loams and silt loams, which are easy to work and have a good water-holding capacity. Probably 60 percent of the total area has imperfect to poor drainage, but only a small acreage is nonagricultural because of an excessive supply of moisture. Soil colors range from the dull brown and light reddish brown of the well-drained soils to the gray and nearly black of the excessively wet soils. Relief ranges from the sharply rolling drumlin areas to the flat lake plain between the northern ends of the lakes, and from the undulating till plain of the central part to the rolling and undulating southern uplands.

The agriculture consists of general and cash-crop farming, fruit and vegetable growing, and dairying, which is carried on in conjunction with other farm enterprises. The better soils can be classed as excellent, and they allow a great diversification in the crops grown. Dairying occupies a subordinate place in the agriculture because a greater return to the acre can be obtained from the production of cash crops, grains, and vegetables than from the use of land as pasture. Dairying supersedes the production of cash crops on the heavy-textured and poorly and imperfectly drained soils mainly because these soils produce good yields of timothy hay and red clover and furnish good pasture but do not produce good yields of grain and vegetables.

Fruit is grown on the well-drained soils in all parts of the county, but especially on the slopes to Seneca and Cayuga Lakes, where the longer frost-free season has been the determining factor in the more intensive fruit production of these areas.

The soils occur in belts crossing the county in an east-west direction. In the northwestern corner of the county there is a large area of soils that have developed from light-textured wind-blown sands. Much of this land is rough and is not used for farming. The soil has a low water-holding capacity and is not adapted to grain and field crops. Agriculture consists principally of the production of vegetables and fruit. The soils warm early in the spring and are easy to work. The long roots of fruit trees draw on the deep subsoil for moisture.

Across the northern part of the county is a large area of soils on long oval hills of glacial till, known to geologists as drumlins. The soils are well drained, have light or medium textures, and have friable highly calcareous subsoils. The only unfavorable characteristic of these soils is that some of them are on rough and steep slopes. The soils are suitable for a wide range of crops and have medium to high natural fertility. Alfalfa, winter wheat, peas for canning, field beans, and corn are grown with excellent results, and yields are considerably increased by the use of commercial fertilizers.

Scattered through the drumlins are rounded gravel hills of irregular shapes. Soils on these hills are more droughty than those of the drumlins.

Extending across the county in the vicinity of Seneca Falls and Waterloo is a belt of soils that have developed from lake-laid sediments. They are imperfectly or poorly drained and in general are heavy in texture. Fewer crops can be grown successfully on these soils than on those of the drumlins. The better drained areas are

planted to wheat, oats, and corn, and the less well drained areas are planted to timothy and clover or are used for pasture. Some areas of shallow muck have been artificially drained and are used for producing vegetables, principally potatoes.

South of this belt and extending to Fayette the soils are better drained and have an undulating to rolling relief. In places the soils of this area are thin and the underlying rock comes within 18 to 24 inches of the surface. The soils are calcareous and are adapted to a wide range of crops. Fruit, wheat, oats, alfalfa, field beans, and some vegetables for canning are grown extensively.

From Fayette south to Ovid the land is level to undulating except on the slopes adjacent to the lakes (pl. 2). The soils are imperfectly or poorly drained and are developed from calcareous glacial till. Drainage is not so poor as to interfere seriously with hay and grain crops. A larger proportion of this area, including the towns of Varick and Romulus, is in pasture, and more hay is grown than farther to the north. Besides hay and pasture, winter and spring grains and fruit, principally grapes along the lakes, are the important crops grown.

From Ovid south to the county line is a transitional zone (pl. 3). The soil materials grade from the highly calcareous glacial till of the Ontario lowlands to acid relatively shallow glacial till of the Southern New York section of the Appalachian Plateaus. In Seneca County the soils are medium to slightly acid and the parent materials are alkaline, but not far south of the county line the limestone influence fades out and the soils and parent materials are strongly acid. On the slopes adjacent to the lakes the soils are similar to those farther north because of the greater quantity of limestone mixed with the materials by the thick lobes of ice that passed over them during glacial time. Consequently, on these slopes agriculture is similar to that of areas to the north, but, in the higher parts midway between the lakes, agriculture is based mainly on the production of dairy products. This is the only part of the county where very much land has been abandoned.

For discussion, the soils are grouped, according to the physiographic units they occupy, as follows: (1) Soils of the drumlins and drumlin-like hills; (2) soils of the gravel hills; (3) soils of the glacial till plain; (4) soils of the Appalachian Plateaus, Southern New York section; (5) soils of the glacial outwash plains; (6) soils of the flood plains; (7) soils of the glacial lake plain; (8) soils of the swamps and marshes; and (9) miscellaneous land types. Drainage, whether excessive or poor, has much to do with determining the crops produced on the soils. It is, in turn, determined largely by local relief or slope

EXPLANATORY LEGEND FOR PLATE 2

VERTICAL AERIAL PHOTOGRAPH OF AREA JUST SOUTH OF FAYETTE, SENECA COUNTY, N. Y.

- A. Area of Honeoye silt loam.
- B. Areas of Darien silt loam.
- C, D, E, Areas of Kendaia silt loam, Lyons silty clay loam, and wooded Carlisle muck, respectively.
- F, Lyons silty clay loam.
- G, Honeoye silt loam.
- H, Areas of Romulus silt clay loam.





and to a considerable extent by the texture of parent materials. Soils with radically different drainage characteristics are described in the same group because of close association in the field. Texture also is an important soil characteristic in this county with its diversification of agriculture. The presence or absence of lime in the surface soil or subsoil determines to a great extent the distribution of such crops as alfalfa and cabbage. The physiographic units occupied by these soils are shown in figure 3.

In the following pages the soils of Seneca County, N. Y., are described in detail and their agricultural relationships are discussed; their location and distribution are shown on the accompanying soil map; and their acreage and proportionate extent are given in table 5.

TABLE 5.—Acreage and proportionate extent of the soils mapped in Seneca County, N. Y.

Type of soil	Acres	Per-cent	Type of soil	Acres	Per-cent
Ontario loam.....	12,928	6.2	Palmyra gravelly loam.....	704	0.3
Ontario loam, steep phase.....	640	.3	Chenango gravelly loam.....	320	.2
Ontario fine sandy loam.....	2,816	1.3	Wayland silt loam.....	3,328	1.6
Cazenovia silt loam.....	1,216	.6	Alluvial soils, undifferentiated.....	3,392	1.6
Groton gravelly loam.....	256	.1	Dunkirk fine sandy loam.....	1,856	.9
Honeoye silt loam.....	23,232	11.1	Dunkirk silt loam.....	7,744	3.7
Honeoye silt loam, eroded phase.....	2,112	1.0	Dunkirk silt loam, shallow phase.....	1,216	.6
Cayuga silt loam.....	5,184	2.5	Collamer silt loam.....	704	.3
Darlen silt loam.....	15,232	7.3	Schoharie silt loam.....	4,096	2.0
Darlen silt loam, slope phase.....	576	.3	Schoharie silty clay loam.....	13,952	6.7
Lansing silt loam.....	10,752	5.1	Poygan silty clay loam.....	11,328	5.4
Lansing silt loam, shallow phase.....	10,560	5.0	Toledo silty clay loam.....	448	.2
Lansing silt loam, shallow steep phase.....	832	.4	Ottawa loamy fine sand.....	3,840	1.8
Farmington loam.....	512	.2	Ottawa loamy fine sand, rolling phase.....	768	.4
Ovid silt loam.....	640	.3	Berrien loamy fine sand.....	1,984	.9
Romulus silty clay loam.....	9,216	4.4	Granby fine sandy loam.....	2,496	1.2
Romulus silty clay loam, shallow phase.....	3,776	1.8	Carlisle muck.....	8,192	3.9
Kendaia silt loam.....	10,176	4.8	Carlisle muck, shallow phase.....	2,304	1.1
Lyons silty clay loam.....	8,064	3.8	Edwards muck.....	896	.4
Wootter gravelly loam.....	832	.4	Wallkill silt loam.....	1,728	.8
Lordstown flaggy silt loam.....	768	.4	Rough broken land.....	2,944	1.4
Langford silt loam.....	7,168	3.4	Made land.....	512	.2
Erle silt loam.....	5,888	2.8	Total.....	209,920	100.0
Chippewa silty clay loam.....	1,792	.9			

SOILS OF THE DRUMLINS AND DRUMLINLIKE HILLS

Soils of the drumlins and drumlinlike hills are well-drained soils with light to medium textures and calcareous subsoils. They include members of the Ontario and Cazenovia series. These soils occur mainly north of the Seneca River, although Ontario loam also occurs in the southern part of the county. The soils of the group are char-

EXPLANATORY LEGEND FOR PLATE 3

VERTICAL AERIAL PHOTOGRAPH OF AREA SOUTHEAST OF OVID AND NORTHEAST OF LODI, SENECA COUNTY, N. Y.

A, Lansing silt loam and dark streaks indicating very narrow strips of poorly drained soil, probably Lyons silty clay loam, along drainageways.

B, Lyons silty clay loam.

C, Kendaia silt loam.

D, Alluvial soils, undifferentiated, along Sheldrake Creek.

E, Orchard on Lansing silt loam.

F, Honeoye silt loam—one area wooded—whereas most of Honeoye silt loam is cultivated.

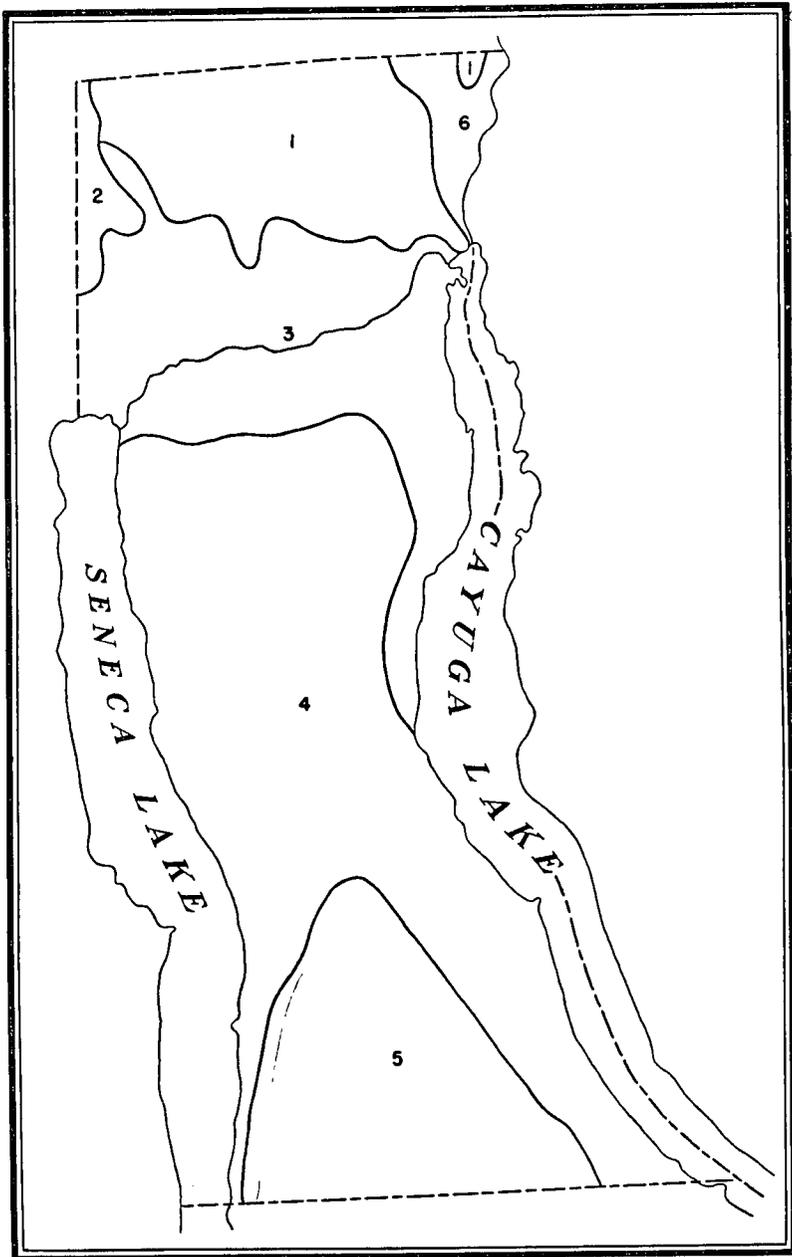


FIGURE 3.—Physiographic units of Seneca County, N. Y.: 1, Drumlins and drumlinlike hills; 2, gravel hills and glacial outwash plains; 3, glacial till plain; 4, Appalachian Plateaus, Southern New York section; 5, flood plains, swamps, and marshes; 6, glacial lake plain.

acterized by dull-brown or grayish-brown surface soils, and all are somewhat gravelly. The subsoils are friable. Drainage, both external and internal, is good. Ontario loam is the most extensive soil of this group.

The agriculture practiced on these soils consists of general and cash-crop farming. Field beans, peas for canning, alfalfa, and winter wheat are the most important crops. Good drainage, favorable physical properties, and calcareous character of the subsoil are properties that make these soils excellent for agriculture, except in areas where the relief is rough and uneven. Unless the slopes of drumlins are farmed properly, they are subject to severe erosion.

Ontario loam.—Ontario loam, the most extensive member of the Ontario series, occurs principally in the towns of Junius, Tyre, Seneca Falls, and Waterloo, in the northern part of the county. In cultivated areas the surface soil is dull-brown or grayish-brown mellow loam, 8 to 10 inches thick, containing variable quantities of angular pieces of gravel and small stones. The subsurface layer, which extends to a depth of 14 inches, is pale brownish-yellow or grayish-yellow friable silt loam that contains less gravel than the surface soil. This layer is underlain in places by a layer of light grayish-yellow slightly compact, brittle, gritty silt loam with a weakly developed platy structure. This layer, which indicates imperfect internal drainage, is not everywhere present. Normally, the yellowish-gray subsurface soil rests on deep-brown slightly plastic heavy silt loam that is moderately dense in places. The lower part of the subsoil below a depth of 36 to 40 inches is pinkish-gray gritty loam with a definite fragmental structure. The structural aggregates range from one-quarter to three-quarters of an inch in diameter and are rather hard. The parent material consists of glacial till derived largely from limestone and to a less extent from shale and sandstone. The limestone part of the till has had an important effect on the significant characteristics of the present soil.

The surface soil is slightly to medium acid, but free lime is present at a depth ranging from 24 to 36 inches. The parent material contains large quantities of limestone gravel and boulders.

The relief is undulating to drumloid, and many of the drumlins are long and narrow with very steep sides. Both internal and external drainage are good. Surface run-off is excessive on some of the steep-sided narrow drumlins. The areas between the elongated hills are generally flat and more slowly drained.

The original forest cover consisted mainly of deciduous trees, principally maple, oak, beech, tuliptree (yellow poplar), basswood, hickory, and ash. The present second- and third-growth forests are composed of the same species.

This soil is used for the production of winter wheat, beans, cabbage, alfalfa, timothy and clover, peas for canning, oats, and corn. The agriculture centers on a general or cash-crop type of farming. Dairying is carried on to some extent, but it furnishes only a part of the farm income. Many of the farms on this soil maintain a small flock of sheep to utilize the pasture and part of the crops.

Thorough drainage, as well as the favorable texture and lime content of the soil, favor the production of cash crops. Alfalfa and cabbage, both lime-loving crops, are grown successfully without the

addition of any soil amendment. Ontario loam warms early in the spring and can be worked under a fairly wide range of moisture conditions.

Approximately 75 percent of the land is cleared and used for agriculture in the following proportions: Winter wheat, 25 percent; hay, either alfalfa or clover and timothy, 40 percent; corn, 15 percent; field beans, 10 percent; and cabbage, peas for canning, and potatoes, 10 percent.

Most of the farmers follow a definite sequence of crops. Winter wheat is usually followed by timothy and clover or alfalfa, corn, beans, or cabbage. Fertilization consists of a 250-pound application of 16-percent superphosphate for the grain crops and 150 to 250 pounds of 2-8-10 or similar analyses for beans. The applications of commercial fertilizer for cabbage usually range from 300 to 700 pounds of 4-8-12. If any manure is available, it is used to top-dress meadows or is applied to land used for corn or cabbage.

Under this system of management approximate normal acre yields of the enumerated crops are: Winter wheat, 25 to 35 bushels; alfalfa, 2 tons; silage corn, 10 tons; beans, 15 to 20 bushels; and cabbage, 9 to 11 tons. Lack of moisture frequently limits the yields. Yields are materially reduced when the rainfall is much below the mean for the growing season, but with very favorable precipitation yields may be 10 percent greater than those listed.

Ontario loam is managed in much the same way as are other calcareous soils of the county. Plowing is usually done in the fall if the weather allows. Farmers have found it unnecessary to use lime for alfalfa, and many fields remain in alfalfa for years. In the areas where free lime does not occur above a depth of 36 inches, new seedings of alfalfa would be helped by a light application of lime. After the roots reach the calcareous subsoil the crop can maintain itself on the supply of lime there.

This soil is susceptible to severe erosion on some of the steeper drumlin slopes. The general practice is to seed these slopes to alfalfa and let them remain in this crop. The large acreage of cultivated crops, such as beans and cabbage, makes erosion a problem. Erosion can be adequately controlled principally by plowing and planting on the contour.

Ontario loam; steep phase.—The steep phase of Ontario loam includes several of the steeper drumlins and the steeply sloping sides of several others. The slopes of these areas range from 20 to 35 percent, which means a drop of 20 to 35 feet in a distance of 100 feet. This soil occurs only in the northern part of the county. In cultivated areas the surface soil is in few places thicker than 4 inches and in some places it has been completely removed by erosion. The subsurface soil is yellowish-brown friable silt loam, which rests on reddish-brown heavy silt loam at a depth of 12 to 14 inches. The subsoil is calcareous gritty loam, moderately compact in place but friable when broken out.

A small part of this soil is used for cultivated or grain crops, but the greater part is in hay or pasture. Severely eroded spots on these steep slopes support little vegetation, except sweetclover, which seems able to maintain itself on the raw highly calcareous subsoil material.

Probably 50 percent of the steep areas remains in forest, 30 percent is utilized as pasture land, 10 percent for alfalfa or timothy and clover hay, 5 percent for grain and cultivated crops, and 5 percent is idle.

Because of the serious erosion that follows when the land is cultivated, this soil should be left in permanent pasture and meadow. Native pastures are only fair, but marked improvement can be obtained with applications of phosphate.

Ontario fine sandy loam.—Ontario fine sandy loam is associated with Ontario loam but is not so extensive. It occurs in the northwestern part of the county on long fairly well defined drumlins or areas of sharply to moderately rolling relief. It has the brown or pinkish-brown color generally associated with the Ontario soils, and angular gravel fragments and small stones are strewn over the surface.

The cultivated surface soil is brown, grayish-brown, or pinkish-brown mellow fine sandy loam, 8 inches thick, underlain to a depth of 15 inches by yellowish-brown firm gravelly loam or silt loam. This rests on a layer of light reddish-brown slightly plastic heavy silt loam. Fine materials from the surface and subsurface layers have been deposited in this layer. The subsoil is pinkish-gray calcareous material with a gritty loam texture and a well-developed fragmental structure.

A few small areas, some of which are along the highway northwest of Waterloo, and two 1 mile southwest of Junius, have a surface layer of yellowish-brown wind-blown sand similar to the material of the Ottawa series. The depth of this sandy covering ranges from 6 to 18 inches. Where the sand layer is thin the soil does not differ materially from typical Ontario fine sandy loam as regards methods of management and crop yields obtained, but in places where it approaches a depth of 2 feet the soil is managed like Ottawa loamy fine sand.

Ontario fine sandy loam is used for growing alfalfa, field beans, cabbage, wheat, and peas for canning. A few apple orchards are on this soil, which is very well adapted for fruit growing. As it occurs south of the main fruit belt, commercial orcharding is not carried on to a great extent. The usual rotation consists of 1 year of grain followed by 2 years of intertilled crops, which may be beans, cabbage, or peas for canning, after which the soil is seeded to hay. Many of the steeper slopes are left in hay for a number of years. The high lime content in the subsoil favors the growth of such legumes as alfalfa and clover.

Complete fertilizers, such as 4-8-12 or 2-8-10, are applied to land devoted to cabbage and beans and sometimes to wheatland. Applications range from 300 to 800 pounds for cabbage and from 200 to 300 pounds for beans and wheat. Cornland is fertilized with 200 to 500 pounds of superphosphate in addition to manure if available.

Very little lime is used on Ontario fine sandy loam, because the subsoil is strongly calcareous at a depth ranging from 24 to 36 inches. In the areas where lime lies 36 or more inches below the surface, new alfalfa seedings and cabbage will respond to the use of lime.

Yields are comparable to those obtained on Ontario loam and Honeoye silt loam where management is the same. Approximate

normal acre yields are: Wheat, 25 to 35 bushels; beans, 15 to 20 bushels; cabbage, 8 to 10 tons; alfalfa, 2½ to 3 tons; corn silage, 8 to 10 tons; and peas for canning, 1,200 pounds of shelled peas. Ontario fine sandy loam can be worked under a fairly wide range of moisture conditions, warms early in the spring, responds well to fertilization, and is not readily leached. It is subject to serious erosion if worked up and down the slopes, but erosion can be controlled by tillage and planting on the contour. Some areas with slopes of 10 to 15 percent present some difficulty in the use of machinery and therefore should be left in hay or pasture. The greater part of the land, however, is level enough to work with most modern farm implements.

Approximately 80 percent of this soil is farmed, and 20 percent is in wood lots. Of the cleared land, 25 percent is used for wheat, corn, and oats, 35 percent for hay, 15 percent for pasture land, and 20 percent for cash crops, such as beans, cabbage, and peas.

Cazenovia silt loam.—Several scattered areas of Cazenovia silt loam lie east of Seneca Falls. This soil has a reddish-brown gravelly silt loam surface soil and a brownish-red heavy silty clay loam upper subsoil layer. The relief is undulating to drumloid. Cazenovia silt loam is closely related to the Ontario soils, but it is redder and has a heavier textured subsurface layer. The depth to calcareous material is less than in that soil.

The cultivated fields have an 8-inch reddish-brown, brown, or grayish-brown silt loam surface soil that is mellow and in places somewhat gravelly. The upper subsoil layer to a depth of 18 to 20 inches is brownish-red firm slightly plastic silty clay loam. The lower part of the subsoil is pinkish-gray gritty silt loam with a well-developed fragmental structure. The material of this horizon is very friable in place, but the individual structural aggregates are hard. Roots and moisture penetrate the subsoil readily. The surface soil is neutral to slightly acid, the upper subsoil layer is alkaline, and the lower subsoil layer is calcareous. The soil has developed from glacial till, which, in places, has probably been reworked with lacustrine sediments. The till was derived principally from limestone and red Medina sandstone with a smaller proportion of crystalline rocks. Just across the Montezuma Marsh in Cayuga County, Cazenovia silt loam is, in places, underlain by limestone bedrock at a depth of 24 to 40 inches. In Seneca County, bedrock lies considerably deeper than this.

Surface drainage is good, and the heavy upper subsoil layer does not interfere with the internal movement of water. A rather well-developed structure allows water to move around the structural aggregates. Most of the soil has an undulating surface, and it is not subject to serious erosion; one or two areas bordering the Montezuma Marsh, however, have slopes of 8 to 15 percent where washing does occur if plowing and cultivating are not done on the contour. These areas usually are left in alfalfa for hay, which effectively controls erosion.

Although not extensive, this soil is excellent cropland, especially suited to alfalfa and other lime-loving crops. Besides hay, which occupies the largest acreage, wheat, corn, oats, and beans are grown. Yields compare favorably with those on the Ontario and Honeoye soils and average between 2 and 3 tons of alfalfa, 30 bushels of wheat,

40 bushels of oats, 15 bushels of field beans, and between 8 and 10 tons of corn silage per acre. Very little fertilizer besides superphosphate is used. A little manure is applied to the land. The soil has high natural fertility, which is easily maintained without great expenditures for commercial fertilizer. Legumes and manure provide sufficient nitrogen. Potash apparently is adequate, but good response is obtainable with phosphate. Less than half of the land is cleared, of which about 60 percent is used for hay, 15 percent for pasture, 10 percent for wheat, 10 percent for corn and oats, and 5 percent for cash crops of beans, peas for canning, and cabbage.

SOILS OF THE GRAVEL HILLS

Soils of the gravel hills are represented by only one type—Groton gravelly loam.

Groton gravelly loam.—Groton gravelly loam has the rough kettle-and-kame relief typical of soil developed from parent materials deposited as moraines. The surface soil is yellowish-brown loose mellow gravelly loam or gravelly sandy loam. The upper part of the subsoil to a depth of 24 inches is brown open and friable gravelly loam, and the lower part, as well as the substratum, consists of bedded sand and gravel. Very little organic matter is present. This soil has an acid surface soil and a calcareous subsoil. The gravel in the soil consists of water-worn rounded material derived from sandstone and limestone. Lime has been leached from the upper 2 feet, but below this depth from 25 to 50 percent of the material is made up of limestone gravel.

The relief is hummocky to sharply rolling with slopes ranging from 10 to 25 percent. The steeper areas are practically nonagricultural and support a growth of sweetfern and scarlet oak. Grasses do not grow well, as the soil is very porous and therefore not retentive of moisture. The one or two areas cropped are used in conjunction with Ottawa loamy fine sand for vegetables and small fruits. The soil is easy to cultivate and can be worked under very wide ranges in moisture content. Only the less gravelly areas are utilized, as the others are rather difficult to work. In places where the gravel content is high, practically all of the water passes immediately into the substratum and is not available to crops. Deep-rooted crops, such as alfalfa and apple trees, should do considerably better on this soil than shallow-rooted crops.

Groton gravelly loam occurs in a few small areas in the northwestern corner of the county and north of Seneca Falls. The largest bodies are in the vicinity of the ponds in the town of Junius. Approximately 20 percent of the land is still covered with timber, 60 percent is idle, 10 percent is used for pasture, 5 percent for hay, and 5 percent for cultivated crops consisting of vegetables and small fruits.

SOILS OF THE GLACIAL TILL PLAIN

Soils of the glacial till plain vary considerably in color, mineralogical composition, and, to less extent, in texture. Most of the land ranges from nearly level to gently rolling, but some slopes adjacent to the lakes are steep.

Both the Honeoye and Cayuga soils are developed on strongly calcareous glacial till. The subsoil of the Cayuga soils is slightly heavier textured than the corresponding layer of the Honeoye soils, and it is somewhat reddish brown. Probably part of the parent material of the Cayuga soils was deposited by the waters of an ancient glacial lake.

The Darien soils are formed from calcareous glacial till that has a grayer color and contains a larger proportion of dark-gray and gray shale fragments than does the parent material of the Honeoye soils. External drainage is medium to rapid, but internal drainage is impeded by the compact subsoil.

The Lansing soils are developed on a till that is intermediate in character between that of the Honeoye and that of the Erie soils. (For a description of the latter, see p. 38.) The proportion of sandstone and shale is higher than in the Honeoye soils. Internal drainage is more rapid than in the Darien soils.

The Farmington soils are developed from very shallow glacial till resting on limestone. Bedrock outcrops in many places.

Mixed calcareous till and lacustrine deposits resembling the parent materials of the Cayuga soils give rise to the Ovid soils. Drainage is slower in the Ovid than in the Cayuga soils.

The Romulus soils are developed from shallow calcareous shaly glacial till over shale bedrock. External drainage is slow, and internal drainage is very slow.

The Kendaia and Lyons soils occur on flats and in depressions in association with well-drained soils developed from calcareous glacial till. External drainage is medium on the Kendaia soils and very slow on the Lyons soils. Internal drainage is slow to very slow in both. The Lyons soils are darker colored and more poorly drained than the Kendaia.

Honeoye silt loam.—Honeoye silt loam is one of the most productive soils of the county. It occupies the slopes above Seneca and Cayuga Lakes and occurs in the central part of the county south of the Seneca River. The land is undulating to gently sloping. External drainage is medium to rapid, and internal drainage is medium to slow, so that moisture conditions usually are nearly ideal for upland crops. Practically all of the land has been brought under cultivation, and only a few scattered wood lots retain a cover of oak, beech, and maple trees.

Under cultivation, the normal soil has an 8-inch surface layer of dull-brown or grayish-brown mellow silt loam with some gravel and small stones. The subsurface soil to a depth of 14 inches is light-gray moderately firm silt loam, alkaline in reaction in the lower part. Between depths of 14 and 36 inches is a horizon of grayish-brown compact gritty silt loam. The structural aggregates, ranging from $\frac{1}{2}$ to 2 inches in diameter, are hard but porous when dry. The material of this horizon effervesces freely with dilute hydrochloric acid, and in places many limestone pebbles and stones are present. The lower subsoil layer is gray compact gritty loam or silt loam containing numerous stones and boulders of limestone and some shale, sandstone, and crystalline rocks. Typical Honeoye silt loam has a moderate quantity of angular gravel and small stones on the surface and mixed through the soil mass. This material is largely gray

sandstone and shale with some pink Medina sandstone, crystalline rocks, and limestone, but nowhere are the rocks abundant enough to interfere with cultivation. Piles of stones along fences and in field corners indicate that many stones have been removed in the past.

Areas of Honeoye silt loam in Seneca County mark the southern limit of the Honeoye series. The presence of considerable shale and sandstone in the parent material makes the color a lighter gray than is characteristic of this soil in counties to the east and north. The slopes immediately adjacent to the lakes in the southern part of the county are steep, and bedrock is exposed in many places; from one-fourth to one-half mile back from the lakes, however, the gradient becomes less and the depth of soil and parent material is considerably greater.

Typically, the relief is undulating or smoothly sloping, although near the lakes the slopes range from 10 to 25 percent. The steeper parts of the land have been eroded and are shown on the map as Honeoye silt loam, eroded phase. The fairly deep glacial till from which the soil has developed was laid down by lobes of ice that passed down the preglacial valleys. Honeoye silt loam occurs in few places throughout the central part of the county, as the mantle of glacial drift is considerably thinner. Limestone is the most important rock constituent of the till; reddish-brown Medina sandstone, crystalline rocks, and local shale and sandstone also are important. The large quantity of limestone gravel, stones, and boulders apparent in exposed sections of the subsoil is characteristic of soils of the Honeoye series.

Surface drainage is well developed, and there is no mottling in the subsoil that would indicate imperfect internal drainage. The compact subsoil below a depth of 24 inches, as well as the substratum, slows up the internal movement of water. Many fields of this soil have been tile-drained.

Excellent results are obtained on this soil with all the important crops produced in the area. Wheat, field beans, alfalfa, corn for grain and silage, timothy and clover for hay, oats, and cabbage occupy the greatest acreage. A large area is devoted to peaches and apples. Most of the apple orchards are in the town of Covert, and the peach orchards are in the same section and on the slopes bordering Seneca Lake. The compact lower subsoil layer and the substratum hinder the deep penetration of roots. Yields are not so great as those obtained on the good soils along Lake Ontario, although they are fairly good. Apples produce an average of 150 bushels an acre and peaches 80 to 100 bushels. Alfalfa and cabbage can be grown without the use of lime; but crops make a marked response to the addition of phosphorus, as this soil, in common with all the soils of the county, is deficient in this element. Tests of fertilizers on several soils at Cornell University brought out the fact that the Honeoye and Ontario soils respond very well to phosphate fertilization (3). Where dairying is not a prominent part of the farm enterprise, a common rotation is wheat, beans, and alfalfa or clover and timothy hay. Where dairying is important, hay, corn, oats, and barley followed by beans and cabbage may be the rotation.

The most common fertilizer used is 20-percent superphosphate, and applications of 200 to 500 pounds an acre are made for grain crops.

Manure is applied to land devoted to corn or cabbage or may be used to top-dress new meadowland. For cabbage, usually from 200 to 600 pounds of complete fertilizer, such as 2-8-10 or one with a similar ratio, is applied, and for wheat and beans 150 to 300 pounds of 4-8-10 or 4-8-16. Apple orchards commonly receive from 2 to 5 pounds of nitrate of soda or ammonium sulfate to each tree.

Acre yields under the average system of management and with fertilizer applied in amounts given above are as follows: Wheat, 25 to 40 bushels; oats, 35 to 50 bushels; barley, 20 to 35 bushels; field beans, 15 to 20 bushels; alfalfa, 2 to 4 tons; and cabbage, 8 to 12 tons. Honeoye silt loam is a strong soil, and its fertility is easily maintained. The limy subsoil favors the growth of legumes, which contribute to the maintenance of a fairly high nitrogen level. Where manure is available and the rotation contains a legume, such as alfalfa, little commercial fertilizer other than phosphate is needed.

Approximately 10 percent of Honeoye silt loam is in wood lots, 15 percent in wheat, 20 percent in spring grains, 25 percent in hay, 15 percent in pasture, and 10 percent in cash crops of beans, cabbage, and peas for canning. Probably 5 percent of the total area is devoted to fruit, principally apples, peaches, and grapes.

Honeoye silt loam, eroded phase.—The eroded phase of Honeoye silt loam occurs along the steep slopes immediately adjacent to the lakes in the southern part of the county. The gradient of these slopes ranges from 10 to 15 percent in the more northern areas to 20 to 30 percent in the southern areas. In many places the slopes are deeply notched by numerous steep-sided narrow gorges extending back one-fourth to three-fourths of a mile from the lake. Between these ravines the land is rolling to smoothly sloping. Slopes that have been cleared and cultivated have lost through erosion practically all of the surface soil and in places the subsurface layer as well.

The profile of the virgin soil is similar to that of the more nearly level less eroded typical soil. It consists of a 6-inch layer of grayish-brown mellow silt loam, underlain to a depth of 14 inches by yellowish-brown firm silt loam. Both the surface and subsurface layers have angular gravel and stone mixed with the finer material. The subsoil is light-gray compact highly calcareous and stony gritty loam or silt loam.

Only a small part of the cleared land is cropped at present, because of difficulties in the use of machinery and because erosion is rapid when the vegetative cover is lost. On the slopes bordering Seneca Lake in the town of Lodi a few peach orchards are on this eroded soil. Clean cultivation of peaches is the rule, because of the belief that quality and yields are superior under this practice; but it is almost impossible to hold the surface soil under such a condition. During the flood period of July 1935 enormous quantities of soil were washed from these orchards. Erosion in the peach orchards might be controlled by diversion ditches or by the use of a vegetative cover. Control through the use of diversion ditches has given good results in a few orchards in Schuyler County, where soil conditions are similar. Special measures for the control of erosion are essential if these steep slopes continue to be used under practices of clean cultivation.

Most of the cleared areas on the steeper slopes are idle or used as pasture. Canada bluegrass, Kentucky bluegrass, and sweetclover are the principal forage plants growing on this soil. Pastures are fair to good in the spring, but they dry out badly late in the season.

Approximately 60 percent of this eroded soil is forested, 5 percent is used for orchards, and the rest is used for pasture or is idle.

Cayuga silt loam.—Cayuga silt loam occurs most extensively on the slopes adjacent to Cayuga Lake from Interlaken northward to Fayette. One large area is at the northern end of Seneca Lake. The slopes are smooth and range in gradient from 6 to 15 percent. The 8-inch surface soil is grayish-brown mellow silt loam or loam containing a small quantity of angular stones and gravel. This is underlain to a depth of 18 inches by light yellowish-brown slightly compact silt loam, marbled with streaks of gray and yellow. Between depths of 18 and 36 inches the material is deep-brown compact silty clay loam with a well-developed prismatic structure. The structural aggregates, $\frac{1}{2}$ to 2 inches in diameter, are hard when dry but are somewhat vesicular. Roots penetrate along the well-developed cleavage planes. The next lower layer is light-gray compact hard gritty silt loam, which grades into raw glacial till. This material contains a large quantity of gravel, stones, and boulders. The lower part of the subsoil and the substratum are very similar to the corresponding layers of Honeoye silt loam.

Surface drainage of this soil is medium to rapid, and internal drainage is medium. The subsoil is sufficiently compact in places to slow up the movement of water through it. The surface soil is slightly acid, the upper subsoil layer is neutral or alkaline, and the lower subsoil layer is calcareous.

Although it is derived predominantly from limestone and red Medina sandstone, the parent material of glacial till also includes some crystalline rocks and shales. In places the till is mixed to some extent with lacustrine clay and silt. It is developed below the levels of former glacial lakes and must have received some still-water sediments, most of which have been removed by subsequent erosion. The distinguishing characteristic of this soil is the development of a deep-brown heavy-textured subsurface layer. The soil resembles Honeoye silt loam in the lower part of the subsoil and in the substratum.

Cayuga silt loam is used mainly for hay, pasture, corn silage, small grains, and beans. Dairying is the principal source of income on farms on this soil. Rotations of hay, corn, small grains, and beans over a period of 4 or 5 years are followed. Fertilization consists of applications of phosphate for grain crops, with manure on cornland or meadows. Very little lime is used, and fair to good stands of alfalfa are obtained. Most of the hay, however, is timothy and clover. Fruit growing is not important on this soil. Native pastures are good, and excellent pastures of Kentucky bluegrass and white clover are possible with the addition of phosphate.

Average acre yields of crops are as follows: Wheat, 25 bushels; oats, 35 bushels; corn silage, between 8 and 10 tons; beans, 15 bushels; and hay $1\frac{1}{2}$ to 3 tons. Probably 20 percent of this soil is still forested, 25 percent is pasture land, 25 percent is used for hay, 15 percent for corn silage and oats, 10 percent for wheat, and 5 percent for field beans.

Darien silt loam.—Darien silt loam has a 6-inch surface layer of gray or grayish-brown silt loam or silty clay loam, which has a tendency to puddle if worked when wet. Little or no gravel is present, but in many places dark-gray shale fragments are abundant. The subsurface soil is yellowish-brown silty clay loam that breaks into large dense irregular fragments. The material between depths of 12 and 28 inches is grayish-brown moderately dense and compact silty clay loam somewhat mottled with dark brown and gray. This material contains a large quantity of partly weathered black shale fragments and limestone pebbles and stones. The lower subsoil layer of yellowish-brown or light grayish-brown compact faintly mottled heavy silt loam continues to a depth of 40 inches. Shale and limestone fragments are present in this layer also. Compaction seems to increase with depth.

The surface layer is slightly acid, but free lime occurs at a depth of 18 to 24 inches. The supply of organic matter is about the same as in the Honeoye soils. The moderately dark gray color of the surface soil is due in part to rock coloration and not entirely to organic matter.

Darien silt loam is well distributed through the central part of the county from Ovid north to the Seneca River. Its total area, 23.8 square miles, exceeds that of any other soil in the county except Honeoye silt loam. The relief is characteristic of an undulating to moderately sloping ground moraine. The soil has developed from fairly deep glacial till derived from limestone and thinly bedded gray and black calcareous shales. It is these shales that give the gray color to the soil material. The content of limestone is less than that in the Honeoye soils, from which Darien silt loam is also distinguished by its grayer color and the faint to moderate degree of mottling in the subsoil. One mile north of Kendaia an area of Darien silt loam is mapped, in which the surface soil is silty clay loam rather than silt loam. The subsoil of this area is somewhat heavier textured, darker gray, and more mottled than that of the typical soil.

Although the relief is adequate to insure good surface drainage, the heavy and somewhat tight and compact subsoil impedes internal movement of water, resulting in slow subsoil drainage.

Darien silt loam is a good agricultural soil used for growing wheat, field beans, alfalfa, timothy and clover, and corn. Dairying has not developed into an important enterprise because of an inadequate water supply and lack of good markets. Good spring pastures can be obtained on this soil, and native pastures of pure stands of Canada bluegrass are common. The low rainfall in late summer is sometimes a limiting factor to the later growth of pasture grasses. The agriculture consists mainly of the production of cash crops, chiefly wheat and field beans. A common rotation includes hay for 2 or 3 years, followed by beans and wheat. Superphosphate or complete fertilizer may be applied to wheatland in quantities ranging from 150 to 300 pounds to the acre. The fertilizers more commonly used are 2-8-10 and 4-12-4. Yields average from 5 to 10 percent less than those on Dunkirk silt loam. Approximately 20 percent of the total acreage of Darien silt loam is in woods, 25 percent in hay, 30 percent in pasture for cattle and sheep, 10 percent in wheat, and 10 percent in other crops, such as beans, cabbage, and corn, and the rest is idle.

Some tile drains have been installed in areas of this soil, mainly on the flatter land having slow run-off. The soil washes readily on slopes that are not protected by a cover of vegetation.

Darien silt loam, slope phase.—South of Willard several areas of Darien silt loam are designated as a slope phase. The slopes range from 12 to 25 percent, whereas in the normal soil the maximum slopes are not greater than 15 percent. The Darien soils erode more rapidly than the Lansing or Honeoye soils having the same degree of slope, and many cultivated areas of the steeper slopes are severely eroded.

The surface soil to a depth of 4 to 8 inches is grayish-brown or gray heavy silt loam, underlain to a depth of 14 inches by yellowish-brown mottled silty clay loam. The subsoil is gray or light-gray silt loam or silty clay loam faintly mottled with yellow and gray. Shale bedrock lies from 24 to 36 inches below the surface. The surface soil is neutral or slightly acid in reaction, and the subsoil is alkaline or calcareous at a depth of 24 inches.

The less steep parts of Darien silt loam, slope phase, are used for hay, pasture, wheat, and orchards. Erosion is not a problem when the soil is protected with a vegetative cover, but wheatland suffers from washing to a certain extent. The orchards are devoted mainly to peaches, and, under the prevailing clean cultivation they are subject to serious washing unless this is controlled by diversion ditches and buffer strips of sod. The steeper areas are mainly idle land or are used for permanent pasture. The blufflike areas adjacent to Seneca Lake have never been cleared of their original forest growth.

Very little fertilizer is used on this soil, and yields are low. Hay yields about 1 ton and wheat from 12 to 18 bushels an acre. Fifteen percent of the land is covered with timber, 25 percent is used as pasture, 25 percent is idle, 15 percent is hay land, 10 percent is used for wheat, and the rest is used for miscellaneous crops, such as orchard fruits, beans, oats, and corn.

Lansing silt loam.—Lansing silt loam occurs in a transitional zone between the high limestone glacial till underlying the Honeoye soils and the till composed largely of shale and sandstone fragments. This soil is everywhere alkaline in the subsoil, generally at a depth of more than 30 inches. Drainage is similar to that of the Darien soils, with which this soil merges in the vicinity of Ovid.

The 6-inch surface layer is dull grayish-brown mellow silt loam with a small content of shale and sandstone fragments. The subsurface layer, which reaches a depth of 18 inches, is yellowish-brown moderately compact gritty silt loam faintly mottled with yellow, brown, and gray. The subsoil is yellowish-brown or light grayish-brown compact gritty silt loam containing a large quantity of shale and sandstone fragments and in places a few limestone fragments. The upper part of the subsoil is mottled, but the color is uniform below a depth of 30 inches. The parent material below a depth of 30 to 36 inches is compact gritty silt, which rests on bedrock at a depth of 4 to 20 feet.

As mapped south of Lodi along Seneca Lake, this soil has a deeper yellow color and contains more sandstone fragments than it does along Cayuga Lake, but mottling is not so pronounced. Some of the areas near Lodi also have an open friable subsoil similar to that of the Wooster soil, except that the material has an alkaline reaction.

The friable subsoil makes this inclusion somewhat superior to the typical soil, as it does not erode so easily and allows better penetration of roots.

The relief is undulating to rolling, with some 8- to 15-percent slopes adjacent to the lakes. The soil has developed from glacial till derived mainly from the local shale and sandstone rocks. Limestone fragments are most common on the slopes adjacent to the lakes.

Lansing silt loam is considered a good soil and is used for general farm crops and fruit. Apples, peaches, and grapes are limited to the areas near the lakes, where the danger from killing frosts in late spring is less. The apple orchards generally are sodded, but grapes and peaches are clean cultivated and subject to severe erosion on some of the steep slopes. Although diversion ditches and sod cover are not used much at present in the vineyards and peach orchards, these measures of controlling erosion are necessary if production is to be maintained.

Alfalfa, wheat, oats, beans, cabbage, corn, and timothy and clover hay are the important crops grown. A 4- or 5-year rotation of hay, corn, and wheat followed by a cash crop of beans or cabbage is practiced. Alfalfa and medium red clover fields usually receive a light application of lime to insure a good catch. Land for corn, oats, and wheat is fertilized with 150 to 250 pounds of 20-percent superphosphate to the acre. Land devoted to wheat and beans frequently receives 150 to 300 pounds of complete fertilizer. Land for cabbage always receives complete fertilization and sometimes lime.

Approximate acre yields are 25 bushels of wheat, from 30 to 45 bushels of oats, 15 bushels of field beans, 2 tons of alfalfa, 8 to 10 tons of corn silage, and 8 tons of cabbage. Peaches yield an average of 110 bushels and apples 150 bushels.

Some farms on Lansing silt loam are devoted to dairying, but an inadequate supply of water is a limiting factor on many of them. A fairly large area of this soil is mapped, of which about 25 percent is in wood lots, 15 percent in pasture, 20 percent in hay, 10 percent in wheat, 10 percent in corn, 5 percent in beans and cabbage, 10 percent in orchards and vineyards, and about 5 percent is idle.

Lansing silt loam, shallow phase.—Lansing silt loam, shallow phase, is associated with the Darien and Ovid soils, as well as with typical Lansing silt loam, from Waterloo south to the southern county line. The largest areas are in the towns of Fayette and Ovid. This soil is characterized by a grayish-brown mellow shaly silt loam surface soil overlying yellowish-brown heavy silt loam, which in places is faintly mottled and somewhat dense. Many thin and soft partly weathered shale fragments are mixed with the material. Shale bedrock occurs at a depth of 12 to 30 inches. As a whole, this shallow soil has a much lower agricultural value than the typical soil, yields averaging only about 60 percent of what they do on the deeper soil. Where bedrock lies no deeper than 18 inches below the surface the land is practically nonagricultural because of extreme dryness late in the season. Areas in which the soil is deeper are used for general farm crops in conjunction with other soils on the farm. North of the Tompkins County line on the slope to Cayuga Lake there is a strip of this soil one-fourth to one-half a mile wide and 3 miles long where considerable fruit is produced. The extreme shallowness of the soil severely limits penetration of roots, and lack of moisture is very

frequently a limiting factor. Yields of peaches and apples average from one-third to one-half of what they do on the deeper soil. Beans, wheat, alfalfa, oats, and corn are grown on the shallow phase of Lansing silt loam in the vicinity and north of Ovid. Approximate acre yields of these crops are 12 bushels of beans, 12 to 18 bushels of wheat, $1\frac{1}{2}$ tons of alfalfa, 30 bushels of oats, and 6 to 8 tons of corn silage. The better areas receive the same fertilization as the deeper soil. Pastures are poor late in the season. Approximately 10 percent of this soil is in wood lots, 20 percent in pasture, 20 percent in hay land, 10 percent in wheat, 10 percent in beans, 15 percent in oats, and 15 percent in corn.

Lansing silt loam, shallow steep phase.—The shallow steep phase of Lansing silt loam occupies the slopes adjacent to Seneca and Cayuga Lakes in the southern part of the county. These slopes, which range in gradient from 20 to 45 percent, are dissected by numerous V-shaped gorges that have been cut into bedrock by small intermittent streams. Numerous ledges and outcrops of rock are common on these steep slopes, a great part of which has never been cleared of timber. In the woods where erosion has not been too active, the soil has a thin grayish-brown granular silt loam surface soil and a yellowish-brown friable subsurface soil of silt loam texture. Between depths of 12 and 24 inches the subsoil is light yellowish-brown friable silt loam resting on bedrock. The few areas that have been cleared are too steep to cultivate; they are used as pasture land and furnish fair pasturage during the early part of the season. Care has to be exercised in the use of these pastures as overgrazing results in breaking the sod cover, after which gullies form rapidly. About 75 percent of the area of this soil is in woods, and 25 percent is used as pasture land.

Farmington loam.—Farmington loam is an inextensive soil. The largest area is in the town of Fayette 3 miles south of Seneca Falls. Some small areas are near Ovid. This soil has an 8-inch surface layer of brown or grayish-brown mellow loam and a subsurface layer of friable brown silt loam. The subsoil between depths of 18 and 30 inches is grayish-brown or dark-gray friable loam resting on limestone bedrock. In places the soil has a rather dark color imparted by black shales that contribute to the parent material. Here and there chips and fragments of limestone are scattered over the surface and mixed with the soil.

This soil has developed from a thin mantle of glacial till and not from materials produced through the weathering in place of the underlying rock. The relief is level to gently undulating. Both surface and internal drainage are good. Excess subsoil moisture passes off through joint planes in the bedrock. The reaction of the surface soil is neutral to slightly alkaline, and the subsoil is alkaline to calcareous.

Farmington loam is used in conjunction with other soils, as very few fields are situated entirely on this type of soil. The main crops are wheat, corn, beans, and hay. Crops do not suffer from deficient moisture except on the areas where bedrock is 2 feet or less from the surface. Fruit is not grown on Farmington loam, and no orchards should be planted on it because of the limited depth available for development of roots. Alfalfa yields well at the first cutting;

second cuttings, however, are short, as a result of the limited water supply.

Fertilizer practices are similar to those on the Lansing soils. Phosphate is applied for grain crops, and complete fertilizers are only infrequently applied for beans and wheat. Little or no lime is used. Wheat yields from 18 to 25 bushels an acre, beans 15 bushels, alfalfa 1½ tons, and corn 6 to 8 tons of silage.

Approximately 20 percent of Farmington loam is in wood lots, 25 percent is hay land, 15 percent is devoted to wheat, 10 percent to beans, 15 percent to corn and oats, and 15 percent to pasture. Native pastures support good grasses and furnish good grazing in the spring, but late-season pasture on this soil is poor because of lack of moisture.

Ovid silt loam.—Only a small total area of Ovid silt loam is mapped. This soil occurs in the vicinity of Sheldrake near Cayuga Lake, where the land is undulating, level, or sloping. The slopes range from 5 to 10 percent.

The surface soil to a depth of 6 or 8 inches is grayish-brown heavy acid silt loam that tends to puddle if worked when moisture conditions are not optimum. The subsurface soil, which reaches to a depth of 17 inches, is yellowish-brown slightly compact acid silt loam mottled with gray, yellow, and brown. The material breaks out into small irregular vesicular lumps. The subsoil is somewhat reddish brown or strong-brown compact hard silty clay loam to a depth of 36 inches. It exhibits an imperfectly developed prismatic structure. Segregation of lime in the form of concretions and nodules occurs at the lower limits of the layer. The material between depths of 3 and 5 feet is brown hard compact gritty silt loam with numerous very dark brown stains. It has a well-developed fragmental structure, the aggregates ranging in diameter from one-fourth to one-half of an inch. Lime streaks and nodules are numerous. The substratum is compact glacial till containing a large quantity of limestone gravel, stones, and boulders.

In most areas surface drainage is fairly well developed, but movement of water through the soil is slow, owing to the compact character of the lower part of the subsoil and the substratum. Only small quantities of gravel and stone are scattered over the surface; the subsurface layer and the upper part of the subsoil are generally free of such material. Roots penetrate the soil readily to a depth of 36 inches, but compaction below this depth is sufficient to hinder materially their growth into the lower subsoil layer.

Ovid silt loam has developed from glacial till and a mixture of till and lacustrine sediments. In places the parent material was composed of a thin smear of lacustrine sediment overlying the till. The till making up the substratum is like that underlying Honeoye silt loam.

This soil is used for wheat, corn, oats, hay, and beans and for pasture land. Little fertilizer other than superphosphate and manure is used. Most of the farms on which this is an important soil derive the greater part of their income from the sale of dairy products. Approximate average acre yields are 15 to 20 bushels of wheat, 1½ tons of hay, 35 to 40 bushels of oats, and 6 to 10 tons of corn silage. Pastures nearly everywhere are good. Improvement

consists primarily in applying superphosphate fertilizer, after which Canada bluegrass is replaced by Kentucky bluegrass and wild white clover. Very little lime is used, and fair stands of medium red clover are possible without the use of this amendment. New seedings of alfalfa, however, would respond to lime, as the surface and sub-surface layer are generally acid in reaction.

Approximately 20 percent of Ovid silt loam is occupied by wood lots, 10 percent is idle, 30 percent is pasture land, 20 percent is used for hay, 10 percent for wheat, and the rest for corn silage, oats, and miscellaneous crops.

Romulus silty clay loam.—Romulus silty clay loam occurs only in the central part of the county, from the village of Ovid northward into the town of Fayette. The relief is slightly undulating to flat, and drainage is slow. The cultivated soil has an 8-inch gray or dark brownish-gray lumpy silty clay surface soil, underlain to a depth of 14 inches by yellowish-gray heavy irregularly blocky silty clay loam highly mottled with yellow, brown, and gray. The subsoil between depths of 14 and 30 inches is gray or light-gray tight calcareous clay showing a well-developed fragmental structure when dry. Shale bedrock is reached at a depth ranging from 30 to 40 inches. Large quantities of partly weathered shale fragments and here and there some limestone gravel and a few stones are present in the subsoil. The surface soil is slightly acid, the subsurface soil is neutral, and the subsoil at a depth of 30 inches is alkaline in reaction.

This soil has developed from thin glacial till deposits and materials produced through the weathering in place of the underlying rocks. The till was derived principally from the local dark-colored shales, although in places a few limestone fragments occur in the parent material. Drainage is slow or poor, because the nearly level relief slows up surface run-off and the heavy-textured subsoil with shale at a comparatively slight depth does not allow free movement of water through the soil.

Romulus silty clay loam is used principally for hay and pasture, although buckwheat, oats, and corn can be grown on the better drained areas. Yields are rather low. Timothy and clover yield about 1½ tons of hay, oats 30 to 40 bushels, buckwheat 20 bushels, and corn 6 to 8 tons of silage an acre. Alsike clover is preferred to medium red clover on this heavy soil. The only fertilizer used is 20-percent superphosphate, and applications for grain crops range from 150 to 300 pounds an acre. Native pastures on this heavy-textured soil are better than average. The predominant pasture grasses are Canada bluegrass and redtop. The use of phosphate on pastures greatly improves their carrying capacity and encourages the growth of Kentucky bluegrass and wild white clover. Some grapes are grown, but they are not well suited to this soil. Yields are about half as large as those obtained on Lansing silt loam.

Any practice that improves surface run-off of excess water would result in higher yields. Some ditching has been done, but the flat terrain and the lack of outlets make this a problem. Tile is not always effective, because of slow lateral movement of water through the soil. Approximately 15 percent of the soil is in wood lots, 45

percent is used for pasture, 20 percent for hay, and 20 percent for oats, corn, and wheat.

Romulus silty clay loam, shallow phase.—The shallow phase of Romulus silty clay loam has developed from materials produced largely through the weathering in place of the underlying soft dark calcareous shales. Bedrock lies from 12 to 24 inches below the surface. The 8-inch surface layer is gray or dark-gray cloddy silty clay loam, underlain to a depth of 14 inches by yellowish-gray clay mottled with brown and gray. The material of this layer is dense and tight, and on drying it assumes a coarse blocky structure. The subsoil is compact gray clay resting on partly weathered shale. This shallow soil occupies flat to slightly undulating areas. Both surface and internal drainage are slow. The surface soil is neutral or alkaline, and the subsoil and parent material are calcareous.

The soil is best suited for timothy and alsike clover hay and pasture land. A few acres with open-ditch drainage are used with fair results for buckwheat and other small grains. No lime and very little commercial fertilizer are used. Small applications of superphosphate may be used where buckwheat, oats, and wheat are grown. Approximate acre yields are $1\frac{1}{2}$ tons of hay, 15 bushels of buckwheat, 30 to 40 bushels of oats, and 12 to 15 bushels of wheat. Pastures are fair in the spring, but they dry up in the late summer. The native grasses are mainly Canada bluegrass and redtop.

The shallow phase of Romulus silty clay loam has a rather low agricultural value; it is slow to dry in the spring, and, when it does dry, the surface layer bakes badly. Approximately 10 percent of the area is in wood lots, 10 percent is idle, 40 percent is used as pasture, 20 percent for hay, 10 percent for buckwheat, and 10 percent for other grain crops.

Kendaia silt loam.—Kendaia silt loam is extensively developed in the central part of the county, chiefly near Kendaia. Although internal drainage is imperfect, this is considered a good soil and is used for the production of a wide range of crops. The 8-inch surface soil under cultivation is grayish-brown mellow silt loam well supplied with organic matter. Variable quantities of angular and subangular stone fragments are scattered over the surface. The subsurface soil to a depth of 17 inches is moderately compact lumpy silty clay loam highly mottled with yellow, brown, and gray. Shale fragments and limestone gravel are mixed with the soil material. The subsoil between depths of 17 and 40 inches is mottled very compact hard gritty silt loam or silty clay loam that breaks into large irregular rather dense lumps. Roots penetrate this highly calcareous subsoil material with difficulty. The substratum is light-gray compact limestone till.

Kendaia silt loam occupies large continuous level to slightly undulating areas. Surface drainage is fair, but the compact subsoil impedes movement of water through the soil. The parent material is glacial till containing many limestone and dark shale fragments, as does the parent material of the associated Honeoye and Darien soils.

The principal crops are alfalfa, wheat, oats, field beans, timothy and clover hay, and fruit. Normally, a soil with so highly mottled a subsoil would be too wet for success with alfalfa and wheat. Kendaia silt loam, however, is used with good results for these crops in places where it is artificially drained. The compact subsoil inter-

feres with the penetration of roots, a greater disadvantage to the growth of apple trees and alfalfa than to that of the more shallow-rooted crops, such as beans and wheat.

Rotations include hay, mainly alfalfa, followed by corn, a small grain, and a cash crop of beans. Rotated pastures of sweetclover also make up a part of the rotation. Superphosphate, the main fertilizer used, is applied in quantities ranging from 200 to 600 pounds an acre. Small quantities of complete fertilizer may be used on wheat and beans. Lime is not necessary for the successful growth of alfalfa.

Yields of fruit are low on this soil, as the compact subsoil is not conducive to deep growth of roots and the imperfect drainage tends to reduce yields. Native pastures are mainly of Canada bluegrass, but applications of phosphate result in a rapid transformation to Kentucky bluegrass and wild white clover.

Approximate acre yields are as follows: Wheat, 20 to 25 bushels; oats, 40 bushels; beans, 12 to 18 bushels; alfalfa, 2 to 3 tons; corn silage, 8 to 10 tons; and apples, 75 to 100 bushels.

Lyons silty clay loam.—Lyons silty clay loam occupies swales, depressions, and streamheads in association with the Honeoye, Darien, Lansing, and Kendaia soils. The 8- to 10-inch surface layer is dark-gray or nearly black silty clay loam, granular in the virgin state but cloddy and lumpy when plowed. The subsurface soil to a depth of 18 inches is light-gray compact gritty heavy silt loam, highly mottled with gray, yellow, and brown. The subsoil is compact hard gritty silt loam with a blocky structure. It rests on a substratum of highly calcareous glacial till. The surface soil is neutral or slightly acid and the subsurface soil is alkaline in reaction. Free lime is present at a depth of about 18 inches, and large quantities of limestone gravel, stones, and boulders are mixed with the soil material.

Under natural conditions surface and internal drainage are poor. Some of the more depressed areas are covered with water much of the time. Such areas never have been cleared of their original forest growth. Most of the cleared areas are too wet for grain crops and are used as permanent pasture. The land may be plowed and planted to corn or wheat in places where it has been possible to hasten surface run-off by ditching. Even though drainage is improved by ditching, the soil is still too wet for good success with grain crops and can be used to better advantage for timothy and alsike clover hay.

Hay yields 1 to 1½ tons an acre, wheat 20 bushels, and corn silage 6 to 8 tons. This type of land makes good permanent pasture and usually has a good turf of Canada bluegrass, redtop, Kentucky bluegrass, and wild white clover. About 15 percent of this soil is forested, 60 percent is used as pasture, 15 percent for hay, and 10 percent for grain crops.

SOILS OF THE APPALACHIAN PLATEAUS, SOUTHERN NEW YORK SECTION

The southern part of Seneca County is on the northern edge of the Southern New York section of the Appalachian Plateaus⁶ and

⁶ FENNEMAN, N. M., and JOHNSON, D. W. PHYSICAL DIVISIONS OF THE UNITED STATES. (Map.) U. S. Geol. Survey (n. d.).

marks the transition from the plateau to the lower lying glacial till plain of west-central New York (pl. 4). Some of the soils classified in this group overlap the two areas.

Most of the soils in this section are developed from glacial deposits composed largely of sandstones and shales, with a very small proportion of limestone and other rocks in some of them. Most of the glacial deposits are comparatively shallow, and bedrock is near the surface in many places.

Wooster gravelly loam is developed on undulating to rolling moraines, largely from deep deposits of loose sandstone and shale fragments. Lordstown flaggy silt loam is developed from shallow noncalcareous sandstone and shale till underlain by bedrock of sandstone and shale. Both of these soils are well drained. Imperfectly drained Langford soils, poorly drained Erie soils, and permanently wet Chippewa soils are developed from compact glacial till composed largely of sandstone and shale fragments and a small proportion of limestone and other rocks. Both the Langford and Erie soils have hardpans and are somewhat droughty in late summer.

Wooster gravelly loam.—Wooster gravelly loam has an undulating or rolling relief, with 5- to 12-percent slopes, and is associated with the Langford and Lordstown soils in the southern part of the county. Both surface and subsoil drainage are thorough—a factor in the higher valuation of this soil over the soils with which it is associated.

Only a small total area is mapped in Seneca County, but extensive areas occur in adjoining counties. The 6- to 8-inch cultivated surface layer is composed of grayish-brown mellow gravelly loam, the gravel being mainly subangular fragments of shale and sandstone. The subsurface layer to a depth of 16 inches is light yellowish-brown firm silt loam containing less gravel than the surface layer. It grades into pale-yellow firm but not compact or hard gravelly silt loam. Numerous thin angular fragments of dense fine-grained sandstone and shale from 1 to 8 inches in diameter are mixed with the subsoil material. The substratum is composed of glacial till derived principally from local materials with a few crystalline rocks. The soil is acid throughout.

The few small areas of Wooster gravelly loam are developed in the town of Lodi. The soil is used in conjunction with the more extensive Langford silt loam for timothy and clover hay, oats, buckwheat, and silage corn. It is well adapted to potatoes and beans,

EXPLANATORY LEGEND FOR PLATE 4

VERTICAL AERIAL PHOTOGRAPH SHOWING THE LONG AND RATHER STEEP SLOPE FROM THE APPALACHIAN PLATEAUS TO SENECA LAKE, SOUTHWEST OF LODI, SENECA COUNTY, N. Y.

- A, Erie silt loam.
- B, Langford silt loam.
- C, Lansing silt loam.
- D, Honeoye silt loam.
- E, Honeoye silt loam, eroded phase.
- F, Rough broken land.
- G, Lordstown flaggy silt loam.
- H, Chippewa silty clay loam.
- I, Vineyard on Honeoye silt loam.



but, owing to its small acreage, it is not used much for these crops. Alfalfa can be grown successfully with the addition of lime. The soil is well drained and can be worked under a fairly wide range of moisture conditions, but it has sufficient body to have good moisture-holding capacity. It responds well to fertilization and is not readily leached.

The only fertilization that the soil receives other than farm manure is 20-percent superphosphate, which is applied in quantities of 150 to 400 pounds an acre for the grain crops. Approximate average acre yields of crops are 1½ tons of hay, 35 bushels of oats, 25 bushels of buckwheat, and 8 tons of corn silage.

Lordstown flaggy silt loam.—Lordstown flaggy silt loam is an extensive soil associated with Langford silt loam. Bedrock lies at a slight depth. The soil occurs on slopes ranging in steepness from 8 to 25 percent. It is differentiated from associated soils on the basis of its shallowness, good drainage, and acid reaction.

The normal 8-inch surface layer consists of yellowish-brown or light grayish-brown mellow granular silt loam. Numerous fragments of shale and sandstone of a composition similar to that of the underlying rocks are scattered over the surface and mixed with the soil material. The subsurface layer to a depth of 12 to 16 inches is brown friable generally stony silt loam or heavy silt loam. This grades into yellowish-brown or light yellowish-brown firm silt loam resting on shale and sandstone at a depth of 24 to 36 inches. Outcrops of the rock are fairly common on the steeper slopes. Enough rock fragments are on the surface to impart a flaggy character to the soil. Although they interfere to a certain extent with cultivation, these fragments in no sense make the soil nonagricultural. In frequently used fields the larger flaggy stones are removed. Stone fences and huge stone piles in field corners are characteristic of fields of Lordstown soils.

Drainage is well established, the slope allows rapid surface runoff, and numerous joint planes in the underlying rock insure downward movement of water through the soil. Although absorption of water is fairly rapid, washing occurs on slopes, especially where fields are plowed up and down the hill. Lordstown flaggy silt loam is acid throughout, and the bedrock also is acid.

The Lordstown soils are important throughout southern New York and in some sections are used extensively for the production of potatoes, a crop for which the soil is well adapted. In this county, however, Lordstown flaggy silt loam is inextensive and occurs in a section that is largely abandoned, owing to the poor surrounding soils. The areas under cultivation are used to grow corn silage, buckwheat, timothy and clover hay, and oats. No complete fertilizer is used, but superphosphate is used on the grain crops by some farmers. Lime is necessary for the successful growth of clover. The fairly strongly acid reaction necessitates a rather heavy application of this amendment. One ton or more of ground limestone should be used for new seedings. Approximate average acre yields of crops, with 200 to 400 pounds of superphosphate an acre on land for grain and enough lime to insure the right reaction for clover, are 18 bushels of buckwheat, 1½ tons of hay, 8 tons of corn silage, and between 30 and 45 bushels of oats.

About 10 percent of the land is forested, 10 percent is used for hay, 15 percent for pasture, and 10 percent for various field crops, and the rest has been abandoned.

Langford silt loam.—As mapped in Seneca County, Langford silt loam represents a transition between the calcareous soils of the limestone area and the acid soils of the shale area in the Southern New York section of the Appalachian Plateaus. Sufficient lime-bearing material was carried by the glacier to give an alkaline reaction to the substrata of the subsequently developed soils. This condition does not extend far south of the county line, and the Canfield, Volusia, and Lordstown soils with their acid parent materials occur only a short distance south of the county.

Langford silt loam has a fair agricultural value. The principal crops grown are those used in support of dairying.

Under cultivation the surface soil consists of light grayish-brown or dull-brown mellow silt loam overlying yellow or pale grayish-yellow friable smooth silt loam, which continues to a depth of 14 inches. This grades into compact lumpy silty clay loam highly mottled with yellow, brown, and gray. The subsoil between depths of 22 and 40 inches is gray compact mottled silty clay loam with more stone fragments than the layers above. It is a semihardpan and has a definitely developed irregular blocky structure. The substratum is olive-drab compact stony slightly calcareous glacial till.

A large continuous area of this soil lies in the extreme southern part of the county midway between the two lakes. The land is rolling, with the moderate 5- to 15-percent slopes typical of southwestern New York. The parent material is derived from glacial till composed mainly of products of the underlying shale and sandstone rocks. Enough limestone is present in the till to give it an alkaline reaction, but the surface and subsurface layers of the soil are acid.

Langford silt loam is devoted to the production of timothy and clover hay, oats, silage corn, and pasture, which are used as forage for dairy herds. One ton or more of lime is used for new seedings, and from 150 to 400 pounds of superphosphate are applied for oats and corn. The soil does not support so prosperous an agriculture as do the Lansing and Honeoye soils. Yields are approximately 10 percent less than those obtained on Lansing silt loam, except that hay produces higher yields on the Langford soil. Native pastures are weedy and poor. Good results are obtained with superphosphate, which stimulates the growth of Kentucky bluegrass and wild white clover.

A fairly large total area of this soil is mapped. About 20 percent of the land is in wood lots, 25 percent is idle, 25 percent is used as pasture, 20 percent for hay, and 10 percent for oats and corn.

Erie silt loam.—Erie silt loam is associated with Langford silt loam along the southern edge of the county. Under cultivation it has a light-gray or pale grayish-brown cloddy surface layer 6 inches thick. The subsurface layer between depths of 6 and 10 inches is pale-yellow friable heavy silt loam mottled with brown and gray. This rests on a hard compact highly mottled silty clay loam hardpan, which continues to a depth of 20 inches. Water and roots penetrate this layer with difficulty. The basic color is olive gray. It is mottled with yellow, brown, and gray. The subsoil is hard and compact

olive-gray till. Angular sandstone fragments, ranging from 1 to 8 inches in diameter, are mixed through the soil mass. This soil has an acid surface soil and subsoil and an alkaline parent material.

This soil occurs in rolling areas or on slopes ranging from 5 to 15 percent. It has developed from glacial till derived principally from the underlying rocks. Sufficient lime-bearing material from the north was carried in by the drift, however, to give an alkaline reaction to the substratum. Surface drainage is fair, but the compact slowly pervious subsoil results in very slow internal drainage. The soil dries out excessively during late summer.

Erie silt loam is not a good soil, and much of the land once cleared and farmed has been abandoned. The farms operating at present produce timothy and clover hay, oats, and corn for silage. Some sheep are raised. Native pastures are poor, as they are composed mainly of weeds and poverty oatgrass; but good grass can be obtained with phosphate fertilization. Crop yields are considerably less than on the Lansing or Honeoye soils with the same fertilization. The present tendency is for the land to be abandoned or sold to public agencies for reforestation. Approximate acre yields are 1 ton of timothy and clover hay, 30 to 40 bushels of oats, 15 to 20 bushels of buckwheat, and 6 to 8 tons of corn silage. These yields are obtained when superphosphate is used on grainfields, manure on cornland, and light applications of limestone on land newly seeded to clover.

About 40 percent of the land is idle or abandoned, 25 percent is in wood lots, 15 percent in pasture, 15 percent in the production of hay, and the rest is used for oats, corn, and buckwheat.

Chippewa silty clay loam.—Chippewa silty clay loam occupies narrow sags, swales, or depressions that are surrounded by the better drained Langford, Erie, Lordstown, and Wooster soils. It has an 8- to 10-inch surface layer of dark-gray or black silty clay loam, underlain to a depth of 16 inches by firm silty clay loam highly mottled with brown, yellow, and gray. The subsoil is very hard compact stony silt loam. Angular stones and gravel from local shale and sandstone rocks are mixed through the soil. The reaction is acid in the surface soil and alkaline in the subsoil. Associated elsewhere with the Volusia and Lordstown soils, however, Chippewa silty clay loam is acid throughout.

In this county Chippewa silty clay loam is an inextensive soil that is too poorly drained for anything except pasture; probably 35 percent of the total area is permanently wet and is covered either with timber or with a growth of reeds, sedges, and coarse swamp grass. Woodland occupies 30 percent of the soil, 30 percent is probably associated with abandoned land, and 40 percent is pastured at present.

SOILS OF THE GLACIAL OUTWASH PLAINS

Members of the Palmyra and Chenango series are developed from gravelly deposits on glacial outwash plains. Both soils are thoroughly drained through the gravelly substrata. The Palmyra soils are agriculturally superior to the Chenango soils because they are developed from gravel that contains a high proportion of limestone pebbles and finer sediments.

Palmyra gravelly loam.—Palmyra gravelly loam is an inextensive soil. It occurs in the northwestern corner of the county and in places along the shores of Seneca and Cayuga Lakes. It occupies level benches.

The 8- to 10-inch surface layer is brown or grayish-brown loose mellow gravelly loam overlying a yellowish-brown firm gravelly silt loam subsurface layer about 10 inches thick. The subsoil and the substratum are composed of sand and gravel, which in most places is assorted into beds of gravel and sand below a depth of 36 inches. The surface soil contains a fair quantity of organic matter and is slightly acid in reaction. The subsurface soil is slightly acid or neutral, and the subsoil at a depth of about 24 inches is calcareous. Much of the gravel in the lower part of the subsoil and in the substratum is composed of limestone. The gravel in the surface and subsurface layers is derived chiefly from red Medina sandstone, crystalline rocks, limestone, and to less extent shale and gray sandstone. All the material is water-worn and rounded.

The parent materials were laid down as deltas and outwash plains. The included soil in areas along the lake shores has developed from sediments deposited as alluvial fans, and such areas are not used much for agriculture, but they furnish sites for summer cottages and recreational areas.

Typical Palmyra gravelly loam, however, is an excellent soil. The acreage in Seneca County is small, but, with the exception of the alluvial fans included in mapping, all the land is under cultivation. Beans and cabbage are grown throughout practically the entire area, but wheat, alfalfa, peas for canning, and corn all yield well. The excessive drainage through the subsoil causes crops to suffer at times from lack of moisture in the late summer. Lime is unnecessary for alfalfa and other legumes, but all crops respond to superphosphate, which is the most common commercial fertilizer used. Beans yield an average of 18 bushels to the acre, and cabbage 10 tons.

Chenango gravelly loam.—Along the Seneca-Schuyler County boundary line are two very small areas of Chenango gravelly loam that occupy moderately sloping positions about 1½ miles back from Seneca Lake. This soil resembles Palmyra gravelly loam, but it is strongly acid in reaction and has little or no limestone gravel in the subsoil and substratum.

The 8- to 10-inch surface layer of grayish-brown loose gravelly loam is underlain to a depth of 20 inches by light yellowish-brown firm gravelly loam or silt loam containing more fine material than the surface soil. This layer rests on sand and gravel, which in places is assorted into layers below a depth of 36 inches. All the materials from which Chenango gravelly loam has developed were derived from local shale and sandstone. In Seneca County the gravel is finer and less rounded than that of the typical Chenango soils, as developed elsewhere. The material in Seneca County was deposited as small deltas or in connection with moraines as small outwash plains. Areas of this soil in this county are not used much, owing to their small size and to the steepness of the surrounding slopes. Typical Chenango gravelly loam, however, is a good soil, capable of intensive use for such crops as beans, potatoes, corn, alfalfa, clover, and oats. It is acid throughout and needs lime for

legumes. Its excellent physical condition is conducive to a favorable response to fertilization and good management. The main disadvantage of the Chenango soils is their loose open gravelly character, which is responsible for their low water-holding capacity and their tendency to leach rapidly. Therefore, applications of lime and fertilizer are necessary at more frequent intervals than on heavier textured soils.

SOILS OF THE FLOOD PLAINS

The flood plains cover a very small area in Seneca County. Wayland silt loam and alluvial soils, undifferentiated, are included in this group.

Wayland silt loam.—Wayland silt loam consists of imperfectly to poorly drained recent alluvium bordering the Montezuma Marsh and some of the larger streams. It has an 8-inch dark-gray granular heavy silt loam surface soil, underlain by a highly mottled grayish-brown silty clay upper subsoil layer. The lower subsoil layer in many places is bluish- or steel-gray tough plastic clay.

Subsoil drainage is always poor; the water table frequently stands at a depth of 12 to 18 inches. The total area of 3,328 acres is used exclusively for pasture. Where the soil is not too wet, bentgrasses make an excellent growth; the wetter areas support sedges, rushes, reeds, and coarse grasses that are not palatable to livestock. Approximately 60 percent of the land is wooded; about one-half of the cleared areas is good to fair pasture, and the other half is poor pasture.

Alluvial soils, undifferentiated.—The areas indicated on the map as alluvial soils, undifferentiated, include narrow bottoms where the soil areas are too small to show as individual types or phases. The materials are variable as to texture and drainage. Most of the soil materials are alluvium and are subject to periodic flooding; small areas, however, occupy terrace positions. Textures range from coarse gravel stream wash to silty clay loam in channels with less gradient. The areas of undifferentiated soils are not used as cropland to a significant extent, but they furnish some pasturage in the larger areas. Much of the land is not used at all, as it is still forested.

SOILS OF THE GLACIAL LAKE PLAIN

Soils of the glacial lake plain vary widely in color, texture of surface soils and subsoils, natural rate of drainage, and suitability for crops. Most of the land is nearly level, but the surface in places is undulating (pl. 5). The soils are developed from various kinds of sediments deposited in and around a glacial lake that was drained a long time ago by natural causes.

The Dunkirk and Collamer soils are developed from calcareous stratified silt, fine sand, and some clay. Under natural conditions, the Dunkirk soils have medium to rapid internal drainage, but the Collamer soils are more slowly drained and consequently are less suitable for fruit and alfalfa.

The Schoharie, Poygan, and Toledo soils are developed from fairly heavy light-red calcareous clays. External drainage is medium on the light-colored Schoharie soils, slow on the dark-colored Poygan soils, and very slow or completely lacking on the very dark colored

Toledo soils, under natural conditions. Internal drainage is slow to very slow in all these soils, because the parent material contains a high percentage of plastic and slowly permeable clay. Artificial drainage is fairly successful where suitable outlets are available.

The Ottawa, Berrien, and Granby soils are developed from sands that were deposited in or near the edges of the old glacial lake. Since deposition, the sands of the well-drained and light-colored Ottawa and imperfectly drained Berrien soils have been more or less reworked by the wind so that the land surface has the appearance of low dunes and drifts. The poorly drained and dark-colored Granby soils occupy depressions between areas of the Ottawa and Berrien soils. Artificial drainage is readily provided in the Granby soils where suitable outlets are available.

Dunkirk fine sandy loam.—Dunkirk fine sandy loam has an 8-inch surface layer of grayish-brown or yellowish-brown mellow fine sandy loam. The subsurface layer to a depth of 14 inches is yellowish-brown firm fine sandy loam, or, in places, very fine sandy loam, showing faint mottles of brown and gray. The subsoil to a depth of 36 inches is slightly compact light yellowish-brown very fine sandy loam that grades through lighter textured material into calcareous laminated silts and fine sand. Variations in this soil include fine sand in some places and very fine sand in others, and in places the depth to silt ranges from 24 to 40 inches.

The typical soil is medium to low in organic matter, but the soil in slight depressions has a grayer surface soil and contains more organic matter. The surface and subsurface layers are acid, but the silt in the lower subsoil layer generally carries free lime. Both surface and internal drainage of the typical soil are good. The parent materials were deposited as lake-laid sediments and are characteristically free from stones and gravel. In small spots the surface soil has been modified to a slight extent by wind-deposited sand.

Although it covers a small total area, Dunkirk fine sandy loam is a very productive soil. It is easy to work, has sufficient moisture-holding capacity, and can be worked early in the spring. Such crops as potatoes, cabbage, beans, and peas for canning do very well on this soil. Apple trees root deeply and maintain high average yields, but fruit growing is not important because of the comparatively small bodies of soil. The main crops are potatoes, beans, alfalfa, wheat, and cabbage. Approximate average acre yields of these crops are: Potatoes, 200 bushels; beans, 15 bushels; alfalfa, 2½ tons; wheat, 30 bushels; and cabbage, 8 tons. Fertilizer practices call for 300 to 500 pounds of commercial fertilizer for cabbage and the same quantity for potatoes where these are the main crop. Land devoted to beans frequently receives com-

EXPLANATORY LEGEND FOR PLATE 5

VERTICAL AERIAL PHOTOGRAPH OF AREA WEST OF WATERLOO AND NORTH OF THE BARGE CANAL IN SENECA COUNTY, N. Y.

- A, Area of Berrien loamy fine sand.
- B, Area of Ottawa loamy fine sand.
- C, Wooded area of Carlisle muck.
- D, Granby fine sandy loam, used for pasture.
- E, Cultivated areas of Dunkirk fine sandy loam.
- F, Wind-eroded areas of Ottawa loamy fine sand.
- G, Made land along the Barge Canal.

plete fertilizer, but in smaller quantities than land devoted to cabbage or potatoes. Land for grain is fertilized mainly with superphosphate. New seedings of alfalfa need an application of lime to satisfy the needs of the crop until the roots are able to draw on the supply in the subsoil.

Most areas of this soil are north of Seneca Lake along the county line. A few very small ones are along the shore of Cayuga Lake north of Canoga. Probably 10 percent of the land has a forest cover, 10 percent is idle, 20 percent is used for pasture, 20 percent for wheat, 20 percent for hay, 10 percent for intertilled crops, such as cabbage and potatoes, and 10 percent for miscellaneous crops, such as peas, apples, and small fruits.

Dunkirk silt loam.—Dunkirk silt loam occurs mainly in the northwestern part of the county near the northern end of Seneca Lake. Smaller areas border the northern end of Cayuga Lake. Under cultivation this soil has a brown or grayish-brown mellow surface layer, except in those areas where the texture is heavier than typical. Here the soil is apt to become puddled if it is worked when the moisture content is too high. The subsurface layer, which lies between depths of 6 and 14 inches, is pinkish-brown blocky silty clay, in places faintly mottled with yellow and gray. The subsoil is composed of pale reddish-brown clay loam with rather distinctly developed breakage planes. The soil aggregates range from $\frac{1}{2}$ to 2 inches in diameter and are dense and tenacious. Movement of subsoil moisture is greatly facilitated by the well-developed cleavage planes between the aggregates. The subsoil continues to a depth of 30 inches. Below this depth the material consists of bedded pink or light reddish-brown calcareous silt, sand, and clay.

The surface and subsurface layers are slightly acid, but free lime occurs at a depth of 24 to 36 inches. The supply of organic matter is rather low, and better tilth is brought about by the incorporation of manure or other organic residues.

Dunkirk silt loam has developed from sediments laid down in still water; the absence of gravel and sand in the surface soil indicates thorough sorting of the parent material. The relief, for the most part, is undulating, but the areas along Cayuga Lake have moderately steep slopes. Surface drainage is good, and internal movement of water is medium to fairly rapid. The well-developed cleavage planes between the soil aggregates allow water to pass through the heavy subsoil material fairly rapidly wherever outlets are available.

Dunkirk silt loam is considered the most productive soil in the county. It cannot be worked under so wide a range of moisture conditions as the Honeoye soils, and it tends to puddle if worked when wet; but the land surface is sufficiently rolling to facilitate quick removal of surface water. The soil is used for the production of cash crops, such as cabbage, beans, and tomatoes. Wheat, oats, barley, corn, alfalfa, timothy, and clover are important crops. On farms where milk is produced commercially the rotation consists of 3 years of hay, either alfalfa or timothy and medium red clover, followed by corn, then by wheat or oats and barley. Superphosphate is applied for the grain crops in applications ranging from 150 to 300 pounds an acre. Manure is applied to the cornland and meadows. Wheatland receives from 150 to 200 pounds of a complete fertilizer, such as

4-8-12 or one of similar analysis. A fairly light application of lime may be necessary, in order to obtain a good catch of alfalfa or clover. Land for cabbage always receives complete fertilizer, generally from 250 to 300 pounds of 3-7-9. An application of 16-percent superphosphate or a light application of 2-8-10, or similar analysis, may be used for beans. Dunkirk silt loam is an important soil for apple orchards in other counties of the State. In Seneca County only one or two commercial apple orchards are located on this soil, but they maintain high average yields.

Acre yields of crops under the prevailing fertilizer practices are among the highest in the county. Wheat yields from 30 to 35 bushels, oats and barley 40 to 45 bushels, beans 20 bushels, cabbage 7 to 10 tons, alfalfa 2 to 3 tons, and corn silage 8 to 10 tons.

Dunkirk silt loam is subject to serious erosion even on the moderate slopes characteristic of this soil. It is free of gravel and stone; and, if it has no vegetative cover, moderately intense rains cause washing. The erodibility of this soil is recognized by the farmers, however, and in most places erosion is well controlled.

A fairly large total area of this soil is mapped. Approximately 15 percent of the land is in wood lots, 20 percent is used for pasture, 10 percent for wheat, 10 percent for oats and barley, 25 percent for hay, and the rest for various cash crops, orchards, and farmsteads.

This is an excellent soil for pasture, and there are many pure stands of Canada bluegrass. When it is seeded to Kentucky bluegrass and white clover, pasture of high quality is readily obtained. The addition of superphosphate markedly stimulates the growth of white clover.

Dunkirk silt loam, shallow phase.—The shallow phase of Dunkirk silt loam covers a comparatively limited area in the town of Fayette $2\frac{1}{2}$ miles south of Seneca Falls. Limestone bedrock lies from 2 to 3 feet below the surface. Except for its shallowness, it is not very different from typical Dunkirk silt loam. It has an 8-inch brown or grayish-brown mellow surface layer, underlain to a depth of 16 inches by light yellowish-brown firm silt loam, which in some places has a few brown stains. The material from a depth of 16 inches to bedrock is yellowish-brown firm silt loam with a well-developed prismatic structure. In places angular fragments of gravel and small stones are scattered over the surface and mixed with the upper part of the soil. The surface and subsurface layers are slightly acid, and the subsoil is neutral or alkaline in reaction. Drainage is well developed. The relief is undulating, conforming to the contour of the underlying limestone bedrock.

Dunkirk silt loam, shallow phase, is used principally for grain, hay, corn, and field beans. These shallow-rooted crops seem to do as well on this soil as on the typical soil. The water-holding capacity is high, and, since bedrock lies practically everywhere at a depth of 30 inches, enough water can be held for ordinary field crops. At present, apples are not grown to a great extent, and no orchards should be planted on this soil because the deep-rooted trees would suffer from a deficiency of moisture on this shallow soil. From 300 to 500 pounds of complete fertilizer is usually applied for cabbage, and sometimes from 150 to 250 pounds for beans and wheat. The most common analyses used are 2-8-10 and 4-8-4. Very little lime is used for hay

crops, which are predominantly clover and timothy. Alfalfa would respond to applications of lime. Superphosphate is sometimes used in place of complete fertilizer, especially if much manure is available.

Normal acre yields of the important crops are: Hay, $1\frac{1}{2}$ tons; wheat, 30 bushels; beans, 18 bushels; cabbage, 7 to 10 tons; and corn silage, 10 tons. Probably 15 percent of the land is in wood lots, 30 percent in hay, 20 percent in pasture, 15 percent in wheat, 10 percent in corn, and 10 percent in vegetable crops, such as beans and cabbage.

Collamer silt loam.—Collamer silt loam is an inextensive soil associated with the Dunkirk soils. It is distinguished from them by the grayer color of its surface layer and the light color and mottles of its subsurface layer—characteristics that are induced by imperfect drainage. The largest area of this soil is northwest of Waterloo; smaller ones are in the town of Fayette and elsewhere. The land is level to slightly depressed.

The 8-inch surface layer of grayish-brown mellow silt loam is underlain to a depth of 18 inches by light yellowish-brown or grayish-brown firm silt loam mottled with brown and gray. This material grades into yellowish-brown moderately compact faintly mottled silt loam. Between depths of 30 and 40 inches the material is stratified light-yellow or light-brown silt and clay. Free lime occurs at a depth of about 36 inches. In some places the substratum is tight compact clay; in others it is stratified clay and silt.

Collamer silt loam is used for the same crops as Dunkirk silt loam, but it is not so desirable a soil, as it does not dry so quickly and cannot be worked so early in the spring as that soil. The rainfall during the growing season in this section is rather light, and excess water is not usually a limiting factor in the production of the crops grown on Collamer silt loam. The main crops are wheat, hay, oats, and cabbage. Orchards are not planted on this soil. Land for cabbage receives from 300 to 500 pounds of complete fertilizer, and land for wheat 150 to 250 pounds, or 200 to 400 pounds of 20-percent superphosphate. No lime is used, and good stands of clover are common. Little or no alfalfa is grown. Approximate acre yields are: Wheat, 25 to 30 bushels; cabbage, 6 to 8 tons; oats, 40 bushels; and hay, $1\frac{1}{2}$ to 2 tons.

Collamer silt loam is a strong soil and not subject to severe leaching. The residual effects of fertilizer are more apparent than on soils of lighter texture. This soil is very erodible, but, as most of the land is level, erosion is not serious. All the land is under cultivation. Hay land accounts for 25 percent; 20 percent is in pasture, 10 percent is used for wheat, 15 percent for oats, 5 percent for cabbage, 10 percent for beans and peas for canning, 10 percent for corn, and 5 percent for such miscellaneous crops as tomatoes, cucumbers, and other truck crops.

Schoharie silt loam.—The main body of Schoharie silt loam is just south of the Seneca River near Waterloo. Smaller areas are northwest and northeast of Waterloo and Seneca Falls and north of Seneca Lake. This is a better soil than Schoharie silty clay loam. It has a more undulating relief, which has resulted in more efficient surface drainage, and movement of water through the subsoil is faster. The 8-inch surface layer is brown mellow silt loam with some gravel and a few stones scattered over the surface. The subsurface layer to a

depth of 20 inches is firm heavy silt loam, pinkish brown or yellowish brown with a pink tinge, grading into red silty clay loam having a well-developed fragmental structure. The soil aggregates are from $\frac{1}{2}$ to 1 inch in diameter and resist crushing. The lower subsoil layer is red or reddish-brown blocky clay or stratified silt and clay of pink and red colors. The surface soil is slightly acid, the upper subsoil layer is neutral in reaction, and the lower subsoil layer at a depth of 36 inches is calcareous.

Nearly all of Schoharie silt loam is under cultivation and is used for beans, wheat, cabbage, alfalfa, corn, and oats. The large area south of Waterloo in conjunction with the area of Dunkirk silt loam on the west constitutes one of the best agricultural sections of the county. These silt loams developed from lake-laid sediments have good water-holding capacity, and during dry seasons crops suffer less from lack of moisture than they do on other soils of this section.

Definite rotations are followed on Schoharie silt loam, and most frequently they include hay, corn, wheat or oats, and then a cash crop of beans or cabbage. Complete fertilizers may be used for cabbage and in smaller amounts for beans and wheat. If no complete fertilizers are used, applications of phosphate are made. Lime is not used to a significant extent. Normal acre yields are: Alfalfa, 2 to 3 tons; wheat, 25 to 30 bushels; cabbage, 8 to 10 tons; and corn, 10 tons of silage. Approximately 5 percent of the land is occupied by wood lots, 25 percent is in hay, 25 percent is in pasture, 10 percent is devoted to wheat, 10 percent to beans, 5 percent to cabbage, and 20 percent to corn and oats. Pastures on this soil are better than the average for the county.

Schoharie silty clay loam.—Schoharie silty clay loam, the heaviest textured member of the Schoharie series, is not considered a good agricultural soil. It is slow to dry, is difficult to work, and bakes and lumps very easily. The surface layer to a depth of 6 or 8 inches is dark-brown silty clay that has a good granular structure when sodded, but under cultivation it is generally very cloddy. The subsurface soil, which reaches a depth of 12 or 14 inches, is highly mottled grayish-pink blocky clay. The subsoil is red or reddish-brown dense plastic calcareous clay. As mapped, Schoharie silty clay loam represents a complex of drainage conditions. Undulating to slightly rolling areas that have better run-off do not have the gray highly mottled subsurface soil that is characteristic of the flat areas. The main body of this soil occurs as a large continuous area extending north and west from Seneca Falls. Another area borders the north end of Seneca Lake. The land is flat to slightly undulating, except on the slopes to the streams, where short 15- to 30-percent slopes occur. This soil has developed from sediments laid down in still water, as evidenced by the lack of gravel or stones and the uniformly fine texture. Deep exposures reveal the stratified character of the substratum. Surface drainage is fair on the undulating areas to poor on the more nearly level ones. Internal or subsoil drainage is uniformly slow because of the density and tightness of the clay subsoil.

Schoharie silty clay loam is best used for hay and pasture, although fair yields of wheat, oats, and corn are obtained in seasons when rainfall is well distributed and good seedbeds can be prepared. Alfalfa is not grown successfully because of the heavy texture and imperfect

drainage. Good yields of timothy and alsike clover or red clover are obtained. A common rotation is 3 years of hay followed by corn, then oats or wheat. Manure and superphosphate are the only fertilizers used. Wheat in good seasons may yield 25 to 30 bushels an acre, but the average yield over a period of years is nearer 18 bushels. Normally corn does not give good results in wet seasons. The seed rots in the ground if prolonged rains occur, and when it is dry the sprouting plant has difficulty pushing through the crust that usually forms on the surface.

Pure stands of Canada bluegrass are common in the pastures, and good stands of Kentucky bluegrass and wild white clover can be obtained and maintained by phosphate fertilization. Approximately 30 percent of this land is in wood lots, 55 percent in hay or pasture land, 5 percent in wheat, and 5 percent in corn and oats, and 5 percent is idle or abandoned.

Poygan silty clay loam.—Poygan silty clay loam is closely associated with the Schoharie soils and is developed from the same kind of calcareous lake-laid clays. It has a very dark gray or nearly black silty clay loam or silty clay surface soil that is high in organic matter. In a sodded or uncultivated condition the surface layer is highly granular, but under cultivation it generally is very cloddy. Between depths of 8 and 20 inches is highly mottled tight heavy dense blocky clay. The basic color is pinkish gray, and the mottles are yellow, brown, and gray. The subsoil is pink or red bedded calcareous clay, silt, and some sand. The clay is dense and plastic and highly mottled to a depth of 30 to 36 inches. It is similar to that underlying Schoharie silty clay loam. Lime nodules and concretions are characteristically present in the lower part of the subsoil, where the materials are heavy textured.

Typically, the surface soil has a heavy texture, but in a few spots it is silt loam or loam. South of Seneca Falls, Poygan silty clay loam occupies narrow elongated swales and depressions surrounded by areas of the Schoharie soils. North of this village the bodies are long and continuous.

The total area is fairly large. The poor surface and internal drainage limit the uses to which the soil can be put. Most of the land is used for pasture and for the production of timothy and alsike clover for hay. Some wheat is grown where surface run-off is facilitated by ditches, but the soil is not well adapted to grain crops. Good stands of Canada bluegrass are numerous, and bentgrasses are grown with the aid of phosphate. Kentucky bluegrass and wild white clover are readily established. From 1 to 1½ tons of hay an acre is produced, 12 to 20 bushels of wheat, and 35 bushels of oats. Probably 70 percent of the land is used for pasture, 15 percent for hay, and 5 percent for grain and corn, and 10 percent is in timber.

Toledo silty clay loam.—Toledo silty clay loam occupies depressed areas in association with Poygan silty clay loam. Several small areas are on the flat lands north of Waterloo and north of Seneca Falls. This soil has a 10-inch surface layer of black smooth silty clay loam overlying a highly mottled dense plastic clay subsurface layer. The basic color is light gray, and the mottles are yellow, brown, and gray. Between depths of 16 and 24 inches is an upper subsoil layer of bluish-gray dense clay mottled with rusty brown and gray. The

lower subsoil layer is gray and red clay similar to that of the Poygan and Schoharie silty clay loams. Drainage is poor, as the position of this soil in depressions prevents surface run-off and the tight impervious subsoil retards internal movement of water. In the natural condition the land is nonagricultural. The soil would produce good crops of hay if excess moisture were removed through artificial drainage. At present 90 percent of it is forested, and 10 percent is used as pasture land. The pasture plants are mainly sedges, rushes, and coarse swamp grasses.

Ottawa loamy fine sand.—Ottawa loamy fine sand occurs along the western boundary of the county north of Seneca Lake in the towns of Waterloo and Junius. Under cultivation it has a yellow to rust-brown loose mellow surface soil that is low in organic matter. The texture of the 10-inch surface layer is a uniform loamy fine sand. Between depths of 10 and 30 inches the material consists of yellow firm fine sand with streaks of rust-brown mottling. Below this the color changes to light yellow or light gray with streaks of brown mottling. The texture ranges from fine sand to very fine sand, and the material is somewhat more compact than the material above.

This soil is medium to strongly acid in the surface and subsurface layers, but at a depth ranging from 4 to 6 feet it is alkaline. It has developed from sand that was deposited mainly by the wind. The land is level to undulating. Drainage is good to excessive. The low water-holding capacity contributes to the rather low productivity of this soil.

Ottawa loamy fine sand is not used very extensively for crops, and much of it is growing up to weeds and brush. Where it occurs in association with the Ontario soils, field crops such as corn, oats, and hay are grown with fair results. Other areas are used for the production of vegetables and small fruits, for which the soil is best suited. It warms early in the spring and can be worked under a wide range of moisture conditions. Its physical condition is always good. Owing to its large proportion of sand, this soil requires the addition of manure or other organic residues in order to increase its water-holding capacity, and it also requires heavy fertilization before it will return profitable yields. Approximately 60 percent of the land is idle; 15 percent is pasture land, 5 percent is used for hay, 5 percent is used for vegetables and small fruit, and 15 percent still supports a forest cover.

Ottawa loamy fine sand, rolling phase.—The rolling phase of Ottawa loamy fine sand differs from the typical soil in having a rough hummocky uneven relief. Texture, color, and other profile characteristics are the same in the two soils, except that in the more rolling soil mottling is less noticeable in the upper part of the subsoil. The slopes range in gradient from 10 to 30 percent. This land is cultivated to less extent than the smoother land, and a higher percentage is covered with brush and woods. Only the less steep areas can be cultivated. The few acres under cultivation are used in the same way and for the same crops as the smooth areas; yields, however, may be somewhat lower. Vegetables and small fruits are the only crops grown for cash. Part of this soil is used for pasture, but the carrying capacity of the pasture is low.

Berrien loamy fine sand.—Berrien loamy fine sand is associated with the Schoharie, Dunkirk, and Ottawa soils just north of Seneca Lake and in the vicinity of Waterloo. It consists of a mantle of sand deposited mainly by wind action over red clay similar to the subsoil of the Schoharie soils.

The 8- to 10-inch surface layer is brown or grayish-brown mellow loamy fine sand, underlain to a depth of 20 inches by yellowish-brown firm medium or fine sandy loam with a single-grain structure. This material grades into light yellowish-brown loamy sand stained with brown, which, at a depth ranging from 24 to 36 inches, rests on light-red or light reddish-brown dense clay laminated with layers of silt in some places. The content of organic matter in the surface soil is rather low, and the reaction is acid. Lime is present in the heavy clay subsoil. The substratum is either silty material like that of the Dunkirk soil or compact glacial till. Surface drainage is good, but internal drainage is only fair, as the heavy substrata impede downward movement of moisture.

The undulating relief is the result of wind action in depositing the sandy material over the clay. Berrien loamy fine sand in Seneca County is somewhat different from that in Monroe, Orleans, and Niagara Counties. In those counties the subsurface soil is slightly compact and contains iron concretions.

A large part of Berrien loamy fine sand in Seneca County is used for residential sites. Suburban homes line United States Highway No. 20, which traverses an area of this soil between Geneva and Waterloo, and the entire village of Waterloo is located on this soil.

The cultivated areas are used for vegetables, small fruits, apples, field crops, hay, and pasture. The soil is easy to work and so is well suited to crops requiring considerable cultivation. It is better suited to these crops than are the Ottawa soils, because the moisture-holding capacity is markedly increased by the heavy clay subsoil. The natural fertility of the soil is low, and the land requires heavy fertilization in order to produce good yields. Moreover, as fertilizer is soon leached from the soil, annual applications are necessary. Yields of vegetable crops are high when 500 pounds of complete fertilizer to the acre is applied. Apples yield 125 to 150 bushels an acre. Little fertilizer is applied for field crops, like hay and grain, and yields are low. Hay is cut predominantly from timothy with some clover, but not much alfalfa is grown. Alfalfa should do fairly well, as drainage of this soil is sufficiently well developed and there is free lime in the heavy subsoil. It is necessary to supply lime for the alfalfa crop until the roots are able to draw on the subsoil. Average acre yields of crops are as follows: Hay, 1 ton; oats, 30 bushels; and corn silage, 6 to 8 tons. Pastures are generally poor. There are good stands of Canada bluegrass, but they suffer from lack of moisture in late summer.

Approximately 50 percent of the soil is in residential developments, 10 percent is idle, 25 percent is used for pasture, 5 percent for hay, 5 percent for orchards, and 5 percent for truck crops and small fruits.

Granby fine sandy loam.—Granby fine sandy loam has a thin surface layer of partly decomposed organic matter highly matted with roots. Between depths of 2 and 10 inches is a layer of highly organic granular loamy sand overlying light-gray slightly compact sand,

which extends to a depth of 15 inches. Below this is the upper part of the subsoil, which consists of highly mottled compact loamy sand continuing to a depth of 30 inches. The lower part of the subsoil is gray calcareous sand.

Granby fine sandy loam occupies sags and depressions, which are surrounded by Ottawa and Berrien soils. The soil is too wet for cultivation, and most of it still remains in forest. When artificially drained, as it has been in other counties, Granby fine sandy loam makes an excellent soil for such vegetables as celery, onions, and lettuce. Heavy applications of fertilizer are necessary for these crops, owing to the low natural fertility of the soil.

SOILS OF THE SWAMPS AND MARSHES

Soils of the swamps and marshes are developed from peat (pl. 6). In most places the peat is composed of remains of sedges and rushes, but in many places the upper 1 to 2 feet of soil is composed of woody muck. Carlisle muck, with its shallow phase, and Edwards muck and Wallkill silt loam are mapped.

Carlisle muck.—The main body of Carlisle muck makes up part of the Montezuma Marsh. Fairly large bodies also occur in the extreme northwestern corner of the county and in the town of Varick near the center of the county. This muck has a black well-decomposed surface soil, underlain at a depth of 8 to 12 inches by somewhat brown fibrous vegetable material, which extends to a depth of 30 inches. Below this depth the material consists of brown fibrous plant remains in which the original tissue is apparent. In that part of the land under cultivation the color is more nearly black and the decomposed material has greater depth. It is alkaline in reaction. The surface soil in places is composed largely of woody muck, but in areas that never were forested even the surface soil is derived largely from sedges and rushes. In the latter situation some of the soil probably would be classified as Houghton muck, were it more extensive.

With the exception of the several hundred acres along the northern boundary of the county, under cultivation, this type of muck is wet and forested.

The cultivated area is used for the production of vegetables, such as celery, onions, potatoes, sweet corn, and beans. Large quantities of fertilizer are used. Frequently 1,000 pounds of 5-10-5 is applied for potatoes, which yield 250 to 350 bushels an acre. Fields of Red Kidney beans may receive 250 pounds of 2-8-10 an acre and yield 20

EXPLANATORY LEGEND FOR PLATE 6

VERTICAL AERIAL PHOTOGRAPH OF THE NORTHEASTERN CORNER OF SENECA COUNTY
AND PART OF CAYUGA COUNTY, N. Y.

- A, Abandoned Erie Canal passing through wooded Carlisle muck in Montezuma Marsh.
- B, The Barge Canal.
- C, Junction of Barge Canal and Seneca River, with Wallkill silt loam on each side of river.
- D, Intensively cultivated Edwards muck.
- E, Drumlinlike hills of Ontario soils.
- F, Train of barges on Barge Canal.



to 30 bushels. Land devoted to leafy vegetables, such as lettuce, spinach, and celery, may receive a 200- or 300-pound application of nitrate of soda, and return good yields, although not so high as those obtained on the muck in Wayne County that has been derived from wood rather than cattails, reeds, and rushes.

Much of the produce is disposed of at the field to truckers who come from nearby cities. The total area of Carlisle muck is 12.8 square miles, of which approximately 1 square mile is under cultivation; the rest is covered by second-growth forest, cattails, and rushes. Large quantities of cattail leaves, which are used in calking barrels, are harvested annually.

Carlisle muck, shallow phase.—The shallow phase of Carlisle muck has a black granular thoroughly decomposed organic surface layer, from 10 to 20 inches thick, overlying bluish-gray slightly compact sand or clay mottled with yellow and brown. The lower subsoil layer is compact light-blue very plastic and sticky clay.

This shallow Carlisle muck occurs only in the towns of Waterloo, Junius, and Seneca Falls. Where it has been possible to drain the land by means of open ditches, it is used for the production of vegetables. Potatoes are the main crop, but celery, beans, and sweet corn also are grown. Probably 30 percent of the total area is drained and cultivated. The area just north of the village of Waterloo is the most important, and a larger proportion of it is under cultivation. The undrained parts are mostly forested with elm, soft maple, and other trees tolerant of poor drainage.

From 300 to 500 pounds of commercial fertilizer is used on the land for vegetables, and good yields are obtained. Potatoes return from 200 to 350 bushels an acre.

Edwards muck.—Edwards muck is a shallow muck derived from cattails, rushes, sedges, and coarse grasses. It is underlain by marl at a depth ranging from 14 to 30 inches. The cultivated muck has a black granular well-decomposed surface soil about 10 inches thick. The material below this is dark-brown partly decomposed organic matter resting on shell marl.

Only a small total area is mapped, mainly in the extreme northeastern part of the county along the Seneca River. Most of this area is under cultivation and is used for potatoes, lettuce, celery, onions, beans, and sweet corn. Peas for canning are also grown. From 100 to 300 pounds of commercial fertilizer to the acre are used, and good yields of crops are obtained. Growers report 300 bushels of potatoes an acre when 500 pounds or more of fertilizer is used.

The occurrence of marl at this slight depth reduces the value of this muck for agricultural purposes, and muck derived from material such as this is said to be disagreeable to work.

Drainage of muck in the Montezuma Marsh has been brought about by open ditches and is effective enough during normal seasons. The entire marsh is subject to flooding during abnormally high water, a hazard that materially reduces the value of the muck. In the past entire crops have been lost as a result of floods.

Walkill silt loam.—This soil occupies flood plains along the Seneca River in the northeastern part of the county in the Montezuma Marsh.

The alluvium has been deposited close to the stream banks and overlies organic material.

Walkill silt loam has an 8- to 10-inch dark-brown or grayish-brown mellow surface layer overlying a yellowish-brown firm silt loam sub-surface layer. The subsoil is firm grayish-brown or gray silt or silty clay loam, mottled with bluish gray and brown. In most places organic deposits are reached at a depth of 36 or more inches. North of Cayuga Lake much of the soil adjacent to the river is composed of material pumped from the channel when it was improved for navigation. The surface layer is neutral to slightly alkaline, the sub-surface layer is alkaline, and the subsoil above the organic layer is calcareous.

This soil as a whole is permanently wet and is covered with second-growth maple, elm, ash, and thickets of alder. One or two small areas are cleared and sufficiently drained to produce some marsh hay.

MISCELLANEOUS LAND TYPES

The group of miscellaneous land types includes rough broken land and made land.

Rough broken land.—Rough broken land represents a topographic condition rather than a distinct soil type. It includes the steep precipitous bluffs along the shores of Seneca and Cayuga Lakes in the southern part of the county and many of the deep narrow V-shaped gorges along the shores of the lake. Much of the total area is very shallow, as bedrock lies less than 18 inches below the surface. Those areas that are not too steep to support vegetation are covered with a forest growth.

Made land.—Made land consists of material removed in digging the Barge Canal between Waterloo and Seneca Lake and dumps made on Frontenac Point and Lodi Landing for building purposes. The total area is small, and the land has little or no agricultural value.

PRODUCTIVITY RATINGS

In table 6 the soils of Seneca County are listed alphabetically and estimated average acre yields of the principal crops are given for each soil under the prevailing farming practices. The principal use made of each soil and brief descriptions of the management practices are given in the two right-hand columns of the table.

The estimates in table 6 are based primarily on interviews with farmers, the county agricultural agent, members of the State Agricultural Experiment Station and College of Agriculture staffs, and others who have had experience in the agriculture of this county. As such, they are presented as estimates of the average production over a period of years according to the prevailing type of farming. It is realized that these estimates may not apply directly to specific tracts of land for any particular year, inasmuch as the soils as shown on the map vary somewhat, practices of management differ slightly, and climatic conditions fluctuate from year to year. On the other hand, these estimates appear to be as accurate information as can be obtained without further detailed and lengthy investigations, and they serve to bring out the relative productivity of the soils shown on the map.

TABLE 6.—Estimated acre yields of the more important crops on the soils of Seneca County, N. Y.

Soil (soil type, phase, or land type)	Corn (grain)		Corn (silage)		Wheat		Oats		Buckwheat		Timothy		Timothy and red clover		Alsike clover		Alfalfa		Potatoes		Cabbage		Field beans (Red Kidney)		Canning peas		Sweet corn		Celery		Onions		Apples		Pasture		Principal land use, type of farming, or crops	General management practices ¹
	Bu.	Tons	Bu.	Tons	Bu.	Tons	Bu.	Tons	Tons	Tons	Bu.	Tons	Bu.	Tons	Tons	Tons	Bu.	Tons	Bu.	Tons	Bu.	Tons	Bu.	Tons	Bu.	Tons	Bu.	Tons	Bu.	Tons	Bu.	Tons	Cow-acre-days ²					
Alluvial soils, undifferentiated.																																	60	Pasture	Little or no fertilizer or lime (1). Fertilizers and some lime (3). Artificial drainage and heavy fertilization (5).			
Berrien loamy fine sand		6-8	15-20		30		1	1.5								1.5					5-7	12-15	900									{125-150}	60	{Vegetables, fruit, idle, recreational.				
Carlisle muck (drained)																				250-350		20-30	{1,000-1,200}	4	{150-200}	400-800									Vegetables	Artificial drainage and heavy fertilization (5). Little or no fertilizer or lime (1). Artificial drainage and heavy fertilization (5).		
Carlisle muck (undrained)																																		Woods, marsh				
Carlisle muck, shallow phase (drained)																				150-350		15-20	{1,000-1,200}	3	{100-150}	300-500									{Pasture, vegetables, woods.			
Carlisle muck, shallow phase (undrained)																																		Woods, pasture	Little or no fertilizer or lime (1). Phosphate and manure (2). Do. Heavier fertilization and liming than (3); (4). Little or no fertilizer or lime (1).			
Cayuga silt loam	25-35	8-10	25	35	20	1.5	1.5-3									2															100	80	General farming					
Cazenovia silt loam		8-10	30	40		1.5	2										2-3															80	do	Do. Heavier fertilization and liming than (3); (4). Little or no fertilizer or lime (1).				
Chenango gravelly loam ³																																	do					
Chippewa silty clay loam																																40	Pasture, abandoned, forests.					

¹ Fertilization practices vary more or less from farm to farm and from crop to crop. For purposes of convenience the practices are grouped into the following five classes, represented by numerals in parentheses:

- (1) Little or no manure, commercial fertilizer, or lime used. Most areas are in woods, pasture, or swamp.
- (2) Crop rotation of winter wheat; timothy and clover or alfalfa; and corn, beans, or cabbage. Manure used to top-dress meadows or applied to corn or cabbage. About 250 pounds an acre of 16-percent superphosphate applied for grains; 150 pounds of 2-8-10, or similar fertilizer, for beans; and 300 to 700 pounds of 4-8-12, or similar fertilizer, for cabbage. Only slight applications of lime used for new seedings of alfalfa.
- (3) Practices as under (2) except more lime applied.
- (4) Practices as under (2) except heavier applications of both fertilizers and lime.
- (5) Artificial drainage and heavy applications of complete fertilizers.

² Cow-acre-days represents the product of the number of animal units carried per acre and the number of days the animals are grazed without injury to the pasture. For example, the soil capable of supporting 1 animal unit per acre for 360 days of the year rates 360, whereas another soil capable of supporting 1 animal unit per 2 acres for 180 days rates 90. These estimates for pasture are probably less accurate than those for specified crops.

³ Acreage in county too small for yields to be given.

TABLE 6.—Estimated acre yields of the more important crops on the soils of Seneca County, N. Y.—Continued

Soil (soil type, phase, or land type)	Corn (grain)		Wheat	Oats	Buckwheat	Timothy	Timothy and red clover	Alsike clover	Alfalfa	Potatoes	Cabbage	Field beans (Red Kidney)	Canning peas	Sweet corn	Celery	Onions	Apples	Pasture	Principal land use, type of farming, or crops	General management practices
	Bu.	Tons																		
Collamer silt loam	25-35	8-10	25-30	40		1.5	1.5-2	2	2									90	Cash crops, vegetables.	Phosphate and manure (2).
Darien silt loam	25-35	8-10	20-30	40-45	20	1.5	1.5	2	1.5			15						90	General and cash-crop farming.	Do.
Darien silt loam, slope phase.		5-6	12-20	30	15	1	1	1				12						70	Wheat, fruit, pasture, hay.	Little or no fertilizer and lime (1).
Dunkirk fine sandy loam.	25-35	6-8	30	40		1	1.5		2.5	200	8	15	1,000	3-5			150	80	Vegetables, cash crops.	Fertilizers and some lime (3).
Dunkirk silt loam	30-40	8-10	30-35	40-45		1.5	2	2	2-3		7-10	20	{1,000- 1,200}	4-6			150	90	{General and cash-crop farming.	{Do.
Dunkirk silt loam, shallow phase.	20-30	10	30	35		1.5	1.5		2		7-10	18						80	General farming.	Do.
Edwards muck (drained).										300		20-30	{1,000- 1,500}	3	{100- 150}	{300- 500}				{Artificial drainage and heavy fertilization (5).
Edwards muck (undrained).																				Marsh
Erie silt loam		6-8	30-40	15-20		1.5	1	1										70	Abandoned, pasture, hay, buckwheat.	Little or no fertilizer or lime (1).
Farmington loam	20-30	6-8	18-25	20-35		.75	1		1-1.5		6-8	15						40	General farming, cash crops.	Phosphate and manure (2).
Granby fine sandy loam.																		50	Swamps, woods	Little or no fertilizer or lime (1).
Groton gravelly loam						.5	1		1.5								125	40	Idle	Phosphate and manure (2).
Honeoye silt loam	30-40	9-12	20-35	35-50	15-25	1.5	2		2.4		8-12	15-20	1,000	3-6			100	85	General and cash-crop farming, fruit.	Do.
Honeoye silt loam, eroded phase.						1	1		1.5								100	70	Idle, pasture, fruit.	Little or no fertilizer or lime (1).
Kendaia silt loam	20-30	8-10	20-25	40	20	2	2.5	2	2-3			12-18					{75- 100}	90	General farming.	{Phosphate and manure (2).
Langford silt loam	15-25	6-8	15-20	35	20	2	2.5		1									70	Corn silage, oats, hay, buckwheat.	Do.
Lansing silt loam	20-30	8-10	25	30-45	20	1.5	2		2		8	15					150	80	General farming, fruit.	Do.
Lansing silt loam, shallow phase.		6-8	12-18	30	18	1	1.5		1.5			12					75	60	Hay, wheat, beans, idle.	Do.

Lansing silt loam, shallow steep phase.																		40	Idle, pasture, fruit	Little or no fertilizer or lime (1).
Lordstown flaggy silt loam.	8	15-20	25-35	18	1	1.5			100-150									50	Pasture, idle, corn silage, oats, buckwheat.	Heavier fertilization and liming than (3); (4).
Lyons silty clay loam	6-8	20	40		1.5	1.5	1.5											85	Pasture, forests	Little or no fertilizer or lime (1).
Made land																				
Ontario fine sandy loam	25-35	8-10	20-30	35-50		1	1.5		2.5-3	150-250	8-10	15-20	1,200	4-6			150	70	General and cash-crop farming, fruit.	Fertilizers and some lime (3).
Ontario loam	25-35	10	20-30	35-50		1	1.5		2-3	100-150	9-11	15-20	1,200	4-6			150	75	do	Phosphate and manure (2).
Ontario loam, steep phase.		4-6	15-25	25-40		.75	1		2	75-150	6-8	10-15					150	70	Pasture, alfalfa, idle	Phosphate on pasture.
Ottawa loamy fine sand		5	15	25		.75	.75			100							150	50	Idle, vegetables, small fruit.	Heavier fertilization and liming than (3); (4).
Ottawa loamy fine sand, rolling phase.																	100	40	Idle	Do.
Ovid silt loam		6-10	15-20	35-40		1.5	1.5	1.5				10-12						90	Corn silage, pasture, wheat, idle.	Phosphate and manure (2).
Palmyra gravelly loam	20-30	8-10	25	35		1	1.5		2-3.5		10	18	{1,000-1,200}	3-5				60	{Cash crops, general farming.	Do.
Poygan silty clay loam			12-20	35		1.5	1-1.5	2										90	Pasture	Do.
Romulus silty clay loam		6-8	15-20	30-40	20	1	1.5	1.5										80	Hay, pasture, wheat, idle.	Do.
Romulus silty clay loam, shallow phase.		4-7	12-15	30-40	20	1	1.5	1.5										70	Hay, pasture, idle	Do.
Rough broken land																				
Schoharie silt loam		10	25-30	35-45		1.5	2	2	2-3		8-10	12-18	{1,000-1,200}					90	{General farming, cash crops.	Phosphate and manure (2).
Schoharie silty clay loam.		5	18	25-35		1.5	2	2	1									90	Hay, pasture, wheat, oats.	Do.
Toledo silty clay loam																		60	Pasture, forests	Little or no fertilizer or lime (1).
Walkill silt loam																				
Wayland silt loam																		60	Swamps, woods.	Do.
Wooster gravelly loam	20-30	8	15-20	35	25	1	1.5		1.5	200								60	Pasture, swamp, woods.	Do.
																		60	Dairy farming, corn silage, oats, hay, buckwheat.	Heavier fertilization and liming than (3); (4).

NOTE.—Absence of indexes shows that the crop is not grown on the particular soil type.

TABLE 7.—Productivity ratings of soils in Seneca County, N. Y.

Soil (soil type, phase, or land type) ¹	Crop productivity index ² for—																	General product- ivity	Physical suitability for use		
	Corn (grain) (100=50 bushels)	Corn (silage) (100=12 tons)	Wheat (100=25 bushels)	Oats (100=50 bushels)	Buckwheat (100=25 bushels)	Timothy hay (100=2 bushels)	Timothy and red clover (100=2 tons)	Alsike clover (100=2 tons)	Alfalfa (100=4 tons)	Potatoes (100=200 bushels)	Cabbage (100=12 tons)	Field beans (Red Kidney) (100=25 bushels)	Canning peas ³ (100=1,200 pounds)	Sweet corn ⁴ (100=6 tons)	Celery ⁵ (100=200 crates)	Onions (100=500 bushels)	Apples (100=200 bushels)			Pasture (100=100 cow-acre-days ⁶)	Grade ⁴	Group ^{6}
Dunkirk silt loam.....	70	75	130	85	80	75	100	100	60	70	80	90	85	80	75	90	1	} Very high to high.	} Excellent to good cropland. (The lay of the land or topography is generally favorable for tillage operations without any great hazard of serious erosion. Suited to all the common farm crops. Moisture relationships generally satisfactory.)		
Honeoye silt loam.....	70	85	110	85	80	75	100	75	75	80	70	85	80	80	50	85	2				
Ontario loam.....	60	80	100	85	80	50	75	65	60	80	70	100	80	80	75	75	2				
Ontario fine sandy loam.....	60	75	100	85	80	50	75	70	100	75	70	100	80	80	75	70	2				
Cazenovia silt loam.....	75	120	80	80	80	75	100	60	70	60	60	80	80	80	80	80	2				
Dunkirk silt loam, shallow phase.....	50	80	120	70	75	75	75	50	70	70	70	70	65	60	75	80	2				
Dunkirk fine sandy loam.....	60	60	120	80	80	50	75	60	100	65	60	85	65	60	75	80	2				
Palmyra gravelly loam.....	50	75	100	70	70	50	75	70	70	80	70	90	70	60	60	60	2				
Schoharie silt loam.....	80	110	80	75	100	100	60	75	60	90	90	90	90	90	90	90	3			} High to moderate	} Good to fair cropland. (Certain unfavorable characteristics in the soils of this group, such as imperfect drainage, shallowness of soil, lower waterholding capacity, and increased stoniness lower the suitability of these soils for the common crops.)
Collamer silt loam.....	60	75	110	80	75	85	100	50	60	85	85	85	85	85	85	85	3				
Kendaia silt loam.....	50	75	90	80	80	100	125	60	60	60	60	60	60	60	45	90	3				
Darien silt loam.....	60	75	100	85	80	75	75	35	60	60	60	60	60	60	60	90	3				
Lansing silt loam.....	50	75	100	75	80	75	100	50	65	60	60	60	60	60	75	80	3				
Cayuga silt loam.....	60	75	100	70	80	75	120	50	60	60	60	60	60	60	50	80	3				
Wooster gravelly loam.....	50	65	70	70	100	50	75	40	100	40	60	60	60	60	50	60	4				
Langford silt loam.....	40	60	70	70	80	100	125	25	30	30	30	30	30	30	30	70	4				
Farmington loam.....	50	60	85	55	40	50	50	30	60	60	60	60	60	60	60	40	5				
Carlisle muck (drained).....	150	100	90	65	90	120	150	100	70	90	50	60	80	80	80	80	5				
Carlisle muck, shallow phase (drained).....	125	70	90	50	60	80	150	100	50	55	75	75	75	75	75	75	5				
Edwards muck (drained).....	150	100	100	50	60	80	150	100	50	55	75	75	75	75	75	75	5				
Berrien loamy fine sand.....	60	70	60	50	75	75	75	35	50	55	75	75	75	75	70	60	5				
Ovid silt loam.....	65	70	75	75	75	75	75	75	45	45	45	45	45	45	45	90	5				
Chenango gravelly loam.....	50	50	60	60	70	40	50	35	90	90	90	90	90	90	90	50	5				

NOTE—See footnotes at end of table.

from the others, although some one may dominate. The factors listed may be grouped simply as the soil factor and the management factor. Slope, drainage, and most of the aspects of climate may be considered characteristics of a given soil type, since the soil type, as such, occupies specific geographical areas characterized by a given range of slope and climatic conditions. Crop yields over a long period of years furnish the best available summation of the associated factors and therefore are used where available.

The right-hand column of table 7 gives a few statements as to the general characteristics and physical suitability for use of the soils of each general productivity group. A grouping of soils on the basis of general productivity will not necessarily coincide in all respects with a grouping on the basis of physical suitability for use, since other characteristics in addition to productivity influence the general desirability of soils in respect to their use for crops. For example, slight differences in productivity may be overshadowed by differences in workability or the maintenance of productivity and the prevention of erosion. The statements given here for each productivity group are applicable to the group as a whole, but it is to be remembered that the arrangement or order of listing of soils is based on general productivity.

Productivity tables do not present the relative roles that soil types, because of their extent and the pattern of their distribution, play in the agriculture of the county. The tables show the relative productivity of individual soils. They cannot picture in a given county the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types devoted to each of the specified crops.

Economic considerations play no part in determining the crop productivity indexes. They cannot be interpreted, therefore, into land values except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land. It is important to realize that productivity, as measured by yields, is not the only consideration that determines the relative worth of a soil for growing crops. The ease or difficulty of tillage and the ease or difficulty with which productivity is maintained are examples of considerations other than productivity that influence the general desirability of a soil for agricultural use. In turn, steepness of slope, presence or absence of stone, resistance to tillage offered by the soil because of its consistence or structure, and size and shape of areas are characteristics of soils that affect the relative ease with which they can be tilled. Likewise, inherent fertility and susceptibility to erosion are characteristics that influence the ease of maintaining soil productivity at a given level. Productivity, as measured by yields, is influenced to some degree by all these and other factors, such as moisture-holding capacity of the soil and its permeability to roots and water, and so they are not factors to be considered entirely separately from productivity. On the other hand, schemes of land classification to designate the relative suitability of land for agricultural use must give some recognition to such factors.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of forces of weathering and soil development acting on soil materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on the physical and mineralogical composition of the parent soil material, the climate under which the soil material has accumulated and existed since accumulation, the plant and animal life in and on the soil, the relief, or lay of the land, and the length of time the forces of soil development have acted on the soil material. External climate is less important in its effects on soil development than is internal soil climate, which depends not only on temperature, rainfall, and humidity, but on the physical characteristics of the soil or soil material and the relief, which, in turn, strongly influences drainage, aeration, run-off, erosion, and exposure to sun and wind.

Seneca County is in the northern part of the Gray-Brown Podzolic soils region of the eastern United States, which includes the midlatitudes between the main Podzolic soils region on the north and the Red and Yellow Podzolic soils region on the south (4, 7). The northern part of the county lies in the Erie-Ontario lowlands, and the southern part, separated by the Portage escarpment, extends south into the Appalachian Plateaus, Southern New York section.⁸

With the exception of the organic deposits in the northeast, the county is almost entirely covered by glacial debris, much of which is unsorted till. A large area is covered with lacustrine sediments and wind-deposited sands. The underlying rocks north of the Seneca River consist of interbedded shales and limestones of the Silurian system. In this part of the county the underlying rocks are deeply buried under glacial debris. From the canal southward, rocks of the Devonian system are exposed and consist of limestone, in a belt 1 to 4 miles wide, followed by shales of the Hamilton formation characterized by a great number of concretions. The shales of this formation are mainly alkaline or calcareous. Outcropping in the vicinity of Ovid is a narrow belt of thin-bedded dark-colored calcareous shales of the Genesee group. South of this to the county line are interbedded shales and thin dense mainly noncalcareous sandstones of the Portage formation and the Ithaca member of the Portage group.

The mantle of till was derived largely from these formations and consequently has a high lime content. As the soils are rather young, lime has been reached only from the upper layers, leaving the lower layers strongly calcareous. In a few small areas, where the mantle of drift is thin, the soils have developed from materials derived from the disintegration in place of the underlying rocks.

Extending across the county at the north end of the lakes is a large area in which the soils have developed from lacustrine sediments laid down in temporary glacial lakes. Many of the drumlins north of these lake-laid deposits were surrounded by the lake water, and the lake sediments extend in fingerlike strips a considerable distance into the drumlin area. Many of the soils that have developed from these sediments are characterized by imperfect or poor drainage.

⁸ BARNES, C. P., and MARSCNER, F. J. NATURAL LAND-USE AREAS OF THE UNITED STATES. (Map.) U. S. Dept. Agr. Bur. Agr. Econ. (Physiographic data assembled.) 1933.

On the west side of the county, north of Seneca Lake, the soil-forming materials are loamy fine sands overlying lacustrine clays and glacial till. Much of the sand has been deposited by wind action, and it has the undulating and dunelike relief characteristic of such deposits.

In the northeastern corner of the county from the foot of Cayuga Lake to the county line is an extensive marsh where the soil material is largely peat, which ranges in depth from 12 inches to 10 feet. A large area of the marsh is underlain by marl deposits, which in some places lie only a few inches below the surface.

The soils of the extreme southern part are those of a transitional zone between highly calcareous materials and acid sandstone and shales. The parent materials are alkaline, owing to the small quantity of lime-bearing erratics carried in by the ice; but just south of the boundary line they have the strongly acid nature characteristic of the upland soils of the southern plateau section of the State.

The soils have developed under a predominantly deciduous forest cover in a temperate and moderately humid region. Under such conditions little organic matter is incorporated into the well-drained soils, and the forest litter on these highly calcareous soils is rapidly lost through decomposition and oxidation. The soils are light-colored except where drainage is poor. The main colors are brown, yellow, pink, and light red. The red and pink colors are inherited from the parent materials and are not due to soil-development processes.

The mean annual precipitation of about 31 inches is sufficient for considerable leaching of the soils by water. Lime has been removed from the surface layers, but many of the soils are calcareous below a depth of 12 to 18 inches. The presence of such large quantities of lime has retarded the development of some soil types. Imperfect or poor drainage has had a strong influence in controlling the trend of development in the soils of certain series.

The most maturely developed soils of this general region and the ones with the most nearly typical Gray-Brown Podzolic profiles are those of the Ontario series. The following description of a profile of Ontario loam, as observed $1\frac{1}{4}$ miles northeast of Tyre, is typical for the series. It represents the virgin soil under a cover of mixed hardwoods.

- 0 to 1 inch, dark-gray highly granular loam with a sparse cover of undecomposed leaves and twigs.
- 1 to 4 inches, grayish-brown mellow loam high in organic matter and without well-defined structure.
- 4 to 10 inches, yellow or brownish-yellow mellow loam with an imperfect granular structure. The aggregates range from very small to one-fourth inch in diameter and are quite firm. The reaction is acid.
- 10 to 14 inches, grayish-yellow firm silt loam with an indistinct platy structure. Light gray and pink interspersed with the basic color have produced a marbled effect. The material is slightly acid.
- 14 to 28 inches, light brownish-red firm heavy silt loam, moderately dense in place. It has an irregular lumpy structure, and the aggregates are vesicular. The reaction is about neutral.
- 28 to 40 inches, strong-brown silt loam, compact in place and of a distinct platy structure. The structural aggregates are hard and dense. The texture is not so heavy and the color is not so intense as in the layer above.
- 40 to 60 inches, grayish-pink gritty loam, neither strongly compact nor hard in place. It has a very pronounced irregular nut structure. The aggregates are very hard. Distinct vertical joint planes are present. The reaction is strongly calcareous.

Members of the Honeoye series resemble those of the Ontario somewhat, but they have more compact subsoils and are calcareous at a depth of 12 to 18 inches. In some respects these soils might be considered as approaching the Brown Forest soils in character.

The Darien soils are related to the Honeoye, but they differ in having a higher percentage of black shale fragments and a darker color throughout. The content of limestone materials is not so high as in the Honeoye soils.

The Kendaia soils have developed from highly calcareous glacial till, but their development has been controlled largely by imperfect drainage. The description of a profile of Kendaia silt loam taken from an excavation dug in an area of second-growth hardwoods 2 miles northeast of Ovid is as follows:

- 0 to 9 inches, dark-gray or dark-brown smooth mellow granular silt loam high in organic matter.
- 9 to 13 inches, gritty heavy silt loam, mottled with yellow and brown, dense but not compact. A distinct line of demarcation appears between the surface and subsurface layers.
- 13 to 17 inches, highly mottled dense clay loam. This material breaks out in large irregular vesicular lumps.
- 17 to 24 inches, dark-gray dense compact silty clay loam mottled with yellow and brown. It has an irregular blocky structure.
- 24 to 40 inches, grayish-brown very hard compact silt loam with mottlings of light gray and yellow. Nodules and concretions of lime are present.
- 40 to 50 inches, drab compact highly calcareous silt loam with an indefinite platy structure. This layer shows no penetration of roots and no segregation of lime.

The Langford soil has developed under imperfect drainage conditions from till derived principally from shales and sandstones. The parent material is alkaline but not calcareous. Erie silt loam differs from Langford silt loam in having the hard compact impervious layer from 8 to 10 inches below the surface, whereas in the Langford soil this layer lies from 18 to 24 inches below the surface.

The soils that have developed from lacustrine sediments are characterized by heavier textures, freedom from gravel and stones, and their pinkish-brown or red color. Dunkirk silt loam, the best-drained member of this group, has the following profile characteristics, which apply to a sample taken from an excavation in a grazed wood lot $2\frac{1}{2}$ miles southwest of Waterloo.

- 0 to 4 inches, grayish-brown granular silt loam. Under cultivation the organic matter is rapidly lost and the surface assumes a faint pinkish-brown color. The reaction is acid.
- 4 to 11 inches, light pinkish-brown silty clay loam with a definite fragmental structure. The structural aggregates range from $\frac{1}{2}$ to $1\frac{1}{2}$ inches in diameter, and considerable pressure is required to crush them. The outer surfaces have a thin gray colloidal coating. The reaction is slightly acid.
- 11 to 30 inches, light reddish-brown or buff clay loam that breaks out in large irregular blocks. The aggregates are hard and vesicular. Breakage planes are distinctly developed. This material is approximately neutral or slightly alkaline, but it does not effervesce with dilute acid.
- 30 to 48 inches, bedded silt and fine sand with a pinkish-brown or gray color. These materials are moderately dense and compact in place. Free lime occurs in the form of nodules and concretions.

The Schoharie soils are differentiated from the Dunkirk soils on the basis of the redder color of the parent material, the less well developed drainage, and the more highly calcareous and heavier

parent material. The Poygan and Toledo soils are Half-Bog catenary associates of the Schoharie soils. They have a very dark colored surface soil and gray and rust mottled subsoils. The Toledo soils are even more poorly drained than the Poygan soils.

North of Seneca Lake is a large area of sandy soils that show evidence of much wind action in their gently rolling to hummocky relief. A profile of Ottawa loamy fine sand, observed $3\frac{1}{2}$ miles northeast of Waterloo under a forest cover of second-growth hardwoods, has the following characteristics:

- 0 to $\frac{1}{2}$ inch, black well-decomposed leafmold.
- $\frac{1}{2}$ to $1\frac{1}{2}$ inches, grayish-red loose loamy fine sand.
- $1\frac{1}{2}$ to 10 inches, reddish-yellow to rust-colored mellow loamy fine sand without definite structure.
- 10 to 30 inches, yellow slightly firm fine sand that also has no definite structure.
- 30 to 45 inches, light-yellow firm to slightly compact fine sand. Streaks of iron staining are present.
- 45 to 60 inches, light-gray or grayish-yellow moderately compact fine sand marbled with rust. This layer also has no definite structure. Roots penetrate beyond this depth.

Granby fine sandy loam has developed from similar materials under poor drainage conditions and is a Half-Bog soil.

Organic soils range in depth from a few inches to 10 feet or more, and they have developed from the remains of swamp and marsh vegetation. In some places marl underlies the organic deposits at a slight depth.

SUMMARY

Seneca County occupies an area of 328 square miles near the geographic center of New York State in the Finger Lakes region. According to the Federal census, the urban population was 10,490 and the rural population 14,493 in 1930. The 1940 census reported a total population of 25,732. Most of the people are descendants of the first settlers, who came from eastern New York, New England, and Pennsylvania. Many of the original settlers were soldiers of the Revolutionary War, who received grants of land from the Colonial government. Settlement started soon after the war, but development was slow until the completion of the Erie Canal furnished transportation for the agricultural products.

For a great many years the agriculture was based on the production of wheat and timothy hay. Wheat has continued to be an important crop, but the market for timothy hay was lost when automobiles and trucks replaced horses in the cities. Other cash crops and dairy products have taken the place of hay. Low rainfall with consequent poor development of pasture and an inadequate water supply restrict the expansion of dairying.

Fortunately, the large areas of excellent soils have allowed the development of a diversified cropping system. The climate, which is of the continental type, is not unduly severe. The presence of the two lakes has a tempering influence on climatic conditions of the adjacent slopes, so that apples, peaches, and grapes may be grown. Wheat, alfalfa, field beans, cabbage, timothy, and clover, corn, oats, barley, peas for canning, and vegetables also have an important place in the agriculture.

The well-drained soils are used for the production of cash crops. Their physical properties are good, and their calcareous subsoils are favorable for practically all crops. The drained part of the Montezuma Marsh has made available a large acreage of much land for the production of such special crops as celery, onions, and potatoes.

The less well drained soils are used for pasture and for growing hay. Where drainage is only imperfect, considerable wheat is grown, especially in those areas where it is possible to facilitate run-off by the use of open ditches. Dairying is carried on chiefly on imperfectly drained soils because they are best used for the production of forage.

The parent materials are largely of glacial origin, and much of the area is covered by a mantle of till. A large area in the northern part of the county is covered by sediments laid down in glacial lake waters. Wind-blown sand and organic deposits are the parent materials of other important areas.

Soils are discussed in the text in the following natural geographic groups: (1) Soils of the drumlins and drumlinlike hills; (2) soils of the gravel hills; (3) soils of the glacial till plain; (4) soils of the Appalachian Plateaus, Southern New York section; (5) soils of the glacial outwash plains; (6) soils of the flood plains; (7) soils of the glacial lake plain; (8) soils of the swamps and marshes; and (9) miscellaneous land types.

The well-drained soils with light to medium textures and calcareous subsoils occur through the northern part of the county, which is one of the main agricultural sections. Chiefly cash crops—wheat, beans, cabbage, peas for canning, and potatoes—are grown. Alfalfa, timothy, and clover and corn also are produced. The soils of this group include the following types: Ontario loam; Ontario fine sandy loam; Ontario loam, steep phase; Palmyra gravelly loam; Groton gravelly loam; Dunkirk fine sandy loam; and Berrien loamy fine sand. All these soils have good physical properties. They warm early in the spring and can be worked under a fairly wide range of moisture conditions without puddling. The alkaline character of the subsoil is favorable for the production of legumes.

The well-drained light-textured soils with acid subsoils include Ottawa loamy fine sand; Ottawa loamy fine sand, rolling phase; Wooster gravelly loam; Chenango gravelly loam; and Lordstown flaggy silt loam. The Ottawa soils occur in the northwest part of the county and have developed from wind-blown sands. They have a rather low fertility level, but with heavy fertilization they can be used successfully for the production of vegetables. The Wooster soil occurs in the southern part of the county in the section underlain by shale and sandstone bedrock. It is an inextensive soil used for field crops.

The soils of the drumlins and drumlinlike hills include Ontario loam; Ontario loam, steep phase; Ontario fine sandy loam; and Cazenovia silt loam. All these soils are well drained and are well suited to general and special farm crops, except Ontario loam, steep phase, which is too steep for clean cultivation. Ontario loam and Ontario fine sandy loam are especially well suited to fruit growing.

Groton gravelly loam is the only soil of the gravel hills. The relief is hummocky, and the slopes range from 10 to 25 percent, so that little of the land is well suited to cultivation. Deep-rooted crops, such

as alfalfa, and apple trees grow better on this soil than do shallower rooted crops, because excessive subsoil drainage makes the soil droughty. Only 20 percent of the land is used for agricultural purposes.

The undulating glacial till plain that forms a band across the south-central part of the county includes a number of soils with widely varying characteristics of drainage and parent material.

Honeoye silt loam, one of the most fertile and productive soils of the county, is developed from strongly calcareous glacial till. It is suitable for general farm crops and in some places is used for the production of fruit as well. Honeoye silt loam, eroded phase, occurs on steep slopes, and most of it should not be cultivated unless practices for the control of erosion are followed. Much of this soil remains in woodland. Cayuga silt loam is much like Honeoye silt loam, except that it has a somewhat heavier textured subsoil and the soil material is composed partly of lacustrine sediments mixed with calcareous till. Darien silt loam also is similar to Honeoye silt loam; but the parent till contains a higher proportion of gray shale. The slope phase of Darien silt loam is subject to severe erosion where cultivated, unless measures are taken to control erosion. Lansing silt loam is developed from glacial till composed of a mixture of gray sandstone, limestone, and shale. Internal drainage is somewhat slower than in Honeoye silt loam, and the soil is suitable for general farm crops but is somewhat less productive than the Honeoye soil. A shallow phase in which the glacial till forms a thin mantle over bedrock and a shallow steep phase are also mapped.

Farmington loam is developed from very shallow glacial till over limestone. Water drains away rapidly through crevices in the rock, and the soil is too droughty for general farm crops. It makes good pasture land in the spring and early summer. Ovid silt loam is developed from the same kind of material as Cayuga silt loam, but internal drainage is slower. Romulus silty clay loam is developed from gray shallow calcareous shaly till over shale. Both external and internal drainage are slow, so that the soil remains wet late in the spring. During late summer it may become too dry for most crops. The shallow phase of Romulus silty clay loam is even less satisfactory for crops than the normal type. Kendaia silt loam and Lyons silty clay loam are mapped in close association with the Honeoye, Cayuga, and Lansing soils and are developed from similar materials. Kendaia silt loam is rather poorly drained, and Lyons silty clay loam is very poorly drained, under natural conditions. Both soils are suitable for general farm crops if drained artificially, and both produce fair pasture without artificial drainage.

Soils of the Southern New York section of the Appalachian Plateaus are developed largely from shale and sandstone till with a very small proportion of limestone in part of them. All the soils are acid in reaction in the upper part. Wooster gravelly loam, one of the most productive of these soils, is developed from gravelly glacial till composed of sandstone and shale fragments. Only a very small area is mapped. Lordstown flaggy silt loam is a well-drained soil developed from a very thin layer of glacial till composed largely of sandstone fragments resting on sandstone and shale bedrock. Both the Lordstown and the Wooster soils are well suited for growing

potatoes, but their total area is so small that they are not used to a great extent even for this purpose. Langford silt loam and Erie silt loam are developed from glacial till composed largely of shale, with a smaller proportion of sandstone, and the parent materials of both soils contain a very small proportion of limestone. Langford silt loam is imperfectly drained, and Erie silt loam is poorly drained, as the movement of water is retarded in both by a hardpan and by the compact underlying glacial till. Chippewa silty clay loam is a dark-colored poorly drained soil in depressions associated with the Lordstown, Langford, and Erie soils. It is used chiefly for forestry and pasture.

Palmyra and Chenango gravelly loams are the soils of the glacial outwash plains. The former soil is developed from highly calcareous gravel and the latter from gravel composed of sandstone and shale fragments. Both soils are well drained and responsive to management, but the Palmyra is better suited to agriculture because of the high content of lime in its parent material and its low acidity in the upper layers.

Wayland silt loam and alluvial soils, undifferentiated, occupy the small area of plains. These soils are poorly drained. Their chief use is for pasture.

The soils of the glacial lake plain cover a wide range of texture and drainage conditions. Dunkirk fine sandy loam, Dunkirk silt loam, and Dunkirk silt loam, shallow phase, are well drained, and all except the last are well suited to general farm crops. Dunkirk silt loam, shallow phase, is somewhat droughty because limestone bedrock lies near the surface. The Dunkirk soils are developed from silty calcareous lacustrine deposits and are highly productive when properly fertilized and managed.

Collamer silt loam is developed from materials similar to but somewhat heavier than those of the Dunkirk soils. Imperfect drainage reduces somewhat the adaptability for crops and the productivity of this soil. Both Schoharie silt loam and Schoharie silty clay loam are developed from light-red calcareous lacustrine clays. The silt loam is a good soil for general farm crops, but the silty clay loam is too heavy in texture to be very highly productive. Drainage is imperfect in both soils. Poygan and Toledo silty clay loams are both dark-colored poorly drained soils developed from the same kind of material as Schoharie silty clay loam. Toledo silty clay loam is even more poorly drained than Poygan silty clay loam. These soils would be suitable for general farm crops were they adequately drained, but much of the land has not been drained and either remains in forest or is used for pasture and hay. Ottawa loamy fine sand and its rolling phase are developed from sand deposits that have been reworked more or less by the wind. The upper layers are excessively drained, but the lower layers remain moist because of a high water table. Although these soils have a rather low value for agriculture, they can be used for certain special crops. Berrien loamy fine sand is associated with and developed from the same kind of material as Ottawa loamy fine sand, but it is even more imperfectly drained than the Ottawa soils. It is more suitable for general and special farm crops than Ottawa loamy fine sand because it is somewhat more moist. Granby fine sandy loam is a poorly drained soil in the low places between areas of Ottawa loamy fine sand

and Berrien loamy fine sand. It is unsuitable for cultivation unless artificially drained.

Soils of the swamps and marshes consist of Carlisle muck; Carlisle muck, shallow phase; Edwards muck; and Wallkill silt loam. Small areas of the mucks are used for special crops, and high yields are obtained on some of them. Wallkill silt loam consists of silty deposits spread out over muck and peat. Most of this land is forested.

Rough broken land and made land are miscellaneous land types with little or no agricultural value.

LITERATURE CITED

- (1) EVERTS, ENSIGN, and EVERTS.
1876. HISTORY OF SENECA CO., NEW YORK, WITH ILLUSTRATIONS DESCRIPTIVE OF ITS SCENERY, PALATIAL RESIDENCES, PUBLIC BUILDINGS . . . AND IMPORTANT MANUFACTORIES. 170 pp., illus. Philadelphia.
- (2) HOWE, FRANK B.
1935. CLASSIFICATION AND AGRICULTURAL VALUE OF NEW YORK SOILS. N. Y. (Cornell) Agr. Expt. Sta. Bul. 619, 83 pp., illus.
- (3) LYON, T. L.
1931. FERTILIZER TESTS OF SEVERAL SOIL TYPES. N. Y. (Cornell) Agr. Expt. Sta. Bul. 520, 19 pp., illus.
- (4) MARBUT, C. F.
1935. SOILS OF THE UNITED STATES. U. S. Dept. Agr. Atlas of American Agriculture, pt. 3 (Advance sheets No. 8), 98 pp., illus.
- (5) MÓRDOFF, R. A.
1925. THE CLIMATE OF NEW YORK STATE. N. Y. (Cornell) Agr. Expt. Sta. Bul. 444, 38 pp., illus. (Revised, 1934).
- (6) SHANTZ, H. J. and ZON RAPHAEL.
1924. NATURAL VEGETATION OF THE UNITED STATES. U. S. Dept. Agr. Atlas of American Agriculture, pt. 3, sec. E, (Advance sheets No. 6), 29 pp., illus.
- (7) SOIL SURVEY DIVISION, BUREAU OF CHEMISTRY AND SOILS.
1938. SOILS OF THE UNITED STATES. U. S. Dept. Agr. Yearbook 1938 (Soils and Men) : 1017-1161, illus.
- (8) UNITED STATES WEATHER BUREAU.
1926. SUMMARIES OF THE CLIMATOLOGICAL DATA BY SECTIONS. U. S. Dept. Agr. Weather Bur. Bul. W., 2d ed., sec. 102, Central New York, 16 pp., illus.



DESCRIPTIVE LEGEND FOR SOIL MAP OF SENECA COUNTY, N. Y. (1936)

Physiographic group	Color on map	Symbol on map	Soil (type, phase, or land type)	Topography	Natural drainage	Parent material	General productivity under prevailing practices
Drumlins and drum linlike hills	Light blue	Ca.....	Cazenovia silt loam...	Undulating to rolling.	Rapid external and internal.	Red calcareous till.....	Very high to high.
		Of.....	Ontario fine sandy loam.	Undulating to rolling.	Rapid external and internal.	Light-red calcareous till...	Very high to high.
		Ol.....	Ontario loam.....	Undulating to rolling.	Rapid external and internal.	Light-red calcareous till...	Very high to high.
		Ol with phase ruling.	Ontario loam, steep phase.	Hilly.....	Rapid external and internal.	Light-red calcareous till...	Moderate.
Gravel hills	Dark blue	Gm.....	Groton gravelly loam.	Hilly.....	Very rapid external and internal.	Gray calcareous gravel....	Low.
Glacial till plain	Light green	Cs.....	Cayuga silt loam.....	Long smooth slopes...	Medium to rapid external; medium to slow internal.	Gray mixed calcareous till and lacustrine material.	Very high to high.
		Hm.....	Honeoye silt loam.....	Undulating to gently rolling.	Medium to rapid external; medium to slow internal.	Gray strongly calcareous till.	Very high to high.
		Hm with phase ruling.	Honeoye silt loam, eroded phase.	Moderate to steep slopes.	Rapid external; medium to slow internal.	Gray strongly calcareous till.	Low.
	Blue green	Fl.....	Farmington loam.....	Gently undulating....	Medium external; rapid internal.	Brown shallow till over limestone.	Moderate.
		Slate gray	Ls.....	Lansing silt loam.....	Undulating to gently rolling.	Medium to rapid external; medium to slow internal.	Gray sandstone, limestone and shale till.	Very high to high.
	Ls with phase ruling.		Lansing silt loam, shallow phase.	Undulating to gently rolling.	Medium to rapid external; medium to slow internal.	Gray sandstone, limestone, and shale till.	Moderate.
	Ls with phase ruling.		Lansing silt loam, shallow steep phase.	Steep slopes.....	Very rapid external; medium to slow internal.	Gray sandstone, limestone, and shale till.	Low.
	Yellow green	Ds.....	Darien silt loam.....	Undulating.....	Medium to rapid external; slow internal.	Gray calcareous shaly till..	Very high to high.
		Ds with phase ruling.	Darien silt loam, slope phase.	Moderate to steep slopes.	Rapid external; slow internal.	Gray calcareous shaly till..	Moderate to low.
	Dark green	Ks.....	Kendaia silt loam.....	Level to gently undulating.	Medium external; slow internal.	Gray calcareous shaly till..	Very high to high.
		Os.....	Ovid silt loam.....	Undulating.....	Medium to rapid external; slow internal.	Gray mixed calcareous till and lacustrine material.	Moderate.
	Light olive	Lc.....	Lyons silty clay loam.	Level.....	Very slow external and internal.	Gray calcareous till.....	Moderate.
		Rs.....	Romulus silty clay loam.	Level to slightly undulating.	Slow external; very slow internal.	Gray shallow calcareous shaly till over shale.	Moderate.
		Rs with phase ruling.	Romulus silty clay loam, shallow phase.	Level to slightly undulating.	Slow external; very slow internal.	Gray shallow calcareous shaly till over shale.	Moderate.
Appalachian Plateaus, Southern New York section	Dark gray	Cc.....	Chippewa silty clay loam.	Upland depressions...	Very slow external and internal.	Gray sandstone and shale till.	Low.
	Light brown	Es.....	Erie silt loam.....	Gently sloping to level.	Medium to slow external; very slow internal.	Gray alkaline sandstone and shale till.	Moderate.
	Dark olive	Lm.....	Langford silt loam.....	Medium slopes.....	Rapid external; slow internal.	Gray alkaline sandstone and shale till.	Moderate.
	Deep orange	Ll.....	Lordstown flaggy silt loam.	Medium to steep slopes.	Rapid external; medium to rapid internal.	Gray acid shallow sandstone till.	Moderate.
	Dark brown	Wg.....	Wooster gravelly loam.	Undulating to hilly...	Rapid external and internal.	Gray acid gravelly sandstone and shale till.	Moderate.
Glacial outwash plains	Orange chrome	Cl.....	Chenango gravelly loam.	Level to undulating...	Medium to slow external; rapid internal.	Gray stratified mixed gravel; no limestone.	Moderate.
	Olive yellow	Pg.....	Palmyra gravelly loam.	Level to undulating...	Medium to slow external; rapid internal.	Gray stratified mixed gravel, including limestone.	Very high to high.
Flood plains	Lemon yellow	Wa.....	Wayland silt loam.....	Level.....	High water table.....	Gray alkaline alluvium...	Low.
		A.....	Alluvial soils, undifferentiated.	Level.....	High water table.....	Mixed alluvium.....	Very low.
Glacial lake plain	Deep pink	Bs.....	Berrien loamy fine sand.	Undulating.....	Medium external; slow internal.	Yellow-gray shallow sand over clay.	Moderate.
		Od.....	Ottawa loamy fine sand.	Undulating.....	Rapid internal.....	Yellow-gray deep sand over calcareous clay.	Moderate to low.
		Od with phase ruling.	Ottawa loamy fine sand, rolling phase.	Rolling dunes.....	Rapid internal.....	Yellow-gray deep sand over calcareous clay.	Low.
	Gray pink	Df.....	Dunkirk fine sandy loam.	Undulating.....	Medium external and internal.	Yellow, gray, and pink stratified calcareous sand, silt, and clay.	Very high to high.
		Dl.....	Dunkirk silt loam.....	Undulating.....	Medium external and internal.	Yellow, gray, and pink stratified calcareous sand, silt, and clay.	Very high to high.
		Dl with phase ruling.	Dunkirk silt loam, shallow phase.	Undulating.....	Medium external and internal.	Yellow, gray, and pink stratified calcareous sand, silt, and clay.	Very high to high.
	Pink	Co.....	Collamer silt loam.....	Gently undulating....	Medium external; slow internal.	Pinkish-gray stratified calcareous silt and clay.	Very high to high.
		Sm.....	Schoharie silt loam.....	Gently undulating....	Medium external; slow internal.	Red stratified calcareous silt and clay.	Very high to high.
	Purple	Ss.....	Schoharie silty clay loam.	Level to gently undulating.	Medium to slow external; slow internal.	Red calcareous clay.....	Moderate.
	Light purple	Gf.....	Granby fine sandy loam.	Level to gently undulating.	Very slow external; slow internal.	Gray alkaline sand and silt.	Low.
	Dark purple	Pc.....	Poygan silty clay loam.	Level.....	Very slow external and internal.	Red calcareous clay.....	Moderate to low.
Te.....		Toledo silty clay loam.	Level.....	Very slow external and internal.	Gray and red calcareous clay.	Low.	
Swamps and marshes	Gray	Ws.....	Walkkill silt loam.....	Level.....	Permanently wet.....	Mineral soil washed over muck and peat.	Very low.
		Em.....	Edwards muck.....	Level.....	Permanently wet.....	Woody peat over marl...	Moderate (if drained).
		Cm.....	Carlisle muck.....	Level.....	Permanently wet.....	Woody peat over sedge peat.	Moderate (if drained).
		Cm with phase ruling.	Carlisle muck, shallow phase.	Level.....	Permanently wet.....	Shallow woody and sedge peat over clay, silt, and sand.	Moderate (if drained).
Miscellaneous land types	Pale yellow	Md.....	Made land.....	.....	.....	Artificially filled-in land..	Very low.
		Rb.....	Rough broken land...	Steep slopes.....	.....	.....	Very low.

Accessibility Statement

This document is not accessible by screen-reader software. The U.S. Department of Agriculture is committed to making its electronic and information technologies accessible to individuals with disabilities by meeting or exceeding the requirements of Section 508 of the Rehabilitation Act (29 U.S.C. 794d), as amended in 1998. Section 508 is a federal law that requires agencies to provide individuals with disabilities equal access to electronic information and data comparable to those who do not have disabilities, unless an undue burden would be imposed on the agency. The Section 508 standards are the technical requirements and criteria that are used to measure conformance within this law. More information on Section 508 and the technical standards can be found at www.section508.gov.

If you require assistance or wish to report an issue related to the accessibility of any content on this website, please email Section508@oc.usda.gov. If applicable, please include the web address or URL and the specific problems you have encountered. You may also contact a representative from the [USDA Section 508 Coordination Team](#).

Nondiscrimination Statement

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the

Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

- (1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;
- (2) fax: (202) 690-7442; or
- (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.