SOIL SURVEY

Livingston County New York

Series 1941, No. 18

Issued August 1956

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with the
CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

How to Use THE SOIL SURVEY REPORT

FARMERS who have lived in one locality for a long time learn about differences among the soils on their own farms and on farms of their immediate neighbors. What they do not know, unless soil surveys have been made, is how nearly their soils are like those at experiment stations or in other places where improved methods of farming have been successful. Their soils may be entirely different from those on which the improved methods were tried. If so, a change to the new methods may result in an expensive failure.

This report, like others of its series, is designed to help farmers avoid some of the risk and uncertainty involved in trying new or improved methods of management. It maps and describes the soils of Livingston County and allows farmers to compare their soils with those on which new methods have been successful.

SOILS OF A PARTICULAR FARM

All the soils of Livingston County are shown on the soil map that accompanies this report. First, find your farm on this soil map by using roads, streams, villages, dwellings, and other landmarks to locate its boundaries.

The next step is to identify the soils on your farm. Suppose, for example, you find on your farm an area marked with the symbol Hd. Look among the rectangles in the margin of the colored map and find the one with Hd printed on it. Just above this rectangle is the name of the soil—Honeoye loam, gently sloping phase. All areas of this soil have the same symbol and the same color, wherever they appear on the map.

What is this soil like? The answer will be found in the section, Soil Types and Phases and Miscellaneous Land Types, where all the soils are described. How much will this soil produce under different kinds of management? This information will be found in table 10, which gives estimated average long term acre yields under A, B, and C levels of management, and in table 9, which lists the management practices needed at these three levels. Compare the yields you are getting with those given at the three levels of management.

SOILS OF THE COUNTY AS A WHOLE

A general idea of the soils of the county is given in the section, The Soils of Livingston County, which tells about the principal kinds of soils, where they are found, and how they are related to one another. After reading this section, study the soil map and notice how the different kinds of soils tend to be arranged in different parts of the county. These patterns are likely associated with well-recognized differences in types of farming, land use, and land use problems.

A newcomer to the county, especially if he considers buying a farm, will want to know about the climate; the types and sizes of farms; the principal farm products and how they are marketed; the kinds of farm tenure; farm equipment and conveniences; availability of roads, railroads, and electric service; industries of the county; and cities, villages, and population characteristics. Information about all of these will be found in the sections, General Nature of the Area, and Agriculture.

This publication on the soil survey of Livingston County, New York, is a cooperative contribution from the—

SOIL CONSERVATION SERVICE

and the

CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

Series 1941, No. 15 Issued August 1956

SOIL SURVEY OF LIVINGSTON COUNTY, NEW YORK

By C. S. PEARSON, in Charge, G. A. JOHNSGARD, WILBER SECOR, H. A. KERR, P. J. WESTGATE, R. H. KIRBY, and R. B. GOODMAN, Cornell University Agricultural Experiment Station; M. G. CLINE and C. S. SIMMONS, Division of Soil Survey,[1] Bureau of Plant Industry, Soils, and Agricultural Engineering, and J. M. GRANVILLE, Soil Conservation Service, United States Department of Agriculture

Area inspected by W. J. Latimer and W. H. Lyford, Soil Survey

United States Department of Agriculture in Cooperation With the Cornell University Agricultural Experiment Station

CONTENTS

	Page
General nature of the area	4
Physiography, relief, and drainage	5
Appalachian Plateau	8
Erie-Ontario Plain	8
Climate	8
Water supply	10
Vegetation	10
Settlement and population	11
Industries, transportation, and markets	12
Agriculture	12
Land use	12
Size of farms	12
Types of farms	13
Farm tenure and labor	13
Equipment and home conveniences	14
Crops	14
Livestock	15
Soil survey methods and definitions	16
The soils of Livingston County	17
Soil types and phases and miscellaneous land types	28
Allis silt loam, sloping phase	28
Alluvial soils, undifferentiated	28
Arkport fine sandy loam:	
Gently undulating phase	28
Gently rolling phase	29
Hilly phase	29
Steep phase	29
Aurora silt loam:	
Gently sloping phase	29
Sloping phase	30
Moderately steep and steep phases	30
Bath channery silt loam:	
Rolling phase	30
Hilly phase	31
The soils of Livingston County—Continued	
Soil types—Continued	
Bath-Mardin channery silt loams:	
Rolling phases	31
Hilly phases	32
Berrien fine sandy loam, gently undulating phase	33
Braceville silt loam	33
Brockport silt loam	34
Burdett silt loam, gently sloping phase	34
Caneadea silt loam:	
Very gently sloping phase	35
Gently sloping phase	36
Sloping phase	36
Moderately steep phase	36
Caneadea silty clay loam:	
Very gently sloping phase	36
Gently sloping phase	37
Eroded gently sloping phase	37
Sloping phase	38
Eroded sloping phase	38
Moderately steep phase	38
Eroded moderately steep phase	38
Canfield gravelly silt loam:	
Gently sloping phase	39
Sloping phase	40
Moderately steep phase	40
Carlisle muck	40
Cayuga silt loam:	
Gently sloping phase	41
Sloping phase	42
Moderately steep phase	42
Cazenovia silt loam:	
Gently sloping phase	42
Sloping phase	43
Moderately steep phase	43

[1] The Division of Soil Survey was transferred to the Soil Conservation Service November 15, 1952.

Page

The soils of Livingston County—Continued
Soil types etc.—Continued
Chagrin silt loam 43
High-bottom phase 44
Chagrin fine sandy loam, High-bottom phase 44
Chagrin shaly silt loam, alluvial fan phase 44
Chenango gravelly loam:
Nearly level phase 45
Sloping phase 45
Alluvial fan phase 46
Chenango fine sandy loam:
Nearly level phase 46
Sloping phase 47
Chenango soils, undifferentiated hilly phases 47
Chippewa silt loam:
Nearly level phase 47
Gently sloping phase 48
Colwood silt loam 48
Conesus silt loam:
Gently sloping phase 48
Sloping phase 49
Dunkirk silt loam:
Rolling phase 49
Hilly phase 50
Edwards muck 50
Eel silt loam 50
Eel silty clay loam 51
Erie channery silt loam:
Gently sloping phase 51
Nearly level phase 52
Sloping phase 52
Moderately steep phase 53
Farmington loam:
Ledgy gently sloping phase 53
Nearly level and gently sloping phases 54
Fredon fine sandy loam 54
Fremont channery silt loam 55
Fulton silt loam 55
Genesee silt loam 56
Genesee fine sandy loam 56
Gravel pits 57
Hilton gravelly loam 57
Holly silty clay loam 57
Honeoye loam:
Gently sloping phase 58
Sloping phase 58
Hornell silty clay loam:
Sloping phase 59
Moderately steep phase 59
Howard gravelly loam:
Nearly level phase 59
Sloping phase 60
Howard fine sandy loam:
Nearly level phase 61
Sloping phase 61
Howard soils, undifferentiated hilly phases 61
Kendaia silt loam 62
Lakemont silty clay loam 62

Page

The soils of Livingston County—Continued
Soil types etc.—Continued
Langford gravelly silt loam:
Gently sloping phase 63
Sloping phase 63
Moderately steep phase 64
Lansing silt loam:
Gently sloping phase 64
Sloping phase 65
Moderately steep phase 65
Lima silt loam, gently sloping phase 65
Lordstown flaggy silt loam:
Sloping phase 66
Moderately steep phase 67
Steep phase 67
Lordstown stony silt loam, steep phase 67
Lyons silt loam 67
Manlius shaly silt loam:
Sloping phase 68
Moderately steep phase 68
Mardin channery silt loam:
Gently sloping phase 68
Sloping phase 69
Eroded sloping phase 70
Moderately steep phase 70
Marl pits 70
Mentor fine sandy loam 71
Middlebury silt loam 71
Odessa silt loam:
Very gently sloping phase 72
Gently sloping phase 72
Sloping phase 73
Odessa silt loam-Berrien fine sandy loam:
Gently sloping phases 73
Sloping phases 74
Ontario fine sandy loam:
Gently sloping phase 75
Sloping phase 75
Moderately steep phase 76
Ontario loam:
Gently sloping phase 76
Sloping phase 77
Eroded sloping phase 77
Moderately steep phase 77
Gray subsoil phase 78
Ottawa loamy fine sand:
Undulating phase 78
Rolling phase 79
Ovid silt loam:
Gently sloping phase 79
Nearly level phase 80
Sloping phase 80
Palmyra gravelly loam:
Nearly level phase 81
Sloping phase 82
Palmyra fine sandy loam:
Nearly level phase 82
Sloping phase 82
Palmyra soils, undifferentiated hilly phases 83
Poygan silty clay loam 83

Page

The soils of Livingston County—Continued
Soil types etc.—Continued
Retsof silt loam:
Gently sloping phase 84
Sloping phase 85
Riverwash 85
Ross silt loam 85
Rough stony land, Lordstown soil material 86
Salt dumps 86
Schoharie silty clay loam:
Undulating phase 86
Gently rolling phase 87
Eroded gently rolling phase 87
Rolling phase 87
Eroded rolling phase 87
Eroded hilly phase 88
Schoharie silt loam:
Undulating phase 88
Gently rolling phase 89
Rolling phase 89
Steep broken land, Caneadea soil material 89
Steep Chenango soils, undifferentiated 89
Steep Langford, Canfield, and Mardin soils, undifferentiated 90
Steep ledgy land 90
Steep Lansing, Ontario, and Honeoye soils, undifferentiated 90
Steep Manlius, Allis, and Hornell soils, undifferentiated 90
Steep Palmyra and Howard soils, undifferentiated 91
Steep Woostern, Valois and Bath soils, undifferentiated 91
Tioga silt loam 91
Toledo silt loam 92
Tuscarora sandy loam 92
Valois gravelly loam:
Rolling phase 93
Hilly phase 93
Volusia channery silt loam:
Gently sloping phase 94
Nearly level phase 95
Sloping phase 95
Moderately steep phase 95
Wallkill silt loam 95
Wayland silty clay loam 96
Wayland silt loam 97
Westland silt loam 97
Woostern gravelly loam:
Rolling phase 98
Hilly phase 99

Page

The soils of Livingston County—Continued
Soil types etc.—Continued
Woostern gravelly loam—Continued
Eroded hilly phase 99
Undulating phase 99
Principles of soil management 100
Planning a soil management system 100
Rotations 100
Liming and fertilization 101
Supporting practices for control of water on the land 104
Use and management of important groups of soils 105
First-class soils—good to excellent for crops or pasture 106
Management group:
1–A 106
1–B 107
1–C 107
1–D 108
Second-class soils—fair to good for crops and fair to excellent for pasture 108
Management group:
2–A 109
2–B 109
2–C 110
2–D 110
2–E 111
2–F 112
2–G 112
Third-class soils—poor to fair for crops and fair to excellent for pasture 112
Management group:
3–A 113
3–B 113
3–C 114
3–D 114
3–E 115
3–F 115
3–G 116
Fourth-class soils—very poor for crops and fair to good for pasture 116
Management group:
4–A 117
4–B 117
4–C 117
4–D 118
Fifth-class soils—poor for crops and poor for pasture 118
Management group:
5–A 118
5–B 118
Soil productivity under different systems of management 119

LIVINGSTON COUNTY is a farming area in the west-central part of New York State. The northern part has very productive soils that contain much lime, and the southern part, strongly acid, poorly drained hardpan soils of low productivity. If well managed, soils covering about 70 percent of the county will maintain their productivity when used for the crops now commonly grown. Soils covering about 16 percent of the county need special management if their productivity is to be maintained. About 14 percent of the county is covered by soils so stony, poorly drained, or shallow that they are poorly suited to agriculture.

Dairying is the main enterprise on about 45 percent of the farms. Silage crops, hay, and pasture needed for livestock account for about half the farmland in the county. Cash grain, potatoes, other field crops, and vegetables for canning are also grown.

This survey was made cooperatively by the United States Department of Agriculture and the Cornell University Agricultural Experiment Station. It is designed to aid farmers in planning the best uses for their soils. Field work was completed in 1941. Unless otherwise specifically indicated, all statements in this report refer to conditions in the county at that time.

GENERAL NATURE OF THE AREA

Livingston County is in the west-central part of New York State, about midway between the Pennsylvania State line and Lake Ontario. Geneseo, the county seat, is 25 miles south of Rochester, 55 miles east of Buffalo, and 85 miles west of Syracuse (fig. 1). Dansville,

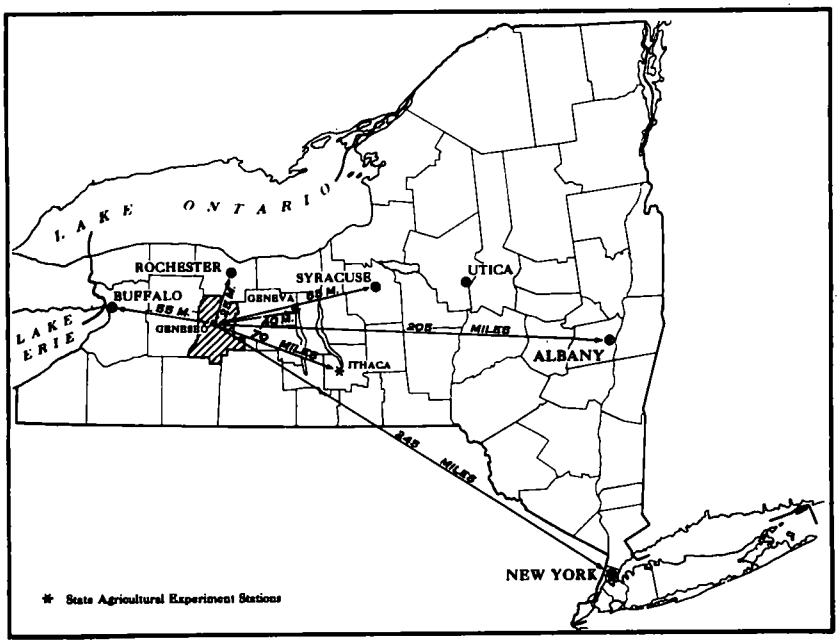


FIGURE 1.—Location of Livingston County in New York.

in the southeastern part of the county, is the largest village.

The county has a land area of approximately 641 square miles and a water area of approximately 8.5 square miles. The southern and the northern boundaries of the county are about 35 miles apart.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

The southern part of Livingston County lies on the northern edge of the Appalachian Plateau, and the northern part on the Erie-Ontario Plain. These physiographic provinces are separated by the Portage Escarpment, which is less well-defined in this area than in counties to the east and west (fig. 2).

Rock formations.[2]—The rock formations that provide most of the parent materials for soils of this county belong to the Devonian period and consist of nearly horizontal layers of limestones and interbedded shales and sandstones.

The Bertie formation (Silurian age) is the oldest in the county. It underlies a small area in the town of Caledonia along the Monroe County line. This formation consists of thin beds of gray argillaceous limestone.

Onondaga limestone (middle Devonian) is a more recent formation than the Bertie and underlies soils at somewhat higher elevations. This formation consists of relatively pure blue-gray calcium carbonate with seams of chert. Floodwaters from glaciers have exposed many stretches of bare Onondaga limestone in this county.

More recent than the Onondaga limestone, but of the middle Devonian period, is the Hamilton formation, which consists of gray and black shales, some of them calcareous, and some thin layers and lenses of limestone.

The Portage formation (upper Devonian) overlies the Hamilton formation in some parts of the county. The Portage formation consists of gray and black soft shales in the lower part and of interbedded shales and sandstone at the top.

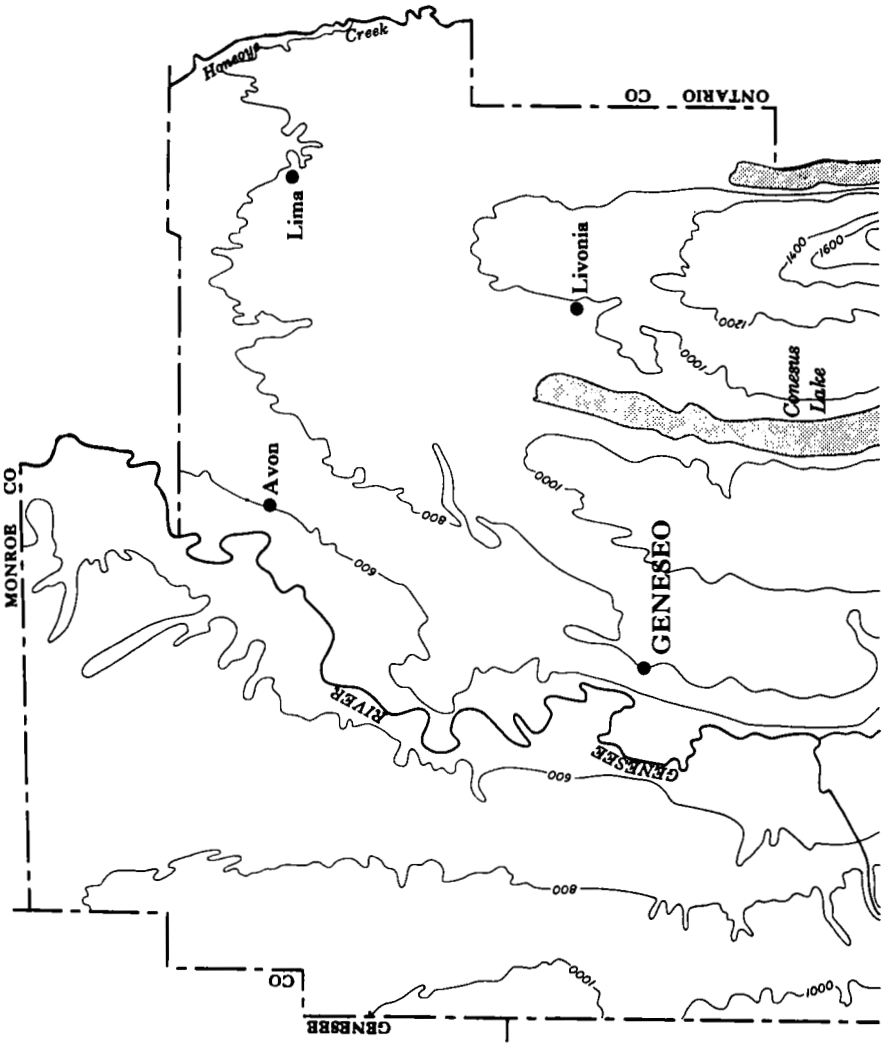
The Chemung formation (upper Devonian) occurs in the higher southern parts of the county. It consists of thin-bedded gray and dark shales and fine-grained and dense sandstone.

Glaciation.—The entire county was overridden by ice during the glacial period, and the present topography shows the effect of these glaciers.[3] The most important work of the glacier in this area was the transporting of loose rock and soil material and spreading it over the land southward. The glacier did not carry the materials far, but smoothed and rounded hills, filled valleys, and changed the drainage pattern. The preglacial Genesee River had two main branches. The eastern branch cut the wide valley in which Dansville is located, and the western branch formed the valley stretching from Portage to Nunda (pl. 1). A large block of glacial drift diverted the flow of the eastern branch from the valley in which Dansville is located. The western branch of the Genesee River was diverted from the

---

[2] MILLER, WILLIAM J. THE GEOLOGICAL HISTORY OF NEW YORK STATE. N. Y State Mus. Bul. 255, 148 pp., illus. (Rev.) 1924.

[3] FAIRCHILD, HERMAN L. GLACIAL GENESEE LAKES. Geol. Soc. Amer. Bul., vol. 7, pp. 423–452. 1896.


Honeoye
Creek
Lima
Avon
MONROE CO
Livonia
Conesus
Lake
GENESEO
RIVER
GENESEE
ONTARIO CO
GENESEE CO
1400
1600
1200
1000
800
600

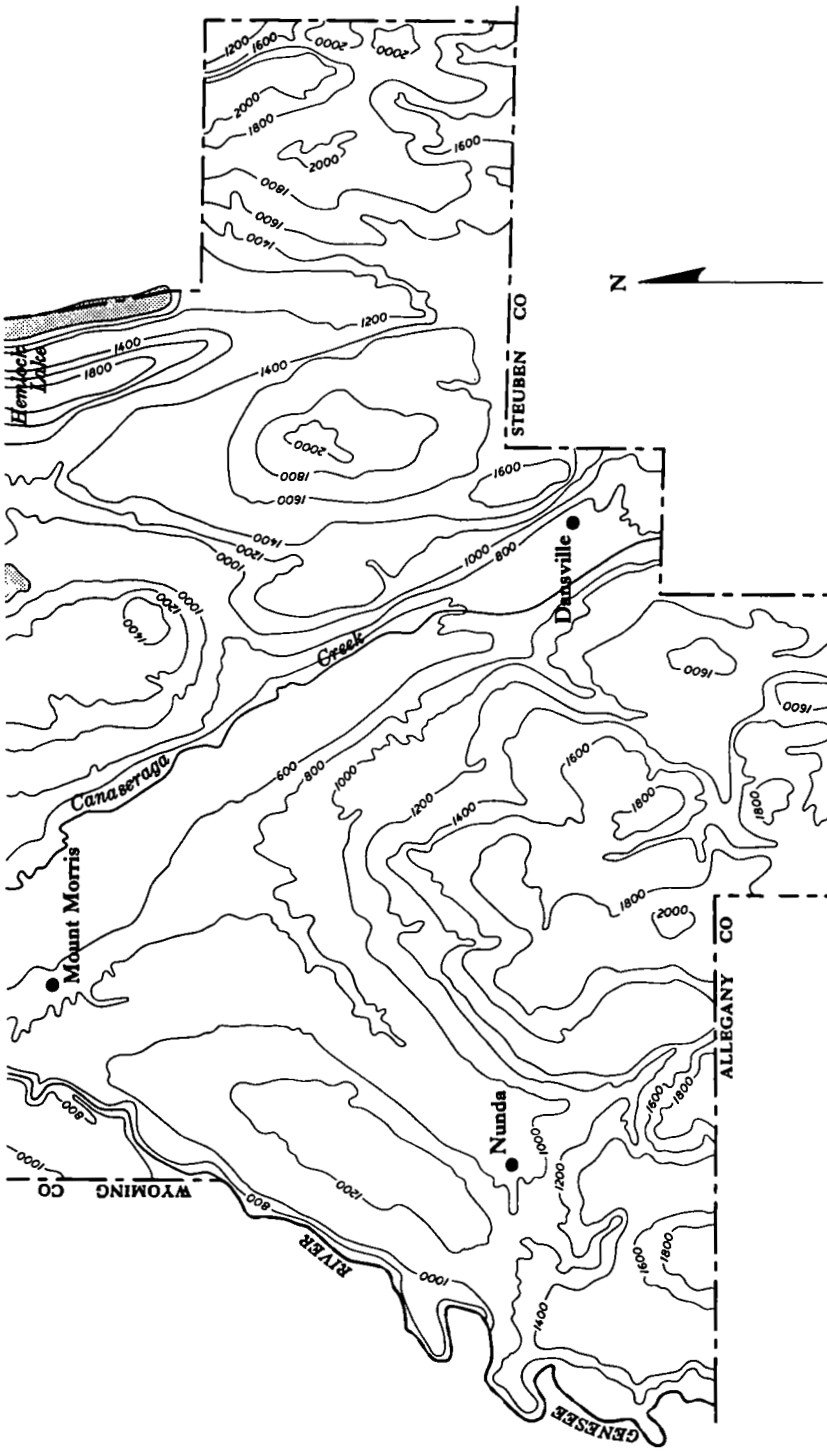


FIGURE 2.—Surface configuration of Livingston County (contour interval, 200 feet).

Nunda section by drift filling and was turned westward to cut the Portage and Mount Morris canyons.[4]

In Portage Town, an area with irregular hilly relief marks the place where the preglacial Genesee River was diverted from its original channel. This drift-filled valley has rough morainic topography and has not been cleared of timber for agricultural use. This rough land is now included in Letchworth State Park.

Most of the county now drains into the Genesee River. A small section in the southwest, which includes part of Springwater Town, drains into the Susquehanna through the Cohocton River.

APPALACHIAN PLATEAU

The southern part of the county is in the Appalachian Plateau section; it is a maturely dissected region cut by steep-sided narrow valleys that have a general north and south trend (pl. 2). The ridgetops are fairly broad and level to rolling but the slopes between them, though smooth, are generally steep, and in some places precipitous. The elevation of the ridgetops ranges from 1,500 to 2,000 feet. The normal difference in elevation between the valleys and hills ranges from 900 to 1,000 feet. The wide valley occupied by Canaseraga Creek extends from Mount Morris to Dansville and divides the hilly southern part of the county into two parts. Sparta and Springwater Towns lying east of this valley have the highest general elevation of any part of the county.

The maximum elevation in the county is 2,260 feet, in Springwater Town, and the minimum is 520 feet at the point where the Genesee River enters Monroe County on the north.

ERIE-ONTARIO PLAIN

The Erie-Ontario Plain comprises the part of the county lying north of Mount Morris, Groveland, and Conesus Towns. This area is an undulating plain 600 to 900 feet in elevation. Smooth-sided oblong hills, called drumlins, up to one-fourth mile wide and one-half mile long, rise from 50 to 120 feet above the general level of the plain.

CLIMATE[5]

Livingston County has long, moderately severe winters and short, cool summers. Temperatures below 0° F. occur occasionally from the first of December to the middle of March. The coldest months normally are January and February. The summer temperatures seldom exceed 100°, but readings above 90° are common during summer, and are occasionally recorded late in spring or early in fall. Normal monthly, seasonal, and annual temperature and precipitation for the United States Weather Bureau station at Hemlock are given in table 1. The climate at Hemlock is considered representative for Livingston County.

---

[4] FAIRCHILD, HERMAN L. THE DANSVILLE VALLEY AND DRAINAGE HISTORY OF WESTERN NEW YORK. Rochester Acad. Sci. Proc., vol. 6, pp. 217–242, illus. 1926.

[5] MORDOFF, RICHARD A., THE CLIMATE OF NEW YORK STATE. N. Y. (Cornell) Agr. Expt. Sta. Bul. 764, 72 pp., illus. 1949.

Livingston County, especially in the western and northern parts, is one of the driest regions in New York State. Long-continued droughts are rare, but periods of 1 to 2 months with a total rainfall of less than 3 inches are common. These dry periods may reduce yields but they seldom cause complete crop failure.

Rainy periods in spring, sometimes accompanied by unseasonably low temperatures, frequently cause late planting of crops. Heavy summer showers often cause considerable local damage.

The wind normally comes from the west or southwest. High winds are rare, and tornadoes have not been recorded. Some storms are accompanied by hail, but little damage is reported.

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

[ELEVATION, 920 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Total for the driest year	Total for the wettest year	Average snowfall
	° F.	*° F.*	*° F.*	*Inches*	*Inches*	*Inches*	*Inches*
December	28.5	64	−16	1.88	0.33	2.54	10.5
January	24.6	63	−20	1.81	1.89	1.95	12.5
February	23.3	63	−22	1.62	.84	2.26	10.6
Winter	25.5	64	−22	5.31	3.06	6.75	33.6
March	32.7	77	−12	2.23	.74	3.89	6.1
April	43.8	87	5	2.66	2.90	2.19	3.2
May	56.2	90	18	3.09	1.73	3.85	.1
Spring	44.2	90	−12	7.98	5.37	9.93	9.4
June	66.1	94	34	3.36	.84	3.13	0
July	70.9	98	40	3.39	2.44	4.72	0
August	68.8	98	37	2.88	1.35	2.59	0
Summer	68.6	98	34	9.63	4.63	10.44	0
September	62.2	90	29	2.66	1.66	5.42	(3)
October	51.2	88	18	2.65	2.01	4.66	.2
November	38.8	72	8	2.19	1.37	5.50	2.9
Fall	50.7	90	8	7.50	5.04	15.58	3.1
Year	47.3	98	−22	30.42	[4] 18.10	[5] 42.70	46.1

[1] Average temperature based on a 57-year record, 1897 to 1953; highest and lowest temperatures from a 34-year record, 1897 to 1930.

[2] Average precipitation based on a 57-year record, 1897 to 1953; wettest and driest years based on a 56-year record, 1898 to 1953; snowfall on a 34-year record, 1897 to 1930.

[3] Trace. [4] In 1909. [5] In 1945.

The average date of the last killing frost in spring is May 5, and the first severe frost in fall, October 14. Frosts have occurred as late as June 1 and as early as September 19. Field beans, corn, and other frost-sensitive crops are sometimes damaged by late spring frosts and must be replanted. Early fall frosts may also damage these crops.

The grazing period normally starts in April and continues until November. Grazing starts 2 to 3 weeks earlier at the lower elevations in the valleys and in the northern part of the county than it does in the southern hill section. The grazing period also varies according to soil type. The sandy and gravelly soils can be grazed sooner because they "warm up" earlier than the finer textured soils of the northern section and the hardpan soils in the south. Spring grazing may not start as early as the climate would permit. Some farmers keep their stock off the pastures until the new grass gets a good start. Otherwise, the livestock may trample the grass, compact the soil, and reduce the productivity of the pasture.

WATER SUPPLY

Livingston County, with an annual precipitation of about 30 inches, is one of the low rainfall areas of New York State. Nevertheless, the water supply for home use seldom becomes critical. The main source of water for most of the farms is dug wells. Flowing springs are important in the southern part of the county, but are not so common in the northern part. Springwater Town takes its name from the fact that this section has an unusually large number of freshwater springs with a perennial flow. Through Caledonia Town, drilled wells are needed to obtain water for farm use in some places. The depth of the permanent water table ranges from 20 feet in the northern part of the county to 8 to 15 feet in the uplands of the south.

The Genesee River furnishes abundant water for the farms bordering it. Some farmers pump from the river for overhead irrigation. Many of the smaller streams of the county are dry late in summer and early in fall, the period of low rainfall.

VEGETATION

Most of Livingston County was forested when it was settled. Early accounts describe vast forests of sugar maple, oak, hickory, black walnut, chestnut, ash, elm, butternut, basswood, and pine.

Judging from the present distribution of important species, the forested areas on flat lands along the Genesee River and Canaseraga Creek had elm, soft maple, black ash, and sycamore in the wetter places and white and red oaks, hard maple, basswood, ash, and hickory on the better drained areas. In the uplands of the northern part of the county, and near the Genesee River in the southwestern part of the county, hard maple, oaks, hickory, ash, black walnut, and basswood were the predominant species. Throughout the hilly part of southern Livingston County the most common association was hard maple and beech, with lesser amounts of yellow birch and hickory. Hemlock grew in moist places. White pine was common.

The forests were open and free of underbrush and were described as having excellent grass for cattle.

The Genesee flats in the vicinity of Mount Morris were described in accounts of Sullivan's Expedition in 1779 as a prairie with grass 10 feet high. In this location the dark grayish-brown surface layer of the well-drained soils reaches depths of 14 to 18 inches. This layer indicates an accumulation of organic matter much greater than could be expected from soils that supported forests.

The largest areas of forest now existing in the county are in the southern part on steep land not well suited to agriculture. Farm woodlots from 1 to 20 acres in size are well distributed over the county. The total area in farm woodland is 46,268 acres. The farm woodland contains mostly second- and third-growth trees of the original forest species. A few small tracts of virgin timber are left in the central part of the county.

The State has reforested some abandoned land in the southern part of the county under its program of purchase and reforestation. Some abandoned lands are slowly reforesting naturally, but the cover consists largely of bramble thickets, low shrubs, aspen, hawthorn, and other undesirable species.

SETTLEMENT AND POPULATION

The Jesuits were the first white people to explore the region now known as western New York. Their first recorded visit occurred in 1616. Later, in 1656, this religious order established a mission at East Bloomfield in Ontario County.[6]

No permanent white settlement was possible in this area before General Sullivan's Expedition of 1779 to break the Indian domination of the region. At this time, western New York belonged to the Seneca Indians, one of the tribes making up the Iroquois Federation. Important Indian villages were at present sites of Cuylerville, Mount Morris, Nunda, Dansville, Conesus, Avon, and East Avon.

After the close of the Revolution, with the Indian domination of the region broken, settlement was rapid. After New York came to an agreement with Massachusetts about sovereignty over western New York, the land was purchased by investors from New England. A land office was opened in Canandaigua (in Ontario County) in 1789 for the sale of land to settlers. Settlement started in 1790 after the roads through the wilderness were improved. Probably the first permanent settlement within the present borders of Livingston County was that at Williamson, a few miles south of the present site of Geneseo. Most of the first settlers came from New England and Pennsylvania. The county of Livingston was organized in 1821 from parts of Genesee and Ontario Counties.

In 1950, the population of Livingston County was 40,257, of which 8,993 was classified as rural farm, and 19,723 as rural nonfarm. The important villages are Geneseo, the county seat, with a population of 2,838, Dansville (pop. 5,253), Mount Morris (pop. 3,450), Avon (pop. 2,412), and Caledonia (pop. 1,683). Much of the land has been held from generation to generation by the same family and is now owned and operated by descendants of the first settlers and owners.

[6] DOTY, LOCKWOOD R., ed., HISTORY OF LIVINGSTON COUNTY, NEW YORK, FROM ITS EARLIEST TRADITION TO THE PRESENT, TOGETHER WITH EARLY TOWN SKETCHES. 142 pp. Jackson, Mich., 1905.

INDUSTRIES, TRANSPORTATION, AND MARKETS

All towns in Livingston County except Ossian have railroad service. The local villages serve as trading centers for the rural population. The nonfarm population of 31,264 consumes only a small part of the agricultural products grown. Three canning factories process farm products, and fairly large amounts of produce are trucked to the neighboring cities of Buffalo and Rochester.

In 1950, two-thirds of the farms in the county were located on hard-surfaced roads, and more than half of the others were on gravel-surfaced roads. Less than 15 percent of the farms were located on dirt or unimproved roads. The average distance to the trading center most frequently visited was 4 miles, and one-tenth of a mile of this was over dirt or unimproved road.

AGRICULTURE

LAND USE

The approximate land area of Livingston County is 408,320 acres. According to the 1950 census, 326,831 acres, or 80 percent of this, was land in farms, distributed as follows:

	Land in farms	
	Acres	*Percent*
All cropland	218, 664	66. 9
Harvested	146, 362	44. 8
Pastured	44, 043	13. 5
Idle or unharvested	28, 259	8. 6
All woodland	46, 268	14. 2
Pastured	14, 683	4. 5
Not pastured	31, 585	9. 7
All other land pastured	39, 732	12. 1
Wasteland and other land in farms not cropped, pastured, or in woods	22, 167	6. 8

This tabulation shows that land pastured totaled 30.1 percent of the land in farms. Much of the wasteland is in the towns of Ossian, Nunda, West Sparta, and Springwater, where elevations are high and the soils are poorer than in the northern part of the county.

The largest area of nonfarm land in the county is in Letchworth State Park, which extends along the Genesee River from Portage nearly to Mount Morris. Most of this land is steep, hilly, and forested; hence, very poorly suited to agriculture. The steep forested slope bordering Hemlock Lake is controlled by the city of Rochester, which takes its water from this lake. The State Department of Conservation has purchased some abandoned land in the hilly southern part of the county for reforestation. Roads, railroads, and village sites occupy other land not included in farms.

SIZE OF FARMS

The farms of the county are grouped by size class in table 2, and the acreage and percentage of land in farms for each class is shown. This table shows that farms 100 to 259 acres and 260 to 999 acres in size each account for about 40 percent of the land in farms. The remaining farms are about evenly divided between the more than 1,000-acre class, and the less than 100-acre class.

TABLE 2.—*Size of farms and land in farms in 1950, Livingston County, N. Y.*

Size class	Number of farms	Land in farms	
		Acres	Percent
All farms	1,835	326,831	100.0
Under 10 acres	127	618	.2
10 to 29 acres	122	2,231	.7
30 to 49 acres	98	3,786	1.2
50 to 69 acres	130	7,603	2.3
70 to 99 acres	182	15,492	4.7
100 to 139 acres	286	33,487	10.2
140 to 179 acres	222	34,871	10.7
180 to 219 acres	184	36,659	11.2
220 to 259 acres	128	30,228	9.3
260 to 499 acres	278	93,613	28.6
500 to 999 acres	63	39,493	12.1
1,000 acres and over	15	28,750	8.8

TYPES OF FARMS

In 1950, there were 1,835 farms in Livingston County. Of this total, 451 farms, or 24.6 percent, were not classified. The remaining farms were classified as follows:

Type of farm:	*Number*	*Percent of total farms*
Dairy	832	45.3
Other livestock	68	3.7
Poultry	54	2.9
Cash grain	196	10.7
General (field crop and livestock)	150	8.2
Other field crop	62	3.4
Vegetable	22	1.2

Dairying is the most common type of farming in Livingston County. In West Sparta, Ossian, and Nunda Towns, the farmers depend almost entirely on dairying. Income from sale of milk in Springwater and West Sparta Towns is supplemented by sale of potatoes. A few farmers in this section specialize in potatoes. Through the Canaseraga Valley and on the alluvial soils along the Genesee River, dairy farming is practiced, but growing of nursery stock and vegetable crops for canning is more important. The uplands adjacent to the Genesee River are used mostly for dairying, but winter wheat, dry beans, and sweet corn and peas for canning are also grown. The acreage of the vegetable crops is greatest within a few miles of the canning factories at Mount Morris and Avon.

FARM TENURE AND LABOR

Most of the farm operators in Livingston County owned their land in 1950. Full owners operated 67 percent of the farms, and part owners an additional 21.5 percent. Hired managers operated 0.5 percent of the farms. All tenants operated 11.0 percent of the farms.

In 1949, 43.3 percent of the farm operators supplemented their farm income by work off the farm, and 28.7 percent of the farm operators had more income from their outside jobs than they did from the sale of agricultural products. Labor was hired at some time during 1949 on 64.9 percent of the farms.

EQUIPMENT AND HOME CONVENIENCES

A total of 2,358 tractors other than garden tractors were reported in 1950 on 1,502 farms; 1,200 motortrucks on 941 farms, and 2,238 automobiles on 1,600 farms. Electricity was reported on 1,732 farms, all except 5 of which were connected to a power line. In 1950, farmers also reported owning 824 milking machines, 460 grain combines, and 284 hay balers. Corn pickers were reported on 107 farms. Telephones served 1,350 farms.

CROPS

Silage crops, hay, and pasture for livestock now occupy nearly half the land in farms in Livingston County. The next most extensive crop is winter wheat. Corn, for grain and for silage, is an important part of the economy, and beans are also grown on a large acreage. Vegetables for canning and processing, especially sweet corn and green peas, are a principal crop of the county. Many tree fruits and grapes are produced. Table 3 gives the acreage of some of the important crops of the county in stated years, and table 4 the number of bearing fruit trees, sugar maples, and grapevines.

TABLE 3.—*Acreage of principal crops in Livingston County, N. Y., in stated years*

Crop	1919	1929	1939	1949
	Acres	*Acres*	*Acres*	*Acres*
Corn, for all purposes	5, 266	13, 175	14, 147	19, 265
For grain	(1)	1, 633	3, 344	6, 402
Small grains threshed:				
Oats	20, 289	15, 288	15, 197	17, 223
Wheat:				
Winter	31, 054	19, 150	20, 071	29, 141
Spring		186	253	342
Rye	5, 265	522	1, 162	664
Barley	6, 585	3, 813	2, 716	709
Buckwheat	2, 320	1, 855	1, 372	1, 803
Mixed grains	1, 629	7, 261	6, 430	3, 382
Potatoes, white, for sale and home use	7, 474	5, 091	3, 937	3, 377
Beans, dry	6, 269	13, 700	19, 420	14, 720
Soybeans, for all purposes	(1)	23	906	77
All hay	79, 693	50, 485	51, 646	44, 392
Timothy and clover, alone or mixed	72, 424	41, 700	27, 632	29, 117
Alfalfa	5, 418	9, 308	17, 730	12, 847
Small grains cut for hay	225	100	292	150
Other hay cut [2]	1, 626	2, 377	5, 992	2, 278
Forage crops	3, 220	3, 005	1, 265	493
Silage crops	5, 691	8, 538	9, 800	13, 092
Alfalfa or clover for seed	(1)	909	613	631
Other field crops for seed	(1)	104	(1)	64

See footnotes at end of table.

TABLE 3.—*Acreage of principal crops in Livingston County, N. Y., in stated years*—Continued

Crop	1919	1929	1939	1949
Vegetables and small fruits for sale:	*Acres*	*Acres*	*Acres*	*Acres*
Sweet corn	2, 753	3, 576	5, 113	6, 919
Peas, green	1, 878	2, 161	2, 068	1, 109
Dry	193	438	298	110
Beans, string, snap, or wax	250	230	131	38
Green limas	(1)	10	59	160
Tomatoes	14	7	186	56
Cabbage	593	859	427	147
Beets, table	143	67	403	358
Squash	1	2	2	13
Spinach	162	151	10	31
Onions	(1)	13	27	55
Carrots	23	5	22	18
Asparagus	6	82	36	17
Celery	215	163	42	82
Strawberries	25	34	35	13
Raspberries	77	56	46	14
Other small fruits	56	15	38	20

[1] Not reported.
[2] Wild hay and tame grasses not otherwise listed.

TABLE 4.—*Fruit trees, sugar maples, and grapevines of bearing age in Livingston County, N. Y.*

Trees or vines	1920	1930	1940	1950
	Number	*Number*	*Number*	*Number*
Apple	117, 014	83, 167	19, 085	19, 039
Peach	15, 222	6, 968	3, 456	1, 861
Pear	12, 744	10, 542	1, 883	1, 143
Cherry	11, 020	7, 503	8, 550	3, 575
Plum and prune	7, 763	3, 465	1, 252	1, 020
Maple (tapped for sirup)	3, 727	(1)	513	611
Grape	108, 562	62, 961	105, 334	105, 661

[1] Not reported.

LIVESTOCK

Well over half of the farms in Livingston County are livestock farms. Most of these are dairies. The number of cattle on farms has increased considerably in the last few decades. In 1950 milk cows totaled 19,000 head, or more than half of the 36,342 head of cattle on farms. The number of horses and mules has declined to about one-fifth of the 1920 figure because work stock is being replaced by tractors. The raising of sheep and chickens, while still important, has declined. Hog production, although not up to the 1920 figure, has been increasing slowly for the last 20 years. Table 5 gives the number of livestock on farms in stated years.

TABLE 5.—*Number of livestock, poultry, and beehives on farms in Livingston County, N. Y., in stated years*

Livestock	1920	1930	1940	1950
Cattle and calves	28, 515	30, 879	[1] 28, 004	36, 342
Horses and colts	12, 950	7, 739	[1] 6, 520	2, 359
Mules and mule colts	139	83	[1] 78	48
Sheep and lambs	37, 396	34, 515	[2] 26, 046	15, 240
Hogs and pigs	13, 760	3, 928	[3] 4, 424	5, 168
Chickens	165, 943	[1] 138, 009	[3] 115, 102	[3] 97, 645
Beehives	2, 934	([4])	1, 598	[5] 1, 532

[1] Over 3 months old.
[2] Over 6 months old.
[3] Over 4 months old.
[4] Not reported.
[5] In 1949.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field. The soil scientist walks over the area at intervals not more than one-quarter mile apart and bores into the soil with an auger or digs holes with a spade. Each such boring or hole shows the soil to consist of several distinctly different layers, called horizons, which collectively are known as the soil profile. Each of these layers is studied carefully for some of the things that affect plant growth.

The color of each layer is noted. The darkness of the topmost layer is usually related to its content of organic matter; streaks and spots of gray, yellow, and brown in lower layers generally indicate poor drainage and poor aeration.

Texture, or the content of sand, silt, and clay in each layer, is first determined by the way the soil feels when rubbed between the fingers and is later checked by mechanical analysis in the laboratory. Texture has much to do with the quantity of moisture the soil will hold in a form available to plants, whether plant nutrients or fertilizers will be held by the soil in forms available to plants or will be leached out, and how difficult the soil may be to cultivate.

Structure, or the way the soil granulates, and the amount of pore or open space between particles indicate how easily plant roots can penetrate the soil and how easily water enters it.

Consistence, or the tendency of the soil to crumble or to stick together, indicates how difficult it may be to keep the soil open and porous under cultivation. The kind of rocks and the parent material from which the soil has been developed affect the quantity and kind of plant nutrients the soil may have naturally.

Simple chemical tests show how acid the soil is. The depth to bedrock or to compact layers is determined. The quantity of gravel or rocks that may interfere with cultivation, the steepness and kind of slope, the quantity of soil lost by erosion, and other external features are observed.

On the basis of all these characteristics, soil areas that are much alike in the kind, thickness, and arrangement of their layers are mapped as one soil type. Some soil types are separated into two or more phases. For example, if a soil type has slopes that range from 0 to 30 percent, the type may be mapped in three phases. A soil

type is divided into phases primarily because of differences in the soil other than those of kind, thickness, and arrangement of layers. The slope of a soil, the spacing of outcropping bedrock, the extent of erosion, or artificial drainage are examples of features that might cause a soil type to be divided into phases.

Two or more soil types may have similar profiles; that is, the soil layers may be nearly the same, except that the texture, especially of the surface layer, will differ. As long as the other characteristics of the soil layers are similar, these soils are considered to belong in the same soil series. A soil series therefore consists of all the soil types that, except for texture, particularly texture of the surface layer, are about the same in kind, thickness, and arrangement of layers. The name of a place near where a soil series was first found is chosen as the name of the series. Thus, the name for the Bath series is taken from the name of a city in Steuben County, N. Y.

When very small areas of two or more kinds of soil are so intricately mixed that they cannot be shown separately on a map of the scale used, they are mapped together, and the areas of the mixture are called a soil complex. Odessa silt loam-Berrien fine sandy loam, gently sloping phases, is a complex of Odessa silt loam, gently sloping phase, and Berrien fine sandy loam, gently sloping phase, in Livingston County.

Areas such as gorges of deeply incised streams, where little true soil exists, are not designated with series and type names but are given descriptive names, such as Steep ledgy land.

The soil type, or where the soil type is subdivided, the soil phase, is the unit of mapping in soil surveys. It is the unit or the kind of soil that is most nearly uniform and has the narrowest range of characteristics. For this reason, land use and soil management practices can be more definitely specified for a phase or a type than for broader groups of soils that contain more variation. One can say, for example, that Honeoye loam, gently sloping phase, is well suited to all of the crops commonly grown in the county and that they can be produced in short rotations with only 1 year of a soil-conserving crop and with relatively simple practices for water control. Statements as specific as this cannot be made for Honeoye loam, the soil type, because it contains another phase, the sloping phase.

The drainage terms used in this report conform to those recently adopted by the Soil Survey as standard. The soil drainage classes of the soil series of Livingston County are shown in table 6.

THE SOILS OF LIVINGSTON COUNTY

The soils of Livingston County vary widely in properties of the profile, and in relief, drainage, and depth. The northern part of the county is crossed by the belt of lime-bearing rocks running east and west through the central part of New York State. The parent materials of these soils contained enough limestone to affect the soils significantly. These "high-lime soils" require little or no additional lime for crops. Glacial action extended the influence of this limestone south of the outcrop for 10 to 15 miles. The effect of the lime-rich parent material gradually decreases as the distance south increases.

Through the southern part of the county are interbedded shales and sandstones that contain little or no lime. The soils developed

344679—56——2

from these rocks are deficient in lime. Many of these soils have compact subsoils and are poorly drained or imperfectly drained "hardpan" soils. In many places throughout the county the bedrock is within 30 inches of the surface, and outcrops are common.

Soils that developed from parent materials derived from local shales and sandstone are usually stonier than soils developed from mixed local and transported materials. None of the soils, however, contain stones in quantities that greatly hinder cultivation.

Approximately 60 percent of the total area of the county, largely in the uplands of the southern part, consists of silt loams. Of this total area of silt loams, 23.2 percent has stones or gravel in the surface soil.

Five percent of the acreage in the county consists of soils finer textured than silt loam; that is, silty clay loams. Twenty-six percent of the county is made up of soils coarser textured than silt loams; that is, of loamy fine sands to loams. About half of these loamy fine sands to loams are gravelly loams that developed from the water-sorted deposits on the outwash plains and terraces. About 9 percent of the county area is covered by water or consists of steep undifferentiated soils or muck.

Surface and internal drainage are good in approximately 46 percent of the county, moderately good or imperfect in 33 percent, and poor or very poor in 14 percent. About 5 percent of the soils of the county are too wet to be used for agriculture. "Hardpan" soils occupy approximately 30 percent of the area, principally in the southern part of the county. The depth to hardpan ranges from 15 to 18 inches in soils where drainage is poor, and from 18 to 20 inches in the moderately well drained soils.

Soils with enough natural lime to grow alfalfa occupy 20 percent of the county, and medium-lime soils that need a little lime to start this crop occupy another 20 percent. Sixty percent of the soils are medium to very strongly acid and do not produce legumes such as red clover or alfalfa well unless they receive periodic applications of lime.

Serious erosion has reduced the productivity of approximately 5 percent of the county. Moderate erosion, which means that 25 to 75 percent of the surface soil has been removed, is characteristic of about 42 percent of the county. On soils covering 52 percent of the county, erosion has not been active, owing to good soil management, forest cover, or level relief. A small percentage of the county, about 2,500 acres, has been so gullied that it has little usefulness for crops.

Soils covering 70 percent of the county, if used under a good system of management, are capable of producing the crops commonly grown in this dairy region. Soils on 16 percent of the county need special practices if their productivity is to be maintained. Approximately 14 percent of the county is occupied by soils very poorly suited to general agriculture because of relief, stoniness, shallow depth, or excess water.

After taking all of these characteristics and others into consideration, the soils of the county were classified and placed in soil series. The parent material and drainage of these soils series are shown in table 6. In table 7 are listed the subdivisions of these series—the soil types and phases, or mapping units, and the percentage of each in cropland, pasture, woodland, land left idle, or land in urban uses.

TABLE 6.—*Parent material, drainage, and relationships of drainage and parent material for the soil series of Livingston County, N. Y.*

Parent material	Drainage				
	Good	Moderate	Imperfect	Poor	Very poor
Glacial till, medium textured:					
Limestone, shallow to moderately deep	Farmington				
Limestone and shale, high lime	Honeoye	Lima		Kendaia	Lyons.
Limestone and pink sandstone, high lime	Ontario	Hilton		do	Do.
Shale and limestone, medium lime	Lansing	Conesus		do	Do.
Shale and sandstone, low lime	Valois	Langford	Erie	Erie	
Sandstone and shale, very low lime:					
Deep, firm	Bath	Mardin	Fremont	Volusia	Chippewa.
Deep, friable	Woostern	Canfield			
Shallow, friable	Lordstown				
Shale, shallow	Manlius				
Glacial till, moderately fine textured:					
Lake clay mixed with high-lime till to depth of 3 feet.	Cayuga	Ovid[1]	Ovid		
Limestone and reworked lake clays, high lime	Cazenovia				
Shale and reworked lake clays, medium lime			Burdett		
Calcareous shale, shallow, partly residual		Brockport			
Dark-gray shale, shallow, medium to low lime		Retsof	Retsof		
Soft gray shale, shallow, medium to low lime		Aurora	Aurora		
Acid gray shale, shallow, strongly acid		Hornell	Hornell	Allis	
Glacial outwash:					
High-lime sand and gravel	Palmyra			Fredon	Westland.
Medium-lime sand and gravel	Howard			do	Do.
Low-lime sand and gravel, deep	Chenango	Braceville			
Low-lime sand and gravel, over clay		Tuscarora			

[1] Most of the Ovid soils of Livingston County have imperfect drainage, but the more sloping parts are somewhat better drained and fall within the lower part of the range of moderate drainage.

TABLE 6.—*Parent material, drainage, and relationships of drainage and parent material for the soil series of Livingston County, N. Y.*—Continued

Parent material	Drainage				
	Good	Moderate	Imperfect	Poor	Very poor
Glacial lake sands:					
Medium to high lime	Arkport				
Very low lime, deep	Ottawa				
Very low lime, moderately deep over clay		Berrien			
Glacial lake silts:					
High to medium lime	Dunkirk				Colwood.
Glacial lake clay and silt:					
High lime, reddish	Schoharie	Schoharie	Odessa	Lakemont	Poygan.
High lime, gray			Fulton	Fulton	Toledo.
Medium lime, gray			Caneadea	Caneadea	Do.
Recent alluvium:					
High lime, low flood plains	Genesee	Eel		Wayland	Wayland.
High lime, low flood plains, dark surface soil	Ross				
High lime, older high terraces	Mentor				
Medium lime, low flood plains	Chagrin	Eel		Wayland	Do.
Low lime, low flood plains	Tioga	Middlebury		Holly	Holly.
Low lime, over organic deposits					Wallkill.
Organic deposits:					
Neutral, deep					Carlisle.
Neutral, shallow over marl					Edwards.

TABLE 7.—*Approximate acreage, proportionate extent, and use of soils of Livingston County, N. Y.*

Soil name	Area		Percentage in—				
	Acres	Percent of county	Cropland	Land left idle	Pasture	Woodland	Urban uses
Allis silt loam, sloping phase	1,276	0.3	26	10	42	21	1
Alluvial soils, undifferentiated	4,645	1.1	11	5	46	37	1
Arkport fine sandy loam:							
Gently undulating phase	2,968	.7	79	4	7	6	4
Gently rolling phase	257	.1	37	11	23	25	4
Hilly phase	384	.1	29	9	50	11	1
Steep phase	170	(1)	1	2	49	44	4
Aurora silt loam:							
Gently sloping phase	382	.1	63	4	5	27	1
Sloping phase	614	.2	49	10	30	11	--------
Moderately steep and steep phases	295	.1	31	9	46	13	1
Bath channery silt loam:							
Rolling phase	8,782	2.1	56	12	6	25	1
Hilly phase	1,964	.5	29	28	12	30	1
Bath-Mardin channery silt loams:							
Rolling phases	1,542	.4	48	11	15	25	1
Hilly phases	365	.1	32	9	12	47	--------
Berrien fine sandy loam, gently undulating phase	1,722	.4	64	1	20	5	10
Braceville silt loam	836	.2	66	11	9	8	6
Brockport silt loam	406	.1	67	--------	26	5	2
Burdett silt loam, gently sloping phase	977	.2	70	11	10	8	1
Caneadea silt loam:							
Very gently sloping phase	4,043	1.0	67	7	17	8	1
Gently sloping phase	2,512	.6	55	14	22	8	1
Sloping phase	701	.2	36	10	30	23	1
Moderately steep phase	601	.1	14	10	19	57	--------

See footnotes at end of table.

TABLE 7.—*Approximate acreage, proportionate extent, and use of soils of Livingston County, N. Y.*—Continued

Soil name	Area		Percentage in—				
	Acres	Percent of county	Cropland	Land left idle	Pasture	Woodland	Urban uses
Caneadea silty clay loam:							
Very gently sloping phase	2,231	0.6	33	11	35	8	13
Gently sloping phase	480	.1	36	18	31	10	5
Eroded gently sloping phase	592	.1	59	11	21	8	1
Sloping phase	109	(1)	11	9	28	47	5
Eroded sloping phase	720	.2	57	12	25	6	--------
Moderately steep phase	103	.1	3	--------	41	56	--------
Eroded moderately steep phase	648	.2	11	17	38	14	20
Canfield gravelly silt loam:							
Gently sloping phase	6,998	1.7	62	9	14	14	1
Sloping phase	3,473	.8	53	13	15	18	1
Moderately steep phase	1,021	.2	24	21	11	43	1
Carlisle muck	2,403	.6	47	11	13	28	1
Cayuga silt loam:							
Gently sloping phase	3,096	.7	73	3	15	5	4
Sloping phase	740	.2	53	3	32	10	2
Moderately steep phase	646	.1	17	16	46	19	2
Cazenovia silt loam:							
Gently sloping phase	2,879	.7	75	5	13	4	3
Sloping phase	356	.1	57	6	20	1	16
Moderately steep phase	131	(1)	37	15	34	14	--------
Chagrin silt loam	309	.1	39	20	13	24	4
High-bottom phase	1,327	.3	67	8	6	15	4
Chagrin fine sandy loam, high-bottom phase	109	(1)	66	17	17	--------	--------
Chagrin shaly silt loam, alluvial fan phase	1,118	.3	76	5	12	2	5
Chenango gravelly loam:							
Nearly level phase	2,566	.6	67	7	7	9	10
Sloping phase	806	.2	61	14	9	14	2
Alluvial fan phase	1,243	.3	65	6	16	8	5

Chenango fine sandy loam:							
Nearly level phase	596	.1	66	9	11	11	3
Sloping phase	339	.1	78	14	1	5	2
Chenango soils, undifferentiated hilly phase	363	.1	46	12	25	16	1
Chippewa silt loam:							
Nearly level phase	1,981	.5	23	16	30	30	1
Gently sloping phase	824	.2	22	13	46	18	1
Colwood silt loam	903	.2	26	1	47	26	--------
Conesus silt loam:							
Gently sloping phase	6,035	1.5	69	4	19	7	1
Sloping phase	114	(1)	41	--------	48	11	--------
Dunkirk silt loam:							
Rolling phase	564	.1	49	4	26	19	2
Hilly phase	210	.1	44	6	21	28	1
Edwards muck	1,487	.4	5	27	15	53	--------
Eel silt loam	10,901	2.6	61	3	27	8	1
Eel silty clay loam	1,312	.3	46	7	32	14	1
Erie channery silt loam:							
Gently sloping phase	7,691	1.8	53	11	20	15	1
Nearly level phase	2,476	.6	76	8	9	6	1
Sloping phase	1,676	.4	52	9	25	13	1
Moderately steep phase	135	(1)	59	1	20	20	--------
Farmington loam:							
Ledgy gently sloping phase	3,241	.8	50	9	28	8	5
Nearly level and gently sloping phases	777	.2	57	2	39	2	--------
Fredon fine sandy loam	1,658	.4	84	3	7	5	1
Fremont channery silt loam	1,066	.3	45	16	12	26	1
Fulton silt loam	1,842	.4	62	5	20	12	1
Genesee silt loam	8,163	1.9	66	2	23	8	1
Genesee fine sandy loam	2,370	.6	34	4	28	33	1
Hilton gravelly loam	1,286	.3	79	2	15	3	1
Holly silty clay loam	1,104	.3	35	20	14	31	--------
Honeoye loam:							
Gently sloping phase	14,177	3.4	82	2	10	4	2
Sloping phase	838	.2	72	1	23	3	1
Hornell silty clay loam:							
Sloping phase	501	.1	22	13	11	54	--------
Moderately steep phase	515	.1	8	7	13	72	--------

See footnotes at end of table.

TABLE 7.—*Approximate acreage, proportionate extent, and use of soils of Livingston County, N. Y.*—Continued

Soil name	Area		Percentage in—				
	Acres	Percent of county	Cropland	Land left idle	Pasture	Woodland	Urban uses
Howard gravelly loam:							
Nearly level phase	3,193	0.8	62	5	5	7	21
Sloping phase	1,975	.5	48	9	21	10	12
Howard fine sandy loam:							
Nearly level phase	903	.2	78	3	12	2	5
Sloping phase	692	.2	42	4	17	22	15
Howard soils, undifferentiated hilly phases	1,379	.3	37	13	23	26	1
Kendaia silt loam	7,964	1.9	57	4	24	14	1
Lakemont silty clay loam	2,030	.5	40	4	40	15	1
Langford gravelly silt loam:							
Gently sloping phase	2,863	.7	72	7	11	8	2
Sloping phase	836	.2	50	17	20	13	--------
Moderately steep phase	545	.1	23	17	21	38	1
Lansing silt loam:							
Gently sloping phase	9,851	2.4	75	6	12	6	1
Sloping phase	2,462	.6	63	11	16	8	2
Moderately steep phase	1,306	.3	20	20	29	24	7
Lima silt loam, gently sloping phase	18,046	4.7	73	3	17	6	1
Lordstown flaggy silt loam:							
Sloping phase	3,918	.9	36	12	19	32	1
Moderately steep phase	4,699	1.1	19	13	21	46	1
Steep phase	3,161	.8	40	9	16	34	1
Lordstown stony silt loam, steep phase	3,513	.9	3	6	7	83	1
Lyons silt loam	2,373	.6	24	8	30	38	--------
Manlius shaly silt loam:							
Sloping phase	314	.1	67	4	6	20	3
Moderately steep phase	326	.1	51	20	19	10	--------

Mardin channery silt loam:							
Gently sloping phase	7,477	1.8	52	13	11	23	1
Sloping phase	4,469	1.0	37	20	14	28	1
Eroded sloping phase	456	.1	40	22	20	18	--------
Moderately steep phase	1,735	.4	15	18	27	40	--------
Mentor fine sandy loam	623	.2	52	1	20	1	26
Middlebury silt loam	1,143	.3	49	10	16	22	3
Odessa silt loam:							
Very gently sloping phase	20,898	5.4	49	3	35	11	2
Gently sloping phase	3,086	.8	34	6	34	21	5
Sloping phase	671	.2	31	12	30	26	1
Odessa silt loam:							
Berrien fine sandy loam, gently sloping phases	881	.2	80	--------	11	7	2
Odessa silt loam: Berrien fine sandy loam, sloping phases	300	.1	26	11	51	10	2
Ontario loam:							
Gently sloping phase	17,239	4.5	80	2	12	4	2
Sloping phase	2,991	.7	66	4	21	7	2
Eroded sloping phase	818	.2	90	2	7	1	--------
Moderately steep phase	911	.2	37	4	45	13	1
Gray subsoil phase	2,089	.5	71	4	8	17	--------
Ontario fine sandy loam:							
Gently sloping phase	5,807	1.4	77	1	11	6	5
Sloping phase	848	.2	56	1	23	15	5
Moderately steep phase	171	(1)	38	3	28	29	2
Ottawa loamy fine sand:							
Undulating phase	624	.2	54	2	27	12	5
Rolling phase	377	.1	27	3	44	23	3
Ovid silt loam:							
Gently sloping phase	5,193	1.3	72	4	17	6	1
Nearly level phase	7,635	1.8	69	7	15	8	1
Sloping phase	1,963	.5	54	12	22	11	1
Palmyra gravelly loam:							
Nearly level phase	7,686	1.8	83	2	10	2	3
Sloping phase	2,075	.5	78	2	15	1	4
Palmyra fine sandy loam:							
Nearly level phase	488	.1	51	3	32	9	5
Sloping phase	192	(1)	66	4	21	1	8
Palmyra soils, undifferentiated hilly phases	633	.2	48	6	30	11	5

See footnotes at end of table.

TABLE 7.—*Approximate acreage, proportionate extent, and use of soils of Livingston County, N. Y.*—Continued

Soil name	Area		Percentage in—				
	Acres	Percent of county	Cropland	Land left idle	Pasture	Woodland	Urban uses
Poygan silty clay loam	934	0.2	28	3	48	21	--------
Riverwash	554	.1	2	11	28	59	--------
Retsof silt loam:							
Gently sloping phase	7,175	1.7	67	7	17	8	1
Sloping phase	932	.2	53	20	21	6	--------
Ross silt loam	852	.2	95	1	4	--------	--------
Rough stony land, Lordstown soil material	1,416	.3	1	2	1	96	--------
Schoharie silty clay loam:							
Undulating phase	1,831	.4	35	5	48	9	3
Gently rolling phase	167	(1)	12	--------	83	5	--------
Eroded gently rolling phase	325	.1	65	4	29	2	--------
Rolling phase	91	(1)	3	--------	27	70	--------
Eroded rolling phase	417	.1	26	16	56	2	--------
Eroded hilly phase	1,549	.4	12	6	43	38	1
Schoharie silt loam:							
Undulating phase	912	.2	77	4	13	4	2
Gently rolling phase	1,589	.4	51	8	22	18	1
Rolling phase	562	.1	34	11	27	28	--------
Steep broken land, Caneadea soil material	2,053	.5	4	10	14	71	1
Steep Chenango soils, undifferentiated	227	.1	9	38	19	33	1
Steep Langford, Canfield, and Mardin soils, undifferentiated	374	.1	12	6	20	62	--------
Steep ledgy land	6,547	1.6	1	1	5	92	1
Steep Lansing, Ontario, and Honeoye soils, undifferentiated	1,051	.3	14	9	41	36	--------
Steep Manlius, Allis, and Hornell soils, undifferentiated	400	.1	3	12	21	64	--------
Steep Palmyra and Howard soils, undifferentiated	2,089	.5	9	11	29	48	3
Steep Woostern, Valois, and Bath soils, undifferentiated	2,648	.7	15	15	21	47	2
Tioga silt loam	314	.1	70	10	15	4	1
Toledo silt loam	1,813	.4	31	9	45	14	1
Tuscarora sandy loam	411	.1	64	3	30	2	1

Valois gravelly loam:							
Rolling phase	2,757	0.7	73	3	11	10	3
Hilly phase	1,343	.3	41	11	27	20	1
Volusia channery silt loam:							
Nearly level phase	2,238	.6	34	23	19	23	1
Gently sloping phase	15,006	3.9	35	21	16	27	1
Sloping phase	6,581	1.6	27	21	17	35	-------
Moderately steep phase	928	.2	12	21	17	49	1
Wallkill silt loam	1,281	.3	72	4	2	22	-------
Westland silt loam	524	.1	22	14	39	24	1
Wayland silt loam	405	.1	(2)	(2)	(2)	(2)	(2)
Wayland silty clay loam	5,976	1.6	13	9	46	31	1
Woostern gravelly loam:							
Undulating phase	1,849	.5	65	16	7	7	5
Rolling phase	12,498	3.0	60	9	13	16	2
Hilly phase	3,421	.8	44	16	12	27	1
Eroded hilly phase	478	.1	61	12	13	13	1
Miscellaneous area:							
Gravel pits	588	-------	-------	-------	-------	-------	-------
Intermittent lakes	100	-------	-------	-------	-------	-------	-------
Water surface	5,440	-------	-------	-------	-------	-------	-------
Total area of the county	415,165						

[1] Less than 0.05 percent.
[2] Data not available.

SOIL TYPES AND PHASES AND MISCELLANEOUS LAND TYPES

Allis silt loam, sloping phase (0 to 15 percent slopes) (Aa).—This shallow poorly drained soil occurs on smooth uniform slopes in association with Fremont, Volusia, Lordstown, and Manlius soils. Most of it is on the slopes west of Hemlock Lake. The parent material consists of glacial till derived from strongly acid shale and sandstone. Sandstone or shale bedrock lies at 18 to 24 inches below the surface. Surface drainage is fair, but the tight plastic subsoil and shallow depth to bedrock restrict downward movement of water.

The 6- to 8-inch surface soil is grayish-brown or light brownish-gray heavy silt loam that puddles if worked at high moisture content and forms hard lumps or a crust on drying. The upper subsoil, extending to 12 to 16 inches, is grayish-yellow dense silty clay highly mottled with brown and gray. This layer grades into a tight plastic silty clay, which in turn rests on shale or sandstone bedrock at depths of 18 to 24 inches. The soil is strongly acid throughout.

This soil originally supported a mixed deciduous and evergreen forest that included some white pine. The present woodlots consist of beech, hard maple, cherry, and basswood.

Poor drainage, shallowness to bedrock, and tendency to bake and puddle make this a poor agricultural soil. For use and management see group 4–D.

Alluvial soils, undifferentiated (0 to 2 percent slopes) (Ab).—This unit consists of alluvial material found throughout the county on first bottoms in the narrow valleys of minor streams. Some alluvial terraces too small to separate on the soil map are included. Drainage ranges from good to very poor. Textures range from gravel to silty clay loam.

Most of this unit is too poorly drained for crops and is used for permanent pasture. The average pastures are good because moisture is plentiful, and there is normally an ample supply of water for livestock. These soils are valuable as a supplementary source of pasture, especially if cleared of brush and trees. For use and management see group 5–A.

Arkport fine sandy loam, gently undulating phase (0 to 5 percent slopes) (Ad).—This soil occurs on level to undulating terraces. It developed from thoroughly sorted fine and very fine sands that were deposited in standing water. The soil is well drained, sandy, and free of gravel. It is associated with Palmyra and Odessa soils.

The 10- to 12-inch surface soil is a grayish-brown loose mellow fine sandy loam of fine crumb to single grain structure. It is fairly well supplied with organic matter and slightly acid in reaction. Just below the surface soil is a 4-inch layer of yellowish-brown friable very fine sandy loam, faintly mottled with gray.

The upper subsoil, extending from 15 down to 30 inches, is brown slightly firm loam, neutral in reaction, that breaks out into easily crushed irregular nutlike pieces. In some places this layer has a slight reddish cast, and in others it exhibits faint gray mottling. The lower subsoil starts at a depth of about 30 inches and goes down to 40 inches; it is a loose, brownish, very fine sandy loam mottled with rust-brown streaks. Between 40 and 50 inches the material is brownish gray

loose very fine sandy loam that shows steaks of rust brown. This layer rests on a light brownish-gray, loose, calcareous, very fine sand.

This Arkport soil, like others of the series, is capable of producing sustained high yields of all the crops grown in the region. Alfalfa, wheat, beans, corn, oats, green peas, sweet corn, and other vegetable crops produce high yields. The soil dries early in the spring and is easy to work under a wide range of moisture conditions; it has good moisture-holding capacity and is permeable to roots and water. For use and management, see group 1–D.

Arkport fine sandy loam, gently rolling phase (5 to 10 percent slopes) (Ac).—This soil has a profile like that described for Arkport fine sandy loam, gently undulating phase. The reaction is slightly to moderately acid to depths of 18 to 24 inches; below that the reaction is neutral, and below 40 to 50 inches the soil material contains free lime. The surface soil contains a fair amount of organic matter.

The soil is well drained and easily penetrated by roots, water, and air. It has a fair water-holding capacity. Moisture is sufficient for crops except during long dry spells. The soil is highly erodible, so most of the rotation should consist of sod crops. For use and management, see group 2–E.

Arkport fine sandy loam, hilly phase (10 to 25 percent slopes) (Ae).—The profile of this hilly phase is similar to that of the gently undulating phase of Arkport fine sandy loam, except that the surface soil is thinner. Practically all of this soil is in Dansville Town.

This is a poor soil for intertilled crops because it is hilly and erodes easily. The best use in the present agriculture is for permanent pasture or for long-term legume-grass hay. A few of the less hilly areas can be used for small grains or for intertilled crops such as beans or corn, providing the crops are planted in narrow strips on the contour and not grown more than 1 year on the same strip. Complex topography makes stripcropping impractical on most areas of the soil. For use and management see group 3–F.

Arkport fine sandy loam, steep phase (25 to 45 percent slopes) (Af).—This soil occurs on rough irregular topography, mainly in the southern part of the county. The profile is similar to that of Arkport fine sandy loam, gently undulating phase, except that the surface soil is thinner.

This soil is not suited to tilled crops. More than half of it has been cleared for permanent pasture. The pastures are badly eroded, weedy, and in some places brushy. Usually, improving these pastures is not practical because machinery for spreading fertilizer is difficult to use on such steep complex slopes. Probably this soil is best used for forest. Trees can be planted or the soil can be allowed to reforest naturally. For use and management, see group 5–B.

Aurora silt loam, gently sloping phase (0 to 8 percent slopes) (Ag).—This imperfectly drained soil on gentle slopes is fairly extensive and is associated with Lansing and Ontario soils. It is similar to the Retsof soil, but the parent material is more alkaline, and the depth to shale bedrock is greater. Dark-gray neutral or alkaline shale lies 30 to 36 inches below the surface. The parent material, a mixture of glacial till and residual material, is derived from shales

similar to those that underlie the soil. The original vegetation was mixed deciduous and evergreen forest. Hard maple, beech, ash and white pine were the most common trees.

Runoff is fairly rapid, but internal drainage is impeded by the firm subsoil and shallow bedrock. The soil is permeable to roots and water in the upper 2 feet, but the compact lower subsoil restricts root development and drainage.

The 8-inch plow layer is a grayish-brown, friable, moderately acid silt loam. This layer is shaly in places and may have moderate amounts of small stones and gravel. It contains fair amounts of organic matter, but the dark color of this layer and others in the profile is partly derived from the underlying dark-gray shale.

The subsoil, extending from 8 down to 18 inches, is a yellowish-brown friable coarsely granular silt loam that is slightly firm in place. This layer grades into firm highly mottled shaly silty clay loam that breaks into irregular medium-sized lumps. Dense, compact, grayish-brown shaly silt loam with mottlings of gray is at depths between 26 and 34 inches.

This soil is used for hay, wheat, oats, corn, and beans. Its effective rooting zone is only 2 feet deep, so it is poorly suited to alfalfa. Timothy and clover do well. New seedings respond to lime, although heavy applications are not necessary. For use and management see group 3–C.

Aurora silt loam, sloping phase (8 to 15 percent slopes) (Ak).—The profile of this soil is similar to that of the gently sloping phase, except that depth to bedrock is less and outcrops of shale are more common. The soil is used for the same crops and is fertilized in the same way as the gently sloping phase, but fairly rapid runoff and low water-storage capacity make it less productive. It should be kept in hay most of the time. For use and management see group 3–E.

Aurora silt loam, moderately steep and steep phases (15 to 40 percent slopes) (Ah).—These phases have a profile similar to that of Aurora silt loam, gently sloping phase, except that the surface soil is thinner and the depth to bedrock is generally less than 20 inches. Runoff is rapid and the moisture-storage capacity is low because of the small volume of soil over bedrock.

These soils are poor for crops, but some timothy and clover hay is grown on less steep slopes. Little fertilizer or lime is used. Pasture can be grown on these phases, but they must be limed and fertilized with phosphorus if they are to provide worthwhile grazing. Where better soils are available for pasture, these shallow strongly sloping soils should revert to forest. For use and management, see group 5–B.

Bath channery silt loam, rolling phase (0 to 15 percent slopes) (Bb) —This strongly acid well-drained soil occurs with others of the series on plateau summits in the southwestern part of the county. It has developed from fairly deep glacial till derived from local gray shales and fine-grained gray sandstone rocks. It is called channery[7] because it contains fairly large amounts of sandstone fragments. Its moisture-holding capacity is good.

[7] A channery soil is one that contains thin angular fragments of sandstone, limestone, or schist up to 6 inches in length.

The plow layer is grayish-brown mellow silt loam containing numerous small angular fragments of thin-bedded sandstone. This layer allows good penetration of roots and water. It is moderately well supplied with organic matter and extremely acid where unlimed. Friable yellowish-brown silt loam is at depths between 8 and 16 inches. This layer grades into lighter yellowish-brown or olive-yellow silt loam, slightly firm but not compact, that continues to about 22 inches.

Downward from 22 inches the soil is more silty and slightly more firm; it is an olive-brown firm silt loam to loam that has vertical olive-gray silty streaks that divide the layer into very coarse columns or prisms. Most of the water moves along these planes. This compact layer is like a weak hardpan; it retards water movement, but not enough to affect crop production seriously. Below 50 inches the material is dense but less firm. The soil is extremely to strongly acid to a depth of about 4 feet, but acidity decreases with depth and in some places the material is calcareous below 5 feet.

This soil and others of the Bath series are probably the best soils of the uplands in the southern two-thirds of the county. They occur at elevations of 1,600 to 2,200 feet, however, and this means a growing season too short for corn and beans. The soils are especially well suited to potatoes. About 80 percent of the potatoes grown in Livingston County are produced on Bath soils (pl. 3).

This rolling phase requires liberal amounts of lime and fertilizer and some attention to water control. Flat stone fragments on the surface and throughout the soil cause some inconvenience during cultivation. For use and management see group 2–B.

Bath channery silt loam, hilly phase (15 to 25 percent slopes) (Ba).—This hilly phase has grayish-brown surface soil, yellowish-brown subsoil, and a firm olive-gray substratum like those of the rolling phase, but the individual layers are thinner and the sandstone fragments on the surface are larger and more numerous. The soil occurs on the upper slopes of long narrow ridges, the tops of which may be occupied by Bath, Lordstown, or Fremont soils. Most of the slopes are fairly uniform and regular, but in Sparta Town a large area of Bath soils has complex irregular slopes very much like those of Woostern soils.

This phase is productive of the crops commonly grown on Bath channery silt loam, rolling phase, but it is more difficult to work and the problem of conserving water and soil is greater. For use and management, see group 3–G.

Bath-Mardin channery silt loams, rolling phases (0 to 15 percent slopes) (Bd).—The complex is made up of intimately associated areas of well drained and moderately well drained medium-textured extremely acid soils. It consists of small areas of Bath channery silt loam and Mardin channery silt loam that are so intermingled it was not practical to map them separately. The Bath soil of the complex has the typical profile described for Bath channery silt loam, rolling phase, and the Mardin soil, a profile like that described for Mardin channery silt loam, rolling phase. A typical distribution of the Bath and Mardin soils within the complex is shown in figure 3.

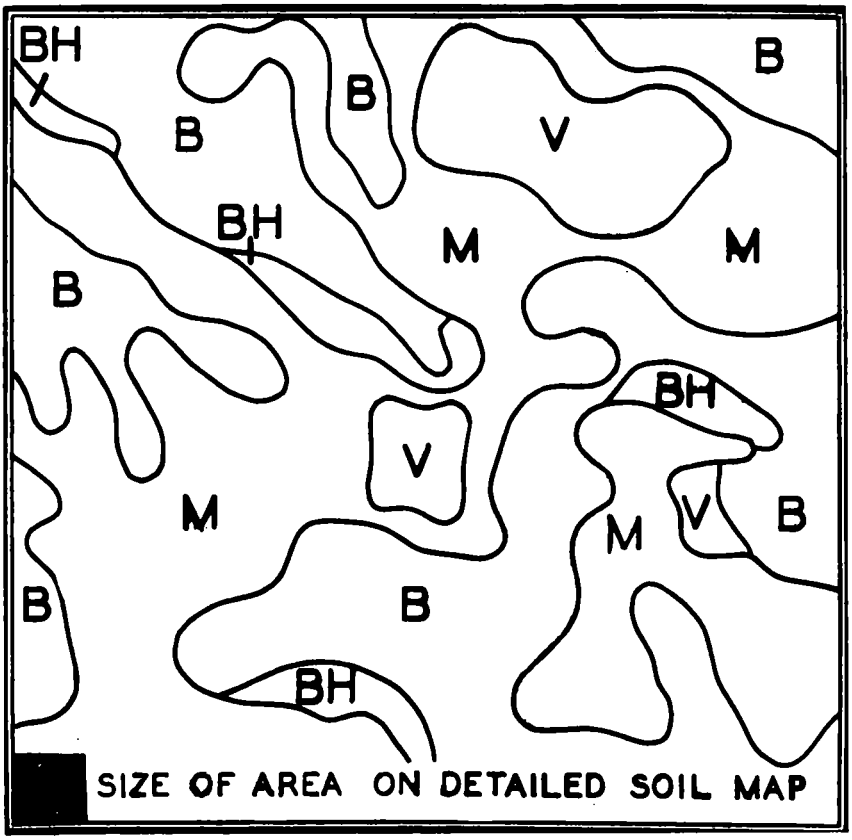


FIGURE 3.—Large-scale map of about 20 acres of Bath-Mardin channery silt loams, rolling phases. Symbols indicate soils as follows:
B, Bath channery silt loam, rolling phase;
BH, Bath channery silt loam, hilly phase;
M, Mardin channery silt loam, gently sloping phase; and
V, Volusia channery silt loam, gently sloping phase.

The soils of this complex are used in much the same way as separate areas of comparable Bath or Mardin soils. This complex is not so well suited to farming as separate larger bodies of the component soils. In general, yields are comparable to those obtained on Mardin channery silt loam, sloping phase. Management needs are similar to those of Mardin channery silt loam, gently sloping phase (see management group 3–A).

Bath-Mardin channery silt loams, hilly phases (15 to 25 percent slopes) (Bc).—The complex occurs in the same general region as the complex of Bath-Mardin channery silt loams, rolling phases, and is similar except for slope (pl. 4).

Conserving water and soil and maintaining organic matter and fertility are the problems in farming this complex. Long-term meadow or permanent pasture is the best use of this complex in the present agriculture. Lime and phosphorus are necessary for suc-

cessful growth of hay or pasture. For use and management see group 4–A.

Berrien fine sandy loam, gently undulating phase (0 to 5 percent slopes) (Be).—This moderately well drained sandy soil developed from fine sand or loamy sand overlying heavy reddish clay like that of the associated Odessa soils. These sands were deposited on top of the clay as deltas in glacial lakes. In places they may subsequently have been shifted about by wind action.

This soil is found only in the northern part of the county; it is mainly level, undulating, or gently sloping, but a few acres with slopes up to 15 percent are included. Nearly all areas except the level ones have lost some surface soil through erosion. In the undulating areas the surface soil lost from upper slopes is deposited in the depressions, sometimes to a depth of 2 to 3 feet. The productive capacity is lowered by the loss of surface soil, but not seriously unless the heavy and impervious clay is exposed.

The 6- to 8-inch surface soil is a grayish-brown, friable, very strongly acid fine sandy loam. It is free from gravel and stones and, except where eroded, moderately well supplied with organic matter. This surface soil is underlain by yellowish-brown firm but friable fine sandy loam, which at depths of 24 to 30 inches grades into slightly more firm strongly acid loamy sand stained with rust brown. This layer of loamy sand rests on tight, blocky, reddish-brown calcareous clay at depths of 30 to 50 inches.

The soil is very permeable to air, roots, and water down to the clay. The water-holding capacity of the sandy upper part is medium to low, but the clay retains enough moisture to meet the needs of growing crops.

This gently undulating phase is moderately productive but it needs phosphorus and potassium. Maintaining nitrogen and organic matter is important on this sandy soil. Contour tillage and stripcropping on slopes above 3 percent are needed to conserve soil and water. Where irregular relief makes these practices difficult, the soil should be kept in hay at least 2 years out of a 4-year rotation. For use and management see group 2–G.

Braceville silt loam (0 to 5 percent slopes) (Bf).—This moderately well drained to imperfectly drained soil has formed from noncalcareous shales and sandstone materials deposited by glacial streams. The parent materials included more silt and clay than those of the associated well-drained Chenango soils, but they were derived from the same source and were deposited in the same way. The soil is on smooth or slightly depressed areas on benches or terraces, mainly in the southwestern part of the county.

The 8-inch surface soil is friable grayish-brown silt loam. Normally it is not gravelly, but a moderate amount of shale and sandstone gravel is on the surface and mixed with the soil in some places. This layer is well supplied with organic matter and very strongly acid.

The upper subsoil, extending to depths of 12 to 15 inches, is a pale-yellow or yellowish-brown firm strongly acid silt loam that may be stained with gray and brown. The lower subsoil, which continues

344679—56——3

to depths of 24 to 28 inches, is a brownish-gray, firm, strongly acid, mixture of sand, gravel, silt, and clay that is mottled with gray, yellow, and brown. This horizon is commonly firm or very firm and appears to be weakly cemented when dry. The substratum is strongly acid sand and gravel, stratified in most places.

A large part of Braceville soil is cleared and used for crops and pasture. It produces more pasture than either Howard or Chenango soils because more moisture is available for grass in very dry periods. The water-holding capacity is higher than in the Chenango soils, and water does not move through the substratum so readily. The compact poorly aerated subsoil restricts root development, but the upper part of the soil profile is fairly well aerated and friable enough to allow good root development to a depth of 12 to 15 inches.

The Braceville soil is not so well suited to oats and beans as Chenango soils because it is wet in the spring, but wheat and corn do fairly well. It is not suited to alfalfa, but in dry years the yields of timothy and clover are somewhat higher than those on Chenango and Howard soils. For use and management see group 2-G.

Brockport silt loam (0 to 8 percent slopes) (Bg).—This is a moderately well drained, moderately deep soil developed mainly from soft gray calcareous shales that have been somewhat crushed and mixed by glacial action. It is associated with the Retsof soils in the west-central and central parts of the county.

The 8-inch surface soil is grayish-brown slightly acid heavy silt loam, granular when in sod but sometimes cloddy and lumpy in cultivated fields.

The subsoil, between depths of 8 and 18 inches, is pale yellowish-brown firm silty clay loam, faintly mottled with gray, neutral in reaction, and of medium blocky structure. This layer grades into gray, dense, highly mottled calcareous clay that has a distinct coarse blocky structure within very coarse prisms. Roots penetrate this horizon through the cracks and along the cleavage planes. The abundant lime in this layer is mainly in nodules but some appears as coatings on the structure particles. Soft, gray, weathered shale, high in lime, begins at depths of 24 to 36 inches.

This soil was originally forested with white and red oaks, black walnut, ash, basswood, soft maple, and yellow-poplar. It is now used for general farming. Wheat is the most important crop, but clover hay, beans, corn, and oats are also grown. Although somewhat fine in texture, and inclined to puddle and crust if worked when too wet, this soil is moderately productive. The silty surface soil and clayey subsoil hold enough moisture for most crops in the deeper areas. Where bedrock is about 24 inches from the surface, the soil is too dry during summer and fall. For use and management of this soil see group 3-C.

Burdett silt loam, gently sloping phase (0 to 8 percent slopes) (Bh).—This soil developed from reworked lacustrine clays that have been mixed with glacial till derived from shales and sandstones. It occupies the central part of long slopes in the central and southwestern parts of the county. Caneadea soils occur below it, and Erie soils above. In some places this soil resembles Caneadea soils, except for its sandstone fragments. In other places it resembles "a heavy Erie

silt loam." Surface drainage ranges from fair in the more level places to good in the sloping areas. Movement of water through the soil is restricted by the tight, fine-textured subsoil.

The surface soil is 6 to 8 inches of dark grayish-brown to grayish-brown, medium acid, heavy silt loam. This layer has granular structure when under sod but is lumpy and cloddy when cultivated. The subsurface layer extends to a depth of 14 inches; it is a medium acid, coarsely granular, light grayish-brown to light yellowish-brown firm silty clay loam. This, in turn, rests on slightly acid, highly mottled, dense silty clay that has a well-developed coarse blocky structure. This dense material continues to a depth of 26 inches, where it grades into a firm silt loam mottled with yellowish brown and gray. The substratum, which begins below 40 inches, is alkaline to mildly calcareous, light grayish-brown till, heavy and clayey in some places and silty in others. A few slabs of shale and sandstone are on the surface and mixed with the soil.

Most of Burdett silt loam, gently sloping phase, has been cleared of the original white pine and mixed hardwood timber and is now used for hay and pasture. Oats, corn, and hay are the chief crops, but a fairly large part of this soil is idle. Because of the fine texture, the soil is poorly suited to beans, and wheat is damaged by winter heaving. Manure and moderate amounts of phosphorus are the only fertilizers used. For use and management see group 3–B.

Caneadea silt loam, very gently sloping phase (0 to 5 percent slopes) (Cc).—This soil, like others of its series, has a gray surface soil, uniform fine texture, freedom from gravel and stones, and a tight, blocky, highly mottled subsoil. It developed from materials laid down in old glacial lakes and occurs in fairly large areas. Associated soils are the Burdett and Erie at higher elevations, and the Braceville at lower elevations.

Surface drainage is slow on the more nearly level areas but moderate where slopes are greater than 2 percent. The soil is subject to erosion even on gentle slopes. It absorbs water slowly because of its fine-textured subsoil and substratum. The supply of organic matter is medium to low.

The native vegetation was mixed evergreen and deciduous forest made up of hard maple, beech, red and white oaks, white ash, hickories, basswood, elm, white pine, and hemlock.

The surface 8 inches is grayish-brown strongly acid silt loam, lumpy and cloddy in cultivated fields but granular when in sod. It breaks sharply to the subsurface layer, which is a yellowish-brown strongly acid silt loam moderately mottled with gray and brown and of weakly developed fine blocky structure. At a depth of 14 inches this layer grades into a highly mottled gray and brown strongly acid silty clay loam to silty clay, which has a coarse blocky structure. At a depth of 23 inches, the material is olive-gray medium acid to neutral silty clay with a more pronounced coarse blocky structure than the layer above. The parent materials, below 48 inches, are calcareous, grayish, laminated silts and clays.

Because tillage is difficult, about two-thirds of this soil is used for hay. Other crops are grown, but winter wheat is frequently damaged by frost heaving, and the crusted or cloddy surface makes ger-

mination difficult for beans, corn, and peas. Building and maintaining the supply of organic matter is an important part of good management. In addition, the soil needs lime, fertilizer, and special practices for water control (see management group 2–C).

Caneadea silt loam, gently sloping phase (5 to 10 percent slopes) (C).—This phase differs from the very gently sloping phase of Caneadea silt loam only in having slightly stronger slopes. It has the same gray color and the same tight highly mottled blocky subsoil and lower subsoil. It erodes very easily. Management practices that reduce erosion, conserve moisture, and maintain or increase organic matter must be used. Use of sod crops, stripcropping, diversion terraces, and liberal amounts of limestone, phosphorus, and manure are important (see management group 3–D).

Caneadea silt loam, sloping phase (10 to 15 percent slopes) (Cb).—The profile of this phase is like the very gently sloping phase of Caneadea silt loam but slopes are stronger. It is easily recognized as a Caneadea soil by the gray color, absence of gravel and stones, uniform fine texture, and the highly mottled dense subsoil. Because of its greater slope, it is less intensively used than either of the less sloping phases and it is suited to few crops.

This phase is poorly suited to row crops but moderately productive of hay and small grains. Runoff control is very important, both to reduce erosion and to store water for crops. The soil absorbs water slowly; any practices that increase granulation and the supply of organic matter help to increase water absorption also. A good practice is to keep this soil in hay as long as yields are good and then to reseed a mixture of timothy, Ladino clover, and alfalfa with wheat or oats as a companion crop. Large amounts of phosphorus fertilizer and moderate amounts of lime are necessary for both meadows and pastures. For use and management, see group 4–B.

Caneadea silt loam, moderately steep phase (15 to 30 percent slopes) (Ca).—Except for slope, this phase is similar to the other phases of Caneadea silt loam. It is a poor soil for agriculture because of steep slope, fine texture, and slow absorption of water. It is highly erodible when cultivated. On most farms this phase is best used for permanent pasture or long-term meadows. This soil needs phosphorus and lime to produce good forage. For use and management see group 4–C.

Caneadea silty clay loam, very gently sloping phase (0 to 5 percent slopes) (Cj).—Large areas of this soil occur on both sides of the Genesee River southwest of Mount Morris. Surface drainage is slow in the more nearly level areas but is adequate where the slope permits runoff. Drainage through the soil is greatly restricted by the tight clayey subsoil and substratum. The soil is free of stones and gravel.

This soil has an 8-inch surface soil of grayish-brown cloddy silty clay loam, low in organic matter and moderately acid in reaction. The layer under the surface soil is 4 to 6 inches of pale yellowish-brown silty clay loam mottled with rust brown and gray. It grades into tight, brownish-gray, medium acid silty clay highly mottled with yellow, brown, and gray. This layer of silty clay has a strong coarse

blocky structure. The lower subsoil, between depths of 24 and 36 inches, is heavy, brownish-gray silty clay with mottlings of brown and gray. This layer is plastic when wet but hard when dry; its gross structural aggregates are strong very coarse prisms coated with gray silty clay, but these break into coarse, strong blocks. The substratum is blocky, calcareous silty clay, in some places interbedded with layers of silts and clays.

This silty clay loam is more difficult to work and more erodible than the silt loam because it absorbs water more slowly. Crops are rotated and fertilized in much the same way, but yields average 5 to 10 percent less. If other land is available for intertilled crops and small grains, this soil can best be used for hay and pasture. It is well suited to grass, and excellent pastures can be obtained by use of lime, phosphorus, and good grazing practices. For use and management see group 2–C.

Caneadea silty clay loam, gently sloping phase (5 to 10 percent slopes) (Cg).—The soil is similar to the very gently sloping phase of Caneadea silty clay loam in all respects except its stronger slopes. Like other Caneadea soils, especially those with silty clay loam texture, it is hard to plow and cultivate and is subject to severe erosion, even on fairly mild slopes.

This is a poor soil for most crops but it produces fair yields of hay and pasture under proper management. If this soil must be used for intertilled crops, they should be planted in narrow strips on the contour between buffer strips of hay. The organic matter in the soil should be increased by applying large amounts of manure and growing hay most of the time. The soil needs large amounts of phosphorus fertilizer and lime for legumes. Nitrogen may be necessary, but potassium is seldom required. For use and management see group 3–D.

Caneadea silty clay loam, eroded gently sloping phase (5 to 10 percent slopes) (Cd).—The profile of this phase is similar to that of Caneadea silty clay loam, gently sloping phase, but the topmost 6 to 12 inches of soil has been lost and the plow layer is now partly in the original subsoil.

This soil consists of areas of Caneadea silty clay loam or silt loam that were improperly used at one time. This resulted in serious washing of the surface soil and greatly lowered productivity of the soil. When the surface soil is lost and the heavy clayey subsoil is exposed, Caneadea soils are very hard to till. When plowed, the surface layer turns as huge clods and lumps that are almost impossible to work into a good seedbed.

Raising the productivity of this soil calls for improving the structure and increasing the supply of organic matter and nitrogen. Contour stripcropping will help control the washing. Planting to long-term meadows or permanent pastures so that the soil will not have to be plowed is probably the best way to increase organic matter and improve the tilth. A rotation consisting of a small grain followed by hay or pasture is best. Adequately limed and fertilized hay or pasture, if allowed to remain only as long as yields are good, will control erosion and improve soil structure. This severely eroded phase needs nitrogen fertilizer more than uneroded Caneadea soils. The amount of

ground limestone applied need not be increased, because Caneadea soils become less acid from the surface downward. For use and management see group 3–D.

Caneadea silty clay loam, sloping phase (10 to 15 percent slopes) (Ci).—This soil is similar to the gently sloping phase of Caneadea silty clay loam except for having stronger slopes. It is a poor soil for small grains or intertilled crops but it gives fair yields of hay. The soil is hard to work and absorbs water slowly. The fine texture and absence of stones and gravel make it highly erodible.

The soil is probably best used in the present agriculture by keeping it in long-term meadows for hay or pasture. Where it must be used for intertilled crops, they should be planted in narrow strips on the contour with intervening buffer strips of hay. On longer slopes, regularly spaced diversion terraces will be needed. For use and management see group 4–B.

Caneadea silty clay loam, eroded sloping phase (10 to 15 percent slopes) (Cf).—The profile of this phase is similar to that of Caneadea silty clay loam, sloping phase, except that the original topmost 6 to 12 inches of the soil has been lost and the plow layer is now partly in the original subsoil. This phase includes most of the cultivated Caneadea silty clay loam on slopes of more than 10 percent. In many places erosion removes so much surface soil that the capacity for producing crops is materially lowered. Where the surface soil has been lost, the exposed subsoil is heavy, intractable, and very difficult to till. When plowed it breaks into large hard clods that are almost impossible to work down into a favorable seedbed.

To restore former structure and productivity, the soil should be used for long-term meadows or kept in pasture. Both lime and phosphorus should be applied liberally. Small grains used as a nurse crop for new seedings of hay need both nitrogen and phosphorus. The soil should remain in hay as long as yields are good; it then can be plowed and reseeded. For use and management see group 4–C.

Caneadea silty clay loam, moderately steep phase (15 to 30 percent slopes) (Ch).—Except for stronger slopes, this phase is like Caneadea silty clay loam, gently sloping phase. Because this soil is extremely difficult to work and erosion is difficult to control, it is very poor for crops and is best used for pasture or forest. Ordinarily, pastures on this phase are poor. They can be improved where the slopes are not too steep to use machinery. Steeper areas should be reforested (see management group 4–C).

Caneadea silty clay loam, eroded moderately steep phase (15 to 30 percent slopes) (Ce).—The profile of this soil phase is similar to that of Caneadea silty clay loam, very gently sloping phase, except that the topmost 6 to 12 inches of the soil has been lost and the plow layer is now partly in the original subsoil. This phase includes badly sheet-eroded areas and areas where many soil-slips have occurred; it occurs mostly on the moderately steep slopes bordering the Genesee River.

This is a poor soil for crops, but a few areas can be used for pasture. Pastures are commonly very poor. Some improvement of pastures can be attained by removing encroaching brush, but additional

practices will bring little further improvement because of the very low moisture supply. Some of the least eroded parts can be used for hay, but lime and phosphorus fertilizer will be needed. The rougher badly washed parts of the soil should be planted to trees or allowed to reforest by natural reseeding. For use and management see group 4–C.

Canfield gravelly silt loam, gently sloping phase [8] (0 to 8 percent slopes) (Ck).—This soil, like others of its series, has developed from deep glacial till that was derived mainly from local shale and sandstone but partly from transported material. It occupies lower slopes of valleys and is associated with Volusia and Woostern soils. It and the other Canfield soils differ from Woostern soils in having a compact mottled subsoil and only moderately good drainage. Mardin and Lordstown soils may also be associated with Canfield soils, although they are normally found at higher elevations. Surface drainage is well established, but the compact lower subsoil retards the movement of water.

The original forest was mixed hardwoods, white pine, and hemlock. Present forested areas are made up of second- and third-growth trees of the original species.

Canfield gravelly silt loam, gently sloping phase, has a 6- or 8-inch plow layer of grayish-brown friable silt loam of crumb structure. It is extremely acid where unlimed. Small stones and subangular pieces of gravel are on the surface and mixed with the soil, but they do not greatly interfere with cultivation.

The upper subsoil, extending to depths of 12 to 18 inches, is a very strongly acid yellowish-brown friable silt loam of very weak very fine crumb structure. This layer normally contains few stones. It grades into a 4-inch layer of firm light yellowish-brown coarsely granular very strongly acid silt loam mottled with gray and brown.

The subsoil extending from 24 down to 50 inches is hard, compact, stony silt loam, acid and highly mottled with gray and rust brown. Acidity decreases with depth. This is a pan layer divided into very coarse prisms 10 to 24 inches across by vertical silt-filled cracks. These cracks become less prominent with depth. When removed the prisms break into firm irregular fragments. Roots penetrate this layer almost entirely along these cleavage planes.

The substratum is compact, stony, olive-gray gritty and silty glacial till, which is normally nearly neutral in reaction at depths of 4 or 5 feet and is commonly calcareous at depths from 6 to 10 feet.

Since the compact lower subsoil restricts most plant roots to the 18 inches above it, preventing runoff and conserving moisture are very important. The soil is deficient in phosphorus. It rapidly becomes deficient in nitrogen and organic matter unless practices to maintain them are used. It needs liberal use of lime, and potassium deficiency is likely to appear under intensive cropping. If properly managed, this is a fair soil for the crops common to dairy farms, but

[8] After completion of the Livingston County survey, a study of Canfield soils in New York and Ohio revealed that soils mapped in Canfield in these two States should not be included in the same series. As the Canfield name originated in Ohio, it has been reserved for that region. The "Canfield" soils of Livingston County would now be divided between the Langford and Mardin series.

it yields poorly under the practices commonly used. For use and management see group 2–D.

Canfield gravelly silt loam, sloping phase (8 to 15 percent slopes) (Cm).—The phase has the same profile as the gently sloping phase of Canfield gravelly silt loam. Slopes are simple in most places, but the soil includes rolling areas with complex slopes also.

The soil is used for the same crops as the gently sloping phase, but is harder to work, and conserving water and soil material are more difficult. The 18- to 20-inch layer of friable soil above the hardpan absorbs moisture readily; when this layer is saturated, additional water is lost as runoff. During the spring the soil may become waterlogged above the compact layer by seepage. Diversion ditches can be used to intercept this seepage and control erosion.

Where intertilled crops are grown on this sloping soil, they should be planted in narrow strips on the contour and for not more than 1 year at a time on the same strip. This soil can be maintained under a rotation of corn, oats, and 2 years of hay, but it can be conserved more easily if the sod crop remains for a longer time. Like the gently sloping phase, this soil needs lime, phosphorus, and potassium for good yields. For use and management see group 3–A.

Canfield gravelly silt loam, moderately steep phase (15 to 30 percent slopes) (Cl).—This soil occurs in long narrow strips along the sides of gullies and ridges. The profile is similar to that of Canfield gravelly silt loam, gently sloping phase, except that the surface soil is thinner.

This soil is poor for crops because of steepness and the difficulty of controlling runoff and erosion. Where it must be used for crops, it should be kept in long-term meadows for hay or pasture as much of the time as possible. Most pastures are poor and weedy, but if enough lime, phosphorus, and potassium are applied, fair yields of hay or pasture are obtained. For use and management see group 4–A.

Carlisle muck (0 to 1 percent slopes) (Cn).—Most of this muck has formed from woody organic deposits in shallow lakes or ponds. Reeds, cattails, and rushes have contributed some of the material, especially where deposits are shallow. Marl does not underlie the Carlisle muck; the shallow muck at the outer edges of the deep areas is underlain by alkaline sand or sandy clay.

Two large areas of drained and cultivated muck are at Groveland Station along Canaseraga Creek and at South Lima in Lima Town. An area at the south end of Conesus Lake and a small area north of Caledonia have not been cleared or drained.

The area at Groveland Station has an upper layer of black granular moderately acid organic material, underlain at a depth of 20 inches by brownish-black coarsely granular well-decomposed organic material. This material grades into brown partially decomposed peat. From 30 to 48 inches the material is grayish or brownish peat, made up of undecomposed remains of plant material.

The area at South Lima consists of black granular organic material containing some silt, underlain at 20 or 30 inches by dark brownish-black fairly well decomposed organic material that rests on brown woody peat. These muck soils are moderately acid in the surface soil and neutral in the subsoil in most places.

All of the muck areas were wet and swampy in their natural state. The native forest was elm, soft maple, black ash, hemlock, white cedar, willows, alder, and other moisture-tolerant species. Swamp vegetation of grass and rushes grew along the outer edges and on the shallow deposits. At present about half of the total area has been artificially drained and cleared and is used intensively for vegetables.

The muck at Groveland Station is used mainly for crops for canning in the factories at Mount Morris. Sweet corn, beets, peas, and field beans are the most important crops and are fertilized heavily. Some areas are used for pasture and furnish good grazing on bentgrass. The South Lima muck area is used for potatoes, flowers, and truck crops. Potatoes occupy the largest acreage.

For use and management of Carlisle muck after it has been drained, see group 1–C. When undrained, this muck falls into management group 5–A.

Cayuga silt loam, gently sloping phase (0 to 8 percent slopes) (Co).—This well-drained soil developed from high-lime materials on undulating to gentle slopes. It occurs near the margins of areas occupied by glacial-lake clay. In these marginal areas, a thin 1- or 2-foot layer of the clay was apparently deposited over calcarious glacial till similar to that which underlies Honeoye and Lima soils. Frost action, slope creep, and turning by tree falls mixed the clay with the upper part of the underlying till. The Cayuga soil was formed from this clay-glacial till mixture. The soil is finer in texture than Honeoye soils. It is associated with Honeoye, Lima, Ontario, Ovid, or Conesus soils in the northern and central parts of the county.

The 8-inch surface soil is grayish-brown friable heavy silt loam that tends to pack and bake if worked when wet. The subsurface layer is a slightly firm light yellowish-brown silt loam ranging from 4 to 8 inches in thickness. Locally this layer shows faint mottling with gray and brown and has a weak platy structure.

The brown to slightly reddish-brown silty clay loam subsoil, 12 to 24 inches thick, breaks into moderate medium and coarse blocks. Roots penetrate the subsoil along the cleavage planes between these blocks. The subsoil is underlain at 24 to 36 inches by grayish-brown glacial till that has some faint gray mottles and has a strong very coarse platy structure. This underlying till is mostly from limestone material, but fragments of red sandstone and crystalline rocks are also common.

The surface soil and subsurface layer are moderately acid, the subsoil is neutral, and the substratum is highly calcareous. Roots easily penetrate the subsoil of Cayuga soils, and water moves through it fast enough to prevent saturation for long periods.

Originally, the soil supported a mixed hardwood forest consisting of oak, hickory, white ash, basswood, hard maple, beech, cherry, and other species. Most of the soil has been cleared and is now used for dairying and general farming. The good moisture-holding capacity, the neutral subsoil, and calcareous substratum are favorable for most crops, although seedlings of some crops such as beans may have difficulty in breaking through a crusted surface.

The gentle slopes are well suited to the use of heavy machinery. Runoff is not rapid, but because of the fairly fine textures, especially

of the upper subsoil, the soil does not absorb moisture readily. On slopes greater than 3 percent, contour cultivation, and on slopes above 5 percent, stripcropping are needed to conserve moisture and prevent erosion. The surface soil has only a moderate supply of organic matter; and manure, crop residues, and green manures should be used to maintain or increase the amount. The soil needs only small amounts of lime but is low in phosphorus and responds well to this fertilizer. For use and management see group 1–D.

Cayuga silt loam, sloping phase (8 to 15 percent slopes) (Cq).—The profile of this phase is the same as that of the gently sloping phase of Cayuga silt loam. The soil is used for the same crops but is not so intensively farmed because it erodes more readily.

This sloping phase should remain in sod crops as much of the time as possible. Where intertilled crops are grown, they should be planted in relatively narrow strips on the contour. Winter cover crops should be grown so that the soil will not be bare early in spring when serious erosion is most apt to take place. Planting legumes and winter cover crops, plowing under green manures, and liberal use of farm manure are needed to maintain or increase organic matter. Lime is needed in some places, and phosphorus is generally deficient. For use and management see group 2–E.

Cayuga silt loam, moderately steep phase (15 to 30 percent slopes) (Cp).—This phase of Cayuga silt loam includes areas developed on moderately steep slopes bordering streams and on breaks between old lake terraces and upland regions. The soil profile is similar to that of Cayuga silt loam, gently sloping phase.

This moderately steep Cayuga soil will produce good crops of corn, beans, and other intertilled crops if well fertilized, but runoff and erosion are serious under these crops. Long rotations that include at least 3 years of sod-forming crops are best. In the present agriculture this moderately steep soil is probably best used for growing alfalfa or as permanent pasture. No lime is necessary for alfalfa or clover in most areas, but phosphorus fertilizer is required for high yields. For use and management see group 3–F.

Cazenovia silt loam, gently sloping phase (0 to 8 percent slopes) (Cr).—This soil and others of the series are among the highest in lime of any in the county; in places free lime is only 15 or 20 inches below the surface. The parent material is heavy reddish glacial till high in lime. This till was derived mainly from glacial lake clays similar to those of the Schoharie series, but the ice picked up this clay and mixed it with some limestone material. This soil and others of the Cazenovia series are associated with Schoharie, Cayuga, and Ontario soils in the northeastern and central parts of the county. Cazenovia soils are well drained.

The surface 8 or 10 inches is grayish-brown silt loam, coarsely granular when in sod but somewhat cloddy under cultivation. It is only slightly acid or neutral.

The upper subsoil, extending from 10 to 20 inches, is neutral or slightly acid brown or reddish-brown heavy silt loam or silty clay loam that breaks into ½- to 1-inch blocks. This layer grades into darker reddish-brown neutral silty clay loam or silty clay with strong medium and coarse blocky structure. The lower part of this layer

may be calcareous. The underlying parent material, at depths of 25 to 36 inches, is firm pinkish-gray calcareous glacial till of heavy silt loam or silty clay loam texture.

The subsoil is moderately firm but roots penetrate it readily. The water-holding capacity is good. Normally, the soil is not gravelly but contains a few angular stone fragments. An area along Honeoye Creek north of Highway 20, however, has a moderate amount of gravel, in both the surface soil and the subsoil.

The soil is used for alfalfa, wheat, corn, oats, beans, and pasture. Alfalfa yields well without lime. The soil texture is somewhat fine for beans, but they are a fairly important crop. Phosphorus is generally deficient, but potassium is less apt to be needed. A 4-year rotation consisting of a row crop, a small grain, and 2 years of hay can be used. All cultivation should be on the contour, and stripcropping is needed on the stronger slopes. For use and management see group 1–D.

Cazenovia silt loam, sloping phase (8 to 15 percent slopes) (Ct).—The profile of this phase is like that for the gently sloping phase of Cazenovia silt loam. Some fields on these 8- to 15-percent slopes have lost much of the surface soil, and these areas are shown on the map by erosion symbols.

This phase is used for alfalfa, wheat, corn, oats, and beans, and is fairly productive of these crops. Great care is needed to control runoff. Because this soil absorbs water slowly and erodes easily, row crops should be planted in strips on the contour and grown only at long intervals. Sod crops should dominate in the rotation, and phosphate fertilizer should be applied. For use and management see group 2–E.

Cazenovia silt loam, moderately steep phase (15 to 30 percent slopes) (Cs).—This soil had the same profile as that described for the gently sloping phase, but erosion has thinned the original surface soil, or in places has removed it and exposed the heavy reddish subsoil. These slopes erode too easily to be good as cropland and should be kept in long-term hay or pasture if possible. The soil is high in lime and is very well suited to alfalfa. It needs phosphorus to maintain yields. For use and management see group 4–C.

Chagrin silt loam (0 to 2 percent slopes) (Cw).—This is a moderately acid alluvial soil with an alkaline substratum. The parent materials are neutral alluvium along streams that drain upland regions where the soil materials have medium content of lime. The soil occupies level flood plains that have good surface and internal drainage, but, like other bottom lands, they are subject to periodic flooding.

The 8- to 10-inch surface soil is grayish-brown mellow medium acid silt loam, or in a few places loam or sandy loam. The subsoil is a dull yellowish-brown friable medium acid loam or silt loam that grades into alternating layers of sandy loam, loam, or silt loam stratified with some thin layers of sand or gravel below 36 inches. The substratum is mildly alkaline. The profile is normally gravel-free, permeable to roots, air, and water and good in moisture-holding capacity.

This soil is used for timothy and clover, alfalfa, oats, silage corn, and pasture. It is capable of high yields and responds well to fertilizers. Phosphorus and manure satisfy most fertilizer requirements

except where the soil is used intensively. Pastures are good and require only moderate amounts of phosphorus. Legumes may need liming. For use and management see group 1–B.

Chagrin silt loam, high-bottom phase (0 to 2 percent slopes) (Cx).—This phase has a somewhat wider range of use than Chagrin silt loam because it occupies higher positions that are not so frequently flooded.

The 10-inch surface soil is moderately acid grayish-brown mellow silt loam. The subsurface layer extends to a depth of 15 inches; it is a dull yellowish-brown friable acid silt loam that grades into more firm dull yellowish-brown slightly acid silt loam. This firm layer, in turn, rests on stratified neutral fine sandy loam, sandy loam, and silt loam alluvium below 36 inches. A few areas along Canaseraga Creek are more alkaline than typical. This soil has good water-holding capacity and is freely permeable to roots and water.

Chagrin silt loam, high-bottom phase, is a very productive soil well suited to most crops of the county. It is used principally for hay, silage corn, oats, and pasture. It will produce good yields of these crops without commercial fertilizers, but very high yields are obtained with large amounts of fertilizer. It is used less for vegetable crops than the comparable Genesee soils because it occurs in small areas farther from the processing plants at Mount Morris and Avon. Alfalfa does well on the soil but yields are increased by moderate amounts of lime. Oats are grown to some extent but they tend to lodge badly if manure has been applied to the soil. For use and management see group 1–B.

Chagrin fine sandy loam, high-bottom phase (0 to 2 percent slopes) (Cu).—This phase resembles the high-bottom phase of Chagrin silt loam except it has a surface soil of coarser texture and a slightly less acid reaction. It is a productive soil and is used for the same crops as other soils on well-drained bottom lands. For use and management see group 1–B.

Chagrin shaly silt loam, alluvial fan phase (0 to 15 percent slopes) (Cv).—This soil is on alluvial fans built by tributary streams where they enter the main valleys. The alluvium consists mainly of material washed from soft alkaline shales, mainly dark in color. The important areas of this phase are along both sides of the valley extending north from Dansville to Mount Morris and at the north end of Hemlock Lake.

The 8- or 10-inch surface soil is dark grayish-brown moderately granular shaly silt loam. It is underlain to depths of 14 to 18 inches by light yellowish-brown weak fine blocky friable silt loam. The lower subsoil, a grayish-brown slightly firm shaly silt loam, rests on a mixture of sand, silt, and small thin shale fragments.

The profile is well supplied with organic matter. The surface layer and subsoil are moderately acid, but the substratum is alkaline though not calcareous. Roots and water readily penetrate the subsoil. The smooth sloping surface drains readily, but runoff is not fast enough to cause serious washing in most areas. However, the soil is subjest to severe damage during flash floods, either by overwash of coarse material or by cutting of stream banks. On most areas special measures are needed to confine the streams to their present channels.

This is a productive soil. It is easy to work and can be tilled early in spring under a fairly wide range of moisture. It is used for timothy

and clover, alfalfa, oats, wheat, corn, and beans. Some lime is needed for alfalfa. For use and management see group 1–B.

Chenango gravelly loam, nearly level phase (0 to 5 percent slopes) (C3).—This and other phases of the Chenango series occur on terraces built by rivers that flowed from the melting glacier. The layered sands and gravels which make up these terraces are derived mainly from sandstone and shale rocks and they are the parent materials of the Chenango soils.

The gravel in most of this soil interferes with planting and cultivating only moderately, but on a few very gravelly areas tillage is difficult. Included with this gravelly loam are small areas of gravelly silt loam, gravelly fine sandy loam, and gravelly sandy loam, all of which are farmed in the same way as the gravelly loam soil. A few areas along the Genesee River with a yellow color and a low gravel content were also included in this phase.

The plow layer of Chenango gravelly loam is 8 to 10 inches of friable grayish-brown gravelly loam that has a fair supply of organic matter. Where unlimed it is very strongly acid. The upper part of the subsoil, extending from 10 to 20 inches, is yellowish-brown very strongly acid friable gravelly loam. This grades into very strongly acid light yellowish-brown friable to loose very gravelly loam that extends to depths of 30 to 40 inches. Next in the profile is loose gravel and sand with brown silty or clayey coatings on the sand and gravel particles. In some places this horizon projects downward in tongues to depths of 5 to 7 feet. In most places, however, it grades to beds of slightly weathered strongly acid grayish sands and gravel at depths of 50 to 60 inches. At depths of 10 feet or more the gravel may be coated with lime.

The soil is very permeable to air, roots, and water, but most of the roots are concentrated in the upper horizons because of the very gravelly substratum. The water-holding capacity is only moderate, but the normal growing-season rainfall of 2 to 3 inches per month is sufficient for crops. Droughts are quickly reflected in crop damage.

Chenango gravelly loam, nearly level phase, is an excellent soil for most crops commonly grown in Livingston County. It is used for timothy and clover, alfalfa, oats, corn, wheat, beans, and potatoes. Not much is in pasture, because the soil is more valuable as cropland. It is a level, well drained, and moderately coarse to medium textured soil suited to the use of heavy machinery. Large amounts of lime and phosphorus are essential for legumes, and are needed for good yields of other crops. All crops respond well to potassium. Maintaining organic matter and nitrogen is important. For use and management see group 1–A.

Chenango gravelly loam, sloping phase (5 to 15 percent slopes) (C4).—This phase has a friable gravelly surface soil, a yellowish-brown subsurface layer, and a gravelly subsoil and substratum like those described for the nearly level phase. Slopes are a little stronger; a few reach 15 percent.

Most of the slopes are simple, but some are irregular enough to make contour tillage and stripcropping difficult. The soil is loose, open, and porous and absorbs water very quickly. Water control and erosion are less of a problem than on most other soils of similar slopes.

The less sloping fields can be used in much the same way as the nearly level phase, but a row crop should not follow a row crop. Steeper areas should be kept in sod crops for longer periods than those less strongly sloping. Lime, phosphorus, and potassium are normally deficient. For use and management see group 2–A.

Chenango gravelly loam, alluvial fan phase (2 to 15 percent slopes) (C2).—The parent material of this soil was deposited by small tributary streams at the places where they enter the main valleys. The materials differ from those of the level and the sloping phases of Chenango gravelly loam in having come from nearby. The pieces of gravel are therefore larger and more angular than those in the level and sloping phases. The coarser materials are usually found at the apex of the fans. The deposits become progressively finer textured as distance from the apex of the fans increases. Many flat slabs of shale and sandstone may be on the surface or mixed with the soil.

Many small areas of this phase are distributed across the southern part of the county. Tioga and Chagrin soils are on the adjoining bottom land, and the upper ends of the fans may lie next to any of the acid soils of the uplands.

The surface 8 inches is grayish-brown gravelly loam. Under this is 20 to 30 inches of yellowish-brown gravelly silt loam. The substratum is a mass of flat, angular stone fragments; fine sand or silt fills the spaces among the fragments. This soil has a higher water-holding capacity than the Chenango gravelly loam on the terraces.

This is potentially a productive soil. In many of the small valleys, it is the best part of the farm and is intensively used for hay, corn, oats, beans, and wheat. It is a better soil for pastures than the Chenango soils on terraces, but is less well suited to this use than the first bottom soils or the finer textured upland soils. It is very strongly acid and needs lime for clover or alfalfa. It also needs phosphorus and potassium. For use and management see group 2–A.

Chenango fine sandy loam, nearly level phase (0 to 5 percent slopes) (Cy).—This soil has less gravel and more sand in the surface soil and upper subsoil than Chenango gravelly loam. The lower subsoil and substratum are similar. Some areas of this soil along the Genesee River are more yellow than is typical of Chenango soils and have a more silty subsoil. These areas resemble the Unadilla soils of Allegany County but were included with the Chenango soil in Livingston County because of their small area.

The surface soil is 8 to 10 inches of grayish-brown friable fine sandy loam that may contain a little fine gravel and some pebbles. It has a moderate supply of organic matter and is very strongly acid. The upper subsoil of yellowish-brown fine sandy loam or loam grades to light yellowish-brown fine sandy loam at depths of 18 to 24 inches. This fine sandy loam extends downward to 30 to 40 inches and is underlain by brown silty gravel and sand. The substratum, beginning below depths of 4 to 5 feet, is bedded sand and gravel. The entire profile is strongly or very strongly acid.

When well managed this is one of the more productive soils of the county. It is associated with Woostern soils and other phases of the Chenango series. It is well suited to all of the crops grown in the

county but is deficient in lime, phosphorus, and potassium. For use and management see group 1–A.

Chenango fine sandy loam, sloping phase (5 to 15 percent slopes) (Cz).—The profile of this soil is like that described for the nearly level phase of Chenango fine sandy loam, but slopes are stronger. The soil absorbs water readily and is not especially erodible.

Most of the slopes are less than 10 percent and simple; they can be used for rotations that include a row crop every 3 or 4 years. Wheat, field beans, corn, and oats are grown. A few areas associated with the hilly phases of Chenango soils have complex irregular slopes ranging up to 15 percent. These rolling areas should be used for long-term meadows. Like other Chenango soils, this phase needs lime, phosphorus, and potassium for most crops. For use and management see group 2–A.

Chenango soils, undifferentiated hilly phases (15 to 25 percent slopes) (C5).—These hilly phases have choppy, hummocky, kame-and-kettle relief. They have a gravelly surface layer, a thin loamy or silty subsurface layer, a gravelly subsoil, and a stratified substratum like those of the other Chenango soils. In some places, however, the soil and substratum are sands that contain less gravel than most Chenango soil materials.

These hilly phases occur mainly in the southwestern part of the county. In older surveys they were called Otisville soils. However, recent studies have shown that these hilly soils have profiles essentially the same as those of the Chenango soils. For this reason they are now placed in the Chenango series. Also included in this unit are the short steep breaks between Chenango terraces and adjacent bottom lands.

These soils are droughty, strongly acid, difficult to work, and low in water-holding capacity. They are poor soils for crops and best suited to long-term hay, permanent pasture, or forestry, the use depending largely on the steepness and complexity of the slopes. For use and management see group 3–G.

Chippewa silt loam, nearly level phase (0 to 3 percent slopes) (C7).—This soil and others of the series are very poorly drained. The soil lies in depressions, narrow drainageways, and around streamheads. The individual areas normally are small, isolated, and surrounded by any of the better drained acid soils of the uplands. The parent material is glacial till derived from shales and sandstone rocks.

The surface layer of this nearly level phase is very dark-gray or black silt loam, somewhat mucky in places. The material below the 8- to 10-inch surface is gray silt loam to silty clay loam, mottled with gray and yellow. It breaks into 10- to 20-inch firm very coarse prisms. This layer grades into compact loam or silt loam till at depths of 24 to 30 inches.

This soil, like most of those associated with it, contains small fragments and flaggy pieces of sandstone. Most of the soil is medium to strongly acid, but some areas associated with Langford or Erie soils are neutral. This Chippewa soil was originally covered with a forest of soft maple, elm, hemlock, willows, and alder.

In its natural state this soil is too poorly drained for use as cropland. Pastures on the undrained soil furnish little grazing. If the soil is

drained by open ditches or tile, it furnishes some good grazing, especially late in summer and early in fall. In many places this soil is artificially drained and farmed with the associated Volusia, Canfield, Mardin, or Fremont soils. In most places this Chippewa soil is too wet for tillage when the rest of the field is ready for cultivation. It usually dries too late in the spring for oats but it sometimes can be used for corn. Drained Chippewa soil is high in organic matter and, if fertilized, good yields of hay are obtained. In most places it needs both lime and phosphorus. For use and management see group 5–A.

Chippewa silt loam, gently sloping phase (3 to 8 percent slopes) (C6).—This gently sloping phase consists mainly of areas on gentle slopes where seepage water comes to the surface. Some slopes are more than 8 percent. The profile is similar to that of the nearly level phase of Chippewa silt loam.

The soil is used and managed in much the same way as the nearly level phase. If undrained, it is too wet for crops. Many areas have been ditched or tiled to permit use of fields that could not be cultivated conveniently because of these wet spots. Good management calls for artificial drainage where feasible and the use of lime and phosphorus. Many areas used as pasture could be greatly improved by removing shrubs and brush. For use and management see group 5–A.

Colwood silt loam (0 to 2 percent slopes) (C8).—This soil occupies shallow depressions in the area occupied by high-lime soils. It has developed from silt and some sand deposited in still water. The soil is not organic, but it has a black surface layer high in organic matter. Uncleared areas are in forests of elm, soft maple, white ash, and willows. Cleared undrained areas support reeds, sedges, cattails, and coarse swampgrass.

The surface 8 to 12 inches is a black mucky silt or silt loam. Light-gray silt loam of weak coarse prismatic structure underlies this and continues to a depth of about 20 inches. The subsoil, extending from a depth of 20 inches down to 30 inches, is light-gray silt loam or loam, stained or coarsely mottled with rust brown. The substratum is calcareous silty or sandy sediments. The surface and subsurface layers are mildly acid or neutral; the subsoil is alkaline.

When undrained, this soil is too wet for agricultural use. The cleared undrained areas are mostly in pastures, but the forage is poor. Approximately 25 percent of the total area has enough artificial drainage to be used as cropland. It is poorly suited to small grains, which tend to lodge. Partially drained areas are used to some extent for hay, pasture, and corn. Where this soil is adequately drained, either by open ditches or tile, it is highly productive of vegetable crops. The soil needs phosphorus but has enough lime. For use and management of the drained soil see group 2–F; for the undrained soil, group 5–A.

Conesus silt loam, gently sloping phase (0 to 8 percent slopes) (C9).—This gently sloping phase developed from firm high-lime glacial till on gentle slopes. It is associated with Lansing soils in the west-central part of the county.

The 6- to 8-inch surface soil is grayish-brown or brown strongly acid friable silt loam. Extending from 8 to 12 inches is a brownish-gray weak platy strongly acid firm silt loam mottled with brown. The upper subsoil, from 12 to 18 inches, is firm yellowish-brown, mottled with pale-brown, silt loam of medium blocky structure. The lower subsoil from 18 inches down to 28 inches is a slightly acid or medium acid olive-brown to light grayish-brown gritty silt loam, highly mottled with yellow, brown, and gray. It is very firm in place and has a weak blocky structure. Lime has segregated in the form of nodules and concretions in the lower part of this layer in some places. The material between depths of 28 and 48 inches is grayish-brown gritty calcareous silt loam faintly mottled with gray and brown; it is less firm than the layer above. Below 48 inches lies highly calcareous firm grayish-brown gritty silt loam of medium blocky structure.

The surface soil has a moderate content of organic matter. Only small amounts of stones and gravel are on the surface and mixed with the soil, although the parent material is both stony and gravelly. The low permeability of the compact subsoil slows movement of water through the profile.

This gently sloping phase is used for the same crops as Lima silt loam, but yields are lower. Pasture, timothy and clover, wheat, corn, oats, beans, peas, and sweet corn are commonly grown, and alfalfa to some extent. Erosion is not serious on this phase, but drainage needs to be improved. Lime and phosphorous fertilizer are important. For use and management see group 2–C.

Conesus silt loam, sloping phase (8 to 15 percent slopes) (C10).—This phase consists of a few areas on moderate slopes that are surrounded by Lansing soils or gently sloping Conesus soils. It has a grayish-brown surface soil, a light-gray upper subsoil, and a very firm highly mottled lower subsoil like those described for the gently sloping phase of Conesus silt loam.

Most of this phase is now used for hay. Control of runoff and erosion is important on this soil. If it is used for intertilled crops, it should be cultivated across the slope and cropped in contour strips. Where less sloping soil is available for intertilled crops, this phase is probably best used in the present agriculture for long-term meadow or pasture. Lime and phosphorus should be applied. For use and management see group 2–E.

Dunkirk silt loam, rolling phase (2 to 15 percent slopes) (Db).—This well-drained silt loam developed from silty materials that were laid down in glacial lakes. In Livingston County it lies south and east of Dansville, where it joins a large area in Steuben County.

The plow layer is a grayish-brown friable medium acid silt loam. At about 8 inches it is underlain by a yellowish-brown, crumb-structured medium acid silt loam that continues to a depth of 15 inches. A light yellowish-brown medium acid silt loam extends from 15 to 24 inches. The lower subsoil from 24 to 36 inches is a brown or yellowish-brown slightly acid or neutral heavy silt loam of moderate medium blocky structure. The substratum is made up of light

344679—56——4

yellowish-brown laminated silts and fine sands, which are neutral at 36 inches and calcareous at 40 to 50 inches.

Typical Dunkirk silt loam is not gravelly, but most of that mapped in this county has some gravel on the surface and mixed with the upper soil layers. The water-holding capacity of this soil is high; it can be worked under a wide range of moisture. Roots penetrate the surface soil and upper subsoil easily, but the compact lower subsoil impedes root growth to some extent.

This soil is used for timothy and clover, alfalfa, wheat, beans, corn, and oats. Because of the rolling slopes and silty texture, this soil erodes easily. Nearly all of this phase not in woodlots has been moderately eroded. Complex slopes limit the use of stripcropping and contour farming; hence, sod crops must be depended on for erosion control. These complex slopes also make difficult the use of heavy farm machinery in many places. The soil needs phosphorus and some lime. For use and management see group 2–E.

Dunkirk silt loam, hilly phase (15 to 30 percent slopes) (Da).—The profile of this hilly phase is similar to that of the rolling phase of Dunkirk silt loam.

This is a poor soil for crops because machinery is difficult to use on the hilly slopes and erosion is difficult to control under crops that require tillage. Fully 60 percent of it has already lost most of the original surface soil and, in some places, part of the subsoil as well. In the present agriculture the soil is probably best used for long-term hay or pasture. If intertilled crops are grown, they should be planted in narrow strips, on the contour, betweeen strips of hay. The soil needs both lime and phosphorus. Where better pasture soils are available, this hilly phase should be returned to forest. For use and management see group 4–C.

Edwards muck (0 to 1 percent slopes) (Ea).—Edwards muck was formed in swampy areas from very shallow organic deposits that overlie marl. It supports a forest of elm, soft maple, white cedar, larch, and other water-tolerant species. The parts continuously under water are covered with cattails, rushes, and sedges. All of Edwards muck is in one area east and north of Caledonia.

The surface 8 inches is a black well-decomposed organic material that overlies 8 to 10 inches of very dark-brown decomposed organic material containing many small soft shells. Soft marl begins at depths of 8 to 24 inches and continues downward for many feet. Thousands of tons of marl have been removed in this area for agricultural lime and industrial use, but this industry has been abandoned for many years.

Nearly all of this muck is too shallow and too wet for crops. The outer edges of the area furnish some pasture. A few acres are well drained and deep enough for growing vegetables. Deficiency diseases of crops are common on this kind of muck. For use and management see group 1–C for the drained soil, and group 5–A for the undrained soil.

Eel silt loam (0 to 2 percent slopes) (Eb).—This moderately well drained neutral or alkaline first-bottom soil is subject to seasonal overflow in spring and flash floods in summer. A few areas lie high enough to escape flooding. The parent materials are recent alluvium

washed from alkaline uplands. The soil occupies large tracts along the Genesee River and Canaseraga Creek in association with Genesee soils. The relief is level or slightly depressed. The original forest was maple, elm, cherry, ash, basswood, hickory, poplar, black walnut, and white oak.

The 10- to 12-inch surface layer is a grayish-brown friable silt loam, or in a few places fine sandy loam. The upper subsoil, extending downward to 18 to 24 inches, is firm light-brown silt loam. This grades into a 6- to 12-inch layer of firm grayish-brown or gray silt loam that is mottled with rust brown and gray. The lower subsoil, extending from 30 to 48 inches, is slightly firm grayish-brown mottled silt loam that overlies a substratum of layered grayish-brown sand, silt, and clay. The soil is nearly neutral throughout.

This fertile soil is productive and easy to work. It is suited to a wide range of crops and is used mostly for green peas, beets, sweet corn, field corn, timothy and clover hay, and field beans. Alfalfa does fairly well on the better drained parts, but the stands are short-lived. Some wheat is grown but it is likely to lodge. Much nursery stock is grown on this soil near Dansville. Flooding is not a great handicap to cropping, because the soil normally drains before planting time in the spring. The soil needs no lime but requires some phosphorus. For use and management see group 2–F.

Eel silty clay loam (0 to 2 percent slopes) (Ec).—The 8- to 10-inch surface soil is dark grayish-brown silty clay loam, commonly puddled or cloddy. The upper subsoil, extending to a depth of 18 inches, is firm heavy silt loam or silty clay loam, mottled in the lower part. This layer grades into a lower subsoil of silty clay loam, highly mottled with brown and gray. The mottled material rests on gray heavy silt loam that extends downward for several feet. The reaction is neutral throughout the profile.

This soil is more difficult to work and maintain in good tilth and does not drain so readily as Eel silt loam. It is less productive and not as well suited to peas, field beans, and alfalfa. Field corn, sweet corn, and beets do fairly well. The soil is excellent for timothy-and-clover meadow or permanent pasture; it needs no lime but requires phosphorus. For use and management see group 2–F.

Erie channery silt loam, gently sloping phase (3 to 8 percent slopes) (Ed).—The parent material of this and other Erie soils is glacial till derived from local shale and sandstone rocks. This till contains enough lime to give the lower subsoils and substrata an alkaline reaction. This soil, like others of the series, contains angular fragments of sandstone; hence, it is termed "channery."[9] It is associated with other Erie soils and the moderately well drained Langford soils. Surface drainage is fair, but drainage through all Erie soils is very slow because of the hard compact subsoil.

The 8-inch plow layer of this phase is grayish-brown silt loam, strongly acid where unlimed. In areas having better drainage a thin yellowish-brown layer almost free of mottling lies just below the plow layer. Otherwise, the subsurface layer, which is at depths between 8 and 15 inches, is light yellowish-brown strongly acid friable silt loam, strongly mottled with gray and brown. At 15 inches be-

[9] See footnote 7, p. 30.

gins a hardpan of olive-brown silty clay loam highly mottled with strong brown and light gray. This layer is divided into 4- to 12-inch prisms that are coated with light-gray or brownish-gray silt. This layer is very hard when dry, firm when moist, and very slowly permeable. Roots penetrate only along the vertical cracks between the prisms. The upper part of the hardpan is medium to strongly acid, but acidity decreases with depth, and the soil is ordinarily neutral below depths of 36 to 40 inches. The pan becomes less hard with increasing depth, and at about 4 or 5 feet it grades into firm platy olive-brown glacial till of loam or silt loam texture. At this depth the substratum may contain free lime. The upper layers are moderately channery, but the pan below 15 inches contains many more flat fragments of stone.

Only a few roots penetrate the tight subsoil of this phase, and water moves through it very slowly. The moisture-holding capacity is rather low because of the small amount of pore space. After the water held by the surface soil and thin subsurface layer is exhausted, little is available in the subsoil for the few roots that penetrate the hardpan.

As mapped, the soil includes both imperfectly and poorly drained soils in very close association. Springs and small seepy spots are common. Diversion terraces or ditches that penetrate the hardpan layer at regular intervals remove excess surface water, prevent serious erosion, and intercept some seepage. Tiling to intercept seepage channels in local wet spots may also be needed.

Much of this gently sloping phase is idle, abandoned, or in unimproved pasture. Timothy and clover hay occupies most of the cultivated soil. Even though the soil is alkaline in the lower subsoil, it needs liberal liming for good growth of crops. The soil is deficient in phosphorus, and continued cropping quickly reduces the potassium supply. Despite its limitations, it can produce fair yields of hay, corn for silage, and small grains under good management. For use and management see group 3–B.

Erie channery silt loam, nearly level phase (0 to 3 percent slopes) (Ef).—This phase has a profile similar to that of the gently sloping phase of Erie channery silt loam. It occurs on nearly level parts of hilltops where surface runoff is slow; furthermore, the hardpan prevents drainage through the soil.

A larger part of this soil is poorly drained. It is less productive than the gently sloping phase of Erie channery silt loam, because it dries later in the spring and remains wet longer after heavy rains. Diversion ditches that intercept seepage from higher lying areas remove some surplus water, but other ditch drainage is ineffective.

In spite of these disadvantages, a greater part of this phase is in crops, less is idle, and less is in woodland than of the gently sloping phase. Hay, corn, oats, and buckwheat are the main crops. Lime and phosphorus are deficient, and potassium is commonly needed. For use and management see group 3–B.

Erie channery silt loam, sloping phase (8 to 15 percent slopes) (Eg).—This sloping phase has the gray surface, the mottled upper subsoil, and the highly mottled, compact, almost impervious subsoil described for the gently sloping phase of Erie channery silt loam

Erosion control is the chief problem on this phase. Since little moisture is absorbed by the soil, water runs off the surface rapidly and in large volume. Diversion ditches to catch and divert water are important for erosion control. Row crops should be grown only at long intervals, and in narrow strips planted on the contour. Small grains should be used only to establish new seedings of sod crops. The soil is poor for many crops and it may well be kept in pasture or long-term meadows.

Liberal use of manure and legumes is needed to maintain or increase the supply of organic matter and nitrogen. Large amounts of lime and phosphorus are essential for either crops or pastures. For use and management see group 3–E.

Erie channery silt loam, moderately steep phase (15 to 30 percent slopes) (Ee).—The soil profile of this phase is similar to that of Erie channery silt loam, gently sloping phase. Steep slopes, poor drainage, and high erodibility make this a poor soil for crops. Moisture conditions are so unfavorable that, even when adequately fertilized, the soil produces low yields of crops.

In the present agriculture permanent pasture is the best use for most of this soil. The less steep parts can be used for long-term meadows if fertilized and limed. The construction of diversion ditches to control runoff is not practical on slopes above 20 percent. If less erodible soil is available for meadows and pastures, the steeper parts of this phase should be kept in forest. For use and management see group 4–D.

Farmington loam, ledgy gently sloping phase (0 to 8 percent slopes) (Fa).—This soil developed on the limestones in the northern part of Livingston County. A large area is in the northwestern corner of Caledonia Town. The soil ranges from shallow to moderately deep and has many rock outcrops and stone fragments. Relief is gentle, but many minor irregularities are caused by sink ridges, rock ledges, sinkholes, and depressions in the bedrock. The native forest was mainly oak and hickory and some walnut, ash, basswood, and yellow-poplar.

The upper 6 or 8 inches of the soil is dark grayish-brown friable moderately acid loam or fine sandy loam. Below 6 or 8 inches is brown friable neutral silt loam, which rests on bedrock. In pockets between outcrops the depth to bedrock may be as much as 36 inches. Parts of the soil have many ledges and outcrops of limestone; other parts contain many fragments of chert and limestone. The soil is very permeable to air, roots, and water and has good water-holding capacity. The soil layer is so thin, however, that the total amount of moisture held is not enough for growing crops.

Most of this ledgy gently sloping phase is very poor for crops. Lack of available moisture limits growth except during abnormally wet seasons. A few cherty areas are cultivated, but the stone fragments interfere with tillage. Parts too stony to cultivate are used for pasture. During spring these pastures furnish good grazing, but during June they dry and furnish little grazing until fall. The soil needs phosphorus and may need lime in spite of shallowness to limestone bedrock. On much of this ledgy soil, the quality and amount of

grazing that can be obtained is so low that it should be allowed to revert to forest. For use and management see group 5–B.

Farmington loam, nearly level and gently sloping phases (0 to 8 percent slopes) (Fb).—These phases are much superior to the ledgy gently sloping phase of Farmington loam for agricultural purposes. They are better for tillage because they contain less chert and gravel and have fewer surface stones, large boulders, and outcrops of bedrock. They hold a little more moisture than the ledgy phase. The largest area occurs in the northwestern corner of Lima Town.

The surface 8 inches is dark grayish-brown friable loam or fine sandy loam. The subsoils are brown friable silt loam that rests on bedrock at 24 to 30 inches. The surface layers are moderately well supplied with organic matter and have a moderately acid reaction. The subsoils are slightly acid to neutral down to the limestone bedrock.

These phases are used mainly for beans, alfalfa, wheat, oats, and corn. Field beans and alfalfa are most successful. At least one good cutting of alfalfa hay each year can be expected, and field beans will mature with less moisture than small grains or corn. Good crops of wheat, oats, and corn are harvested only in years with high summer rainfall.

Spring grazing on these soils is good, but the pastures are usually dry from the middle of June to late in fall. The native pastures contain Canada bluegrass, white clover, yellow trefoil, redtop, and weeds. The soils need phosphorus and may need lime. For use and management see group 3–C.

Fredon fine sandy loam (0 to 5 percent slopes) (Hc).—This imperfectly to poorly drained soil developed from calcareous glacial outwash material. It is associated with well-drained Palmyra and Howard soils but has a higher moisture-holding capacity and less gravel on the surface.

The plow layer is 8 inches of grayish-brown mellow fine sandy loam or silt loam, gravelly in a few places. From 8 inches down to 20 inches is light yellowish-brown firm silt loam or fine sandy loam mottled with yellowish-brown and gray. At depths between 20 inches and 30 to 36 inches lies a panlike layer of firm grayish-brown silty gravel and sand mottled with yellow and gray. The substratum is gray sand and gravel or moderately compact mottled sand. A few thin layers or lenses of slowly permeable silt are common in this substratum.

The surface soil is well supplied with organic matter and is generally slightly acid. The subsoil is slightly acid in the upper part and neutral at 20 to 30 inches; the substratum is strongly calcareous. Roots penetrate the subsoil but not the substratum.

Some areas of Fredon fine sandy loam are more sandy and mainly gravel-free, others have more gravel on the surface and are finer in texture throughout the profile. Relief is level, gently sloping, or slightly depressional.

This soil is easy to till and maintain in good tilth. Water is absorbed rapidly by the upper soil layers, but is stopped by the slowly permeable substratum. Runoff is not rapid, but on slopes of more than 4 percent, crops should be planted on the contour. The soil is low in phosphorus and commonly needs potassium as well. In some

areas it is moderately acid, and legumes will respond to medium amounts of lime. The soil is well suited to timothy and is not too poorly drained for medium red clover. For use and management see group 2–G.

Fremont channery silt loam (0 to 8 percent slopes) (Fc).—This imperfectly drained soil formed on nearly level to gently sloping higher hilltops from glacial till derived from the underlying shale and sandstone rocks. Surface drainage is moderate to rapid, depending on slope. Drainage through the soil is slow because of the compact subsoil.

The soil is associated with Mardin, Bath, Volusia, and Lordstown soils in the southern part of the county. A fairly large acreage is included in complex associations within the mapping units of Volusia soils. In these associations the poor drainage of the Volusia controls soil use and management.

The 8-inch surface soil of Fremont channery silt loam is grayish-brown very strongly acid silt loam or heavy silt loam. At depths between 8 and 16 inches occurs a light yellowish-brown loam or silt loam mottled with gray and rust brown. Below 16 inches is strongly acid olive-brown heavy silt loam that is very dense and very slowly permeable. Light brownish-gray silty or very fine sandy material like that of the layer above extends downward in vertical bands 6 to 12 inches apart. The bands divide the layer into very coarse hard prisms. Roots penetrate mainly along these bands. Flat rectangular pieces of sandstone and shale are fairly abundant in all of the above layers. Below depths of 40 to 50 inches lies the substratum, a medium acid dense olive-gray till containing many stone fragments. Acidity decreases with depth, and the soil is commonly neutral at depths of 6 to 7 feet.

Although somewhat better drained than Volusia channery silt loam, gently sloping phase, this soil is wet and cold in spring and hard and dry during summer. Plant roots grow mainly in the upper 12 to 15 inches and draw little water from the subsoil during dry weather.

Most of the crops go into feed for dairy cattle. Keeping the steepest parts of this soil in meadow or pasture and farming across rather than up and down the slopes are the main practices needed in addition to good rotations, liming, and fertilization. Control of erosion and runoff is fairly simple, and little serious erosion has taken place. Where slopes are greater than 5 percent, diversion terraces should be cut into the hardpan layer to intercept seepage and surface runoff. For use and management see group 2–D.

Fulton silt loam (0 to 5 percent slopes) (Fd).—This imperfectly to poorly drained soil developed from calcareous, glacial-lake clays that were deposited in flats and slight depressions. It may also be found where seepy spots appear on mild slopes. Surface drainage is moderate to slow, depending on the relief, but internal drainage is slow everywhere because of the dense fine-textured subsoil.

The 8-inch surface soil, a very dark-gray or dark brownish-gray silt loam, puddles or forms clods if plowed when too wet. Pale-brown to light yellowish-brown heavy silt loam strongly mottled with yellowish-brown and gray extends from 8 to 15 inches. The upper subsoil beginning at 15 inches is brownish-gray, prismatic, plastic silty clay.

The 6- to 8-inch prisms break to coarse blocks. Block faces are light gray; interiors are brownish-gray with strong-brown mottling. The lower subsoil between 28 and 36 inches is firm silty clay with similar structure but less mottling than the layer above. Lime nodules and concretions are common in this layer. The substratum is laminated calcareous silt and clay of lacustrine origin.

The surface soil is slightly acid; the subsoil, neutral; and the lower subsoil and parent material are calcareous. Relief is level or depressed. The soil is normally free of stone or gravel, but in places gravel and stones have washed onto the surface from nearby soils.

At least some artificial drainage is needed before the soil can be used for crops. When partly drained, it is used for wheat, beans, oats, timothy and clover, and pasture. It is a good soil for timothy and clover or small grains but is not well suited to beans or corn. Phosphorus is needed for good yields, but potassium and lime are rarely deficient. For use and management see group 2–C.

Genesee silt loam (0 to 5 percent slopes) (Gb).—This soil, like Genesee fine sandy loam, developed from recent alluvium washed from calcareous materials. It occupies nearly level first bottoms and is occasionally flooded, chiefly early in spring before farming operations get underway. Individual areas of this soil are large. The native forest consisted of white oak, ash, elm, soft maple, basswood, black walnut, poplar, and sycamore.

The 8-inch plow layer is dark grayish-brown silt loam, neutral or slightly acid in reaction and high in organic matter. Extending from 8 to 14 inches is brown friable silt loam that contains less organic matter than the layer above. This layer is commonly neutral. Light-brown or pale-brown friable silt loam extends from 14 to 36 inches. The substratum consists of stratified alluvium. This material is variable in texture, but the lower layers are generally coarse textured and alkaline to mildly calcareous.

The relief is mainly nearly level except for slight undulations and some sags that mark previous courses of the river. Typical Genesee silt loam is free from gravel and stones, but some gravel may have washed onto it from adjacent uplands. A few strips of gravelly soil are remnants of gravel bars laid down during the normal development of these bottom lands. This well-drained soil is permeable to roots, is well aerated, and allows free movement of soil moisture. Even after flooding it is saturated only for brief periods. Its moisture-holding capacity is high.

Most of this soil has been cleared and is now used for sweet corn, beets, green peas, field beans, alfalfa, field corn, and pasture. The soil responds to fertilizer and large amounts give high yields. Small grains are grown on only small acreages because they are likely to lodge. The soil is excellent for alfalfa and clover. Lime is not needed for these and other crops on this neutral soil. One problem on this soil is erosion of streambanks, which are easily undercut and swept away by high water. At present little is done to prevent this. For use and management see group 1–B.

Genesee fine sandy loam (0 to 10 percent slopes) (Ga).—This soil ordinarily lies next to the streams at a slightly higher elevation than

the Genesee silt loam. All of this fine sandy loam occurs along the Genesee River and along Canaseraga Creek north of Dansville.

The top 10 to 12 inches is grayish-brown mellow fine sandy loam. The upper subsoil, extending to depths of 20 to 24 inches, is pale-brown friable fine sandy loam or light silt loam. The substratum has a fairly wide range in texture but is made up mainly of layers of sandy or silty sediments. The surface soil is well supplied with organic matter. The soil is normally neutral throughout, but in places the subsoil may be mildly calcareous.

Genesee fine sandy loam is an excellent soil for crops. When managed in the same way as Genesee silt loam, the crop yields are similar. It is used more for hay, field corn, and field beans than the silt loam. Potassium deficiency is more apt to appear in this type than in the silt loam. For use and management see group 1–B.

Gravel pits (Gc).—Extensive areas in Livingston County are underlain by deposits of sand and gravel of excellent quality for construction. Gravel pits have been opened in many of these areas. The largest of these, in the northern part of the county, are delineated on the soil map. Small pits and quarries are shown by a conventional symbol. This mapping unit has no value for agriculture.

Hilton gravelly loam (0 to 8 percent slopes) (Ha).—This is moderately well drained loam with a compact, hard, slowly permeable subsoil. It is associated with the Farmington, Honeoye, and Ontario soils in the northwestern corner of the county. Normally it occupies low, broad, or rounded ridges and nearly level areas, but a few areas have slopes as strong as 15 percent.

The 6-inch surface soil is moderately acid grayish-brown mellow gravelly loam or gravelly light silt loam. Between depths of 6 and 15 inches the subsoil is yellowish-brown friable gravelly loam, and from 15 to 20 inches it is pale-brown medium acid firm structureless or weakly platy gravelly loam, mottled with rust brown and gray. The lower subsoil is brown blocky heavy silt loam, mottled with yellow and gray. The substratum is calcareous firm pinkish-gray gritty loam till made up of sandstone, limestone, and crystalline rock fragments firmly embedded in fine sand, silt, and clay.

The compact subsoil layer varies in depth and thickness. Runoff is fairly slow on the gentle slopes, but the volume is fairly large because the compact subsoil allows only slow absorption of water.

Nearly all of Hilton gravelly loam is cleared and under cultivation. It is used for wheat, corn, oats, beans, hay, and pasture. It is less productive than some of the other soils developed from high-lime till. Most of the hay is timothy and clover because the restricted drainage and compact subsoil are not well suited to alfalfa. Small grains and corn do moderately well if enough fertilizer is used. Use of sod crops, manure, and crop residues increases the organic matter and improves the water-absorbing capacity of the soil. The soil needs little lime but requires phosphorus and may need potassium. For use and management see group 2–C.

Holly silty clay loam (0 to 1 percent slopes) (Hb).—This poorly drained gray alluvial soil occurs in low places on first bottoms along streams. It is subject to frequent flooding. The alluvial parent

materials were washed from uplands underlain by acid shale and sandstone.

The surface soil is a gray to black strongly acid silty clay loam that has brown mottling along root channels. It is underlain at a depth of 10 inches by light-gray strongly acid silty clay loam mottled with brown and yellow. Beginning at 30 inches is gray or bluish-gray strongly acid dense silty clay loam or silty clay mottled with brown, yellow, and gray. In some places the mapping unit includes soils of the Papakating series, which are very poorly drained soils with mucky surface soils and sticky, bluish-gray silty clay subsoils.

This soil was originally covered with soft maple, elm, alder, and willow thickets. About 60 percent has been cleared. Most of the cleared areas are in pastures of swampgrass, sedges, rushes, cattails, and bentgrass. These furnish poor grazing but are available when upland pastures are dry. For use and management see group 5–A.

Honeoye loam, gently sloping phase (0 to 8 percent slopes) (Hd).—This is a high-lime soil developed from glacial till that came mainly from limestone and shale. Both surface and internal drainage are good. This soil is one of the most productive in Livingston County and is widely distributed across the northern part.

The 8-inch plow layer of Honeoye loam, gently sloping phase, is dark grayish-brown neutral to medium acid loam. Light-brown friable neutral to medium acid loam begins at a depth of 8 inches and continues to 14 inches. From 14 to 24 inches is brown firm heavy silt loam with strong blocky structure. Below 24 inches, is firm grayish-brown highly calcareous glacial till, faintly mottled with brown and gray. The surface soil and subsoil contain small irregular fragments of limestone, sandstone, and crystalline rocks.

This highly productive soil was originally covered with a mixed hardwood forest but is now all under cultivation except for a few woodlots. The mild slopes are well suited to the use of all types of farm machinery. The principal crops are wheat, field corn, oats, alfalfa, field beans, cabbage, sweet corn, and green peas. The truck crops are grown near the canning factories at Avon and Mount Morris.

This soil requires heavy fertilization. Phosphorus is most important, and high crop yields may deplete the potassium supply. Growing legumes, using manure, and adding other crop residues should be practiced to help maintain the supply of organic matter and nitrogen. On slopes of 4 percent or more contour tillage, stripcropping and widely spaced diversion terraces may be necessary. For use and management see group 1–D.

Honeoye loam, sloping phase (8 to 15 percent slopes) (He).—The profile of this soil is essentially the same as that described for the gently sloping phase of Honeoye loam. It is used for the same crops but needs more intensive practices to control runoff and erosion.

This phase should be tilled across the slope, and crops should be planted in strips on the contour. Row crops should be alternated with sod crops. Heavy fertilization to insure good growth of crops, and use of manure and crop residues to increase organic matter are important. The soil should not be left bare during the winter. Ryegrass seeded during the last cultivation of corn will increase organic

matter and reduce loss of soil during winter and spring. For use and management see group 2–E.

Hornell silty clay loam, sloping phase (0 to 15 percent slopes) (Hg).—This unproductive imperfectly drained soil is difficult to work and very erodible. The parent materials are largely residual from the underlying soft easily weathered shales, although the shale appears to have been broken and moved by glacial action. This soil is associated with Fremont and Lordstown soils in the higher southern uplands.

The surface soil of light grayish-brown strongly or very strongly acid silty clay loam or heavy silt loam puddles very easily. The upper subsoil, beginning at 8 inches and continuing to 14 inches, is strongly acid yellowish-brown silty clay loam mottled with brown and gray. This material has weak fine blocky to coarse crumb structure and is moderately plastic. Plastic silty clay of medium or coarse blocky structure extends from 14 inches down to 24 to 30 inches. Vertical cracks divide this layer into 4- to 8-inch blocks. The interiors of the blocks are brownish gray to light yellowish brown and are strongly mottled with strong brown to brownish yellow. This strongly acid blocky layer rests on partially weathered soft acid shale. Shale fragments are commonly mixed in the subsoil, although typically the surface soil is nearly free from stones. Roots do not penetrate the subsoil readily, but grow along the surfaces of the structural blocks. Water penetrates the subsoil very slowly.

This imperfectly drained soil is wet and cold in the spring, very dry and hard in summer and early fall, and very easily eroded. Preparation of good seedbeds is difficult because of the fine texture and poor structure of the surface soil. Productivity is low.

Much of this soil is idle or wooded; the rest is used mostly for meadow or pasture. Timothy and clover hay, timothy hay, oats, and buckwheat are the principal crops. If intertilled crops are grown, they should be planted in strips on the contour, and diversion ditches should be used to intercept seepage water and excess surface runoff. Pastures on this soil furnish poor grazing. If this soil is to make even fair yields, it must have large amounts of lime and phosphorus, as well as practices to maintain organic matter and nitrogen. For use and management see group 3–E.

Hornell silty clay loam, moderately steep phase (15 to 30 percent slopes) (Hf).—The profile of this soil is similar to that described for the sloping phase of Hornell silty clay loam. This shallow, fine-textured soil is difficult to work, and highly erodible when plowed and cultivated. Fully half of the cleared part has lost all of its original surface soil.

Because it erodes so easily, this soil should be kept in pasture or long-term meadows. It is very poorly suited to cultivated crops. Large amounts of phosphorus and lime are needed if even fair yields are to be obtained. Where other more suitable soils are available for pastures and crops, fertilizer and lime will probably bring greater returns on them, and this soil should then be reforested. For use and management see group 4–D.

Howard gravelly loam, nearly level phase (0 to 5 percent slopes) (Hl).—This soil, like others of the Howard series, developed from

sand and gravel that came from shale and sandstone and some crystalline rocks and limestone. This sand and gravel has been water-sorted into layers.

The 8- to 10-inch surface soil is grayish-brown friable gravelly loam that is fairly well supplied with organic matter and is very strongly acid where unlimed. This changes abruptly to yellowish-brown very strongly acid friable gravelly loam that continues to a depth of 22 inches. From 22 to 36 inches the material is brown or slightly reddish-brown very gravelly clay loam, strongly acid at the top but neutral at the bottom. This layer extends in tongues a few inches to a foot or more wide to depths of 4 or 5 feet in many places. Below this layer and continuing to depths of many feet are layers of gray, calcareous gravel and sand.

The gravel on the surface interferes moderately with cultivation. The soil profile is very permeable to air, water, and roots. The moisture-holding capacity is not high, and yields may be reduced by prolonged dry periods.

This soil, like others of the Howard series, has a profile very much like the Palmyra soils. However, in the Howard soils the brown subsoil horizon is at greater depth and less strongly expressed and the reaction of both surface soil and subsoil is more acid. The Howard soils are between the Palmyra and Chenango soils in lime content. The Howard soils have lime at 3 to 4 feet, the Palmyra soils have lime at 18 to 24 inches, and the Chenango soils have lime at 6 feet or more.

The nearly level phase of Howard gravelly loam is one of the better soils of the county. The nearly level relief and ease of cultivation make it favorable for most crops. It is used for alfalfa, timothy and clover, beans, potatoes, wheat, oats, corn, nursery stock, and crops for canning. These and similar crops may be grown without special practices for erosion control. The soil is not so well suited to pastures as some of those that hold more moisture. It will produce good pastures, but on most farms crops give much higher returns and the soil is not used for permanent pasture. Manuring or use of sod crops are needed to maintain organic matter. Lime is needed to start legumes, although established deep-rooted legumes can obtain lime from the substratum. This soil also needs phosphorus and should receive potassium for continued high yields. For use and management see group 1–A.

Howard gravelly loam, sloping phase (5 to 10 percent slopes) (Hm).—This sloping phase lies mainly on the short slopes between terraces, but a few areas have complex undulating or rolling slopes. The soil profile is similar to that of the nearly level phase of Howard gravelly loam.

This sloping phase is well suited to most crops, but practices to control runoff and erosion are needed. On the few long slopes, contour tillage and stripcropping should be used and rotations should contain not more than 2 years of row crops in 4 years. Short slopes are best used for long-term meadows or close-growing crops. Lime, phosphorus, and potassium are needed, as well as manure, crop residues and legumes to maintain organic matter and supply nitrogen. For use and management see group 2–A.

Howard fine sandy loam, nearly level phase (0 to 5 percent slopes) (Hh).—Most of this fine sandy loam is located near Dansville. Its moisture-holding capacity is somewhat less than that of Howard gravelly loam, nearly level phase, but it is used in about the same way.

The 8-inch surface layer is very strongly acid grayish-brown friable nearly gravel-free fine sandy loam. The upper subsoil, a strongly acid yellowish-brown friable loam, extends to a depth of 18 inches, where it grades into slightly sticky neutral gravelly loam. The gravelly loam rests on beds of calcareous sand and gravel at depths of 36 to 48 inches. The gravel and sands of the substratum contain fairly large amounts of limestone. The soil is fairly well supplied with organic matter and is easily permeable to plant roots, air, and moisture.

This soil is well suited to all of the crops commonly grown in the county and can be used continuously for row crops. Necessary practices include liming, fertilization with phosphorus and potassium, and use of manure, crop residues, cover crops, or legumes to maintain organic matter and nitrogen. For use and management see group 1–A.

Howard fine sandy loam, sloping phase (5 to 10 percent slopes) (Hk).—The profile of this phase is similar to that of the nearly level phase of Howard fine sandy loam, but in some places the surface soil and upper subsoil may not be quite so thick, and some small pebbles may be mixed with the soil.

This soil is suited to the same crops as the other Howard soils but requires special erosion control practices. If intertilled crops are grown, contour cultivation and stripcropping should be used. Where irregular slopes prevent stripcropping, intertilled crops can be grown safely if 2 or more years of sod crops are included in the rotation. Lime, phosphorus, and potassium are needed, and manure, crop residues, cover crops and legumes should be used to maintain nitrogen and organic matter. For use and management see group 2–A.

Howard soils, undifferentiated, hilly phases (15 to 25 percent slopes) (Hn).—This unit includes profiles of both Howard gravelly loam and Howard fine sandy loam. Complex irregular slopes determine the use and management of these Howard soils; hence, the differences between the two types are not considered significant. Hilly Howard soils occur in Ossian, Nunda, and Portage Towns.

Like other Howard soils, these hilly phases are loose and porous and have somewhat low water-holding capacity. However, they are more droughty than other Howard soils, because water runs off the hilly slopes rapidly. Nevertheless, erosion control is less of a problem than on most soils with comparable slopes, because this porous soil absorbs large amounts of water.

Irregular to rough topography and low water-holding capacity make these phases poor for most crops. They are better suited to deep-rooted hay crops than to intertilled crops. Alfalfa and birdsfoot trefoil are able to draw on subsoil water and will produce fairly well. The soils are acid enough to require liming for these crops. They are low in phosphorus and potassium. For use and management see group 3–G.

Kendaia silt loam (0 to 8 percent slopes) (Ka).—This soil occupies poorly drained flats and depressions among better drained soils that have developed on glacial till having a high content of lime. As mapped, the unit includes the less well-drained parts of the associated imperfectly drained soils. It occurs in small areas throughout the northern and central parts of the county. On gentle slopes, a small amount of coarse angular gravel and small stones may be on the surface and mixed through the soil. The native forest consisted of elm, soft maple, black ash, willows, and other species tolerant of poor drainage.

Where associated with Honeoye soils, this soil has an 8- to 10-inch surface layer of very dark grayish-brown, neutral or slightly acid, coarsely granular silt loam containing a large amount of organic matter. The subsoil, extending from 8 inches to 24 inches, is a friable brown, yellow-and-gray mottled, neutral heavy silt loam. This grades into a firm gray calcareous silt loam glacial till. This till is mottled with yellow and rust brown in the upper part but is unmottled below.

Where associated with Lansing soils, Kendaia silt loam has a similar neutral profile, but textures are commonly slightly finer and depth to free lime is 30 inches or more in many places.

Most areas of this soil have been cleared, and many have been at least partially drained. The soil is used principally for pasture and timothy and clover hay. The wet subsoil prevents deep root penetration.

Wheat, corn, and canning crops are grown where the soil is adequately drained by ditches or tile. The natural fertility is high, and where drained and well managed, Kendaia silt loam is more productive than the associated better drained soils. The soil usually needs no lime but it requires phosphorus. Complete fertilizers are needed for intensive cash crops, but potassium is not commonly needed for grasses and legumes. No special practices are needed to control erosion. For use and management see group 1–C.

Lakemont silty clay loam (0 to 2 percent slopes) (La).—This poorly drained soil developed from highly calcareous glacial-lake silts and clays, mainly on level or depressed areas where runoff is slow, but also in small seepy areas on slopes. Very little water penetrates the dense, fine-textured subsoil or substratum. The soil is associated with Schoharie, Odessa, and Poygan soils in the northern and central parts of the county.

The 8- to 10-inch surface soil is dark or very dark gray slightly acid to neutral silty clay loam, highly granular when not cultivated. This layer is underlain by 2 to 4 inches of gray silty clay that has mottles of light gray and brown and a weak coarse blocky structure. At a depth of 12 inches begins a layer of very coarse prismatic silty clay. The prisms are 12 inches across and are coated with gray; the insides are light reddish brown, mottled with gray and yellowish brown. The substratum, beginning at about 24 inches, is pinkish-gray blocky highly calcareous clay or silty clay.

The surface soil is high in organic matter and slightly acid; the subsoil is neutral to alkaline. The soil is normally free of stone or gravel, but stones have been washed onto the soil in a few places.

Roots do not penetrate deeply into the wet dense subsoil, and water moves through it very slowly.

The undrained soil is too wet for any use except pastures of bentgrass, swampgrass, sedges, and rushes. During dry seasons, areas of this soil furnish fair grazing. Corn, oats, and hay are grown on a few areas where excess water is removed by open ditches. Complete drainage is generally not feasible. For use and management see group 5–A for the undrained soil.

Langford gravelly silt loam, gently sloping phase (0 to 8 percent slopes) (Lb).—This soil occupies smooth slightly convex slopes with fair surface drainage. The parent material is glacial till derived mostly from local shale and sandstone. The soil is moderately well drained but has a slowly permeable hardpan at depths of 18 to 24 inches. It is associated with Erie soils in the southern part of the county.

The 8-inch surface soil is very strongly acid grayish-brown friable gravelly silt loam. The upper subsoil, extending from 8 to 16 inches, is friable yellowish-brown very strongly acid gravelly silt loam. This layer grades to pale-brown friable strongly acid loam or silt loam mottled with yellowish brown. The mottled layer ends sharply at depths of 18 to 24 inches and rests on olive-brown firm hard silty clay loam mottled with gray and rust brown. This hardpan layer consists of prisms 2 to 4 inches in diameter that are separated by thin layers of gray soil material. Roots and water penetrate mainly along the layers between the prisms. This pan is strongly acid in the upper part but about neutral below 30 to 36 inches. It grades to neutral firm silt loam glacial till at depths ranging from 50 to 60 inches. In a few places the substratum is calcareous immediately below the pan, but more commonly calcareous material is at 5 feet or deeper. Near the Lansing soils, lime may be found at 40 inches.

Langford gravelly silt loam, gently sloping phase, is a moderately productive soil, fairly well suited to forage and feed crops. Timothy and clover hay, oats, oats and barley mixed, and corn for silage are the most important crops. Wheat, field beans, and green peas are also grown. Both lime and phosphorus are needed for good yields. Potassium may be adequate if the soil is not heavily cropped, but under intensive use potassium fertilizer will be needed for continued good yields. Lime in the substratum is not available to crops.

Cultivation across rather than up and down the slopes will adequately control erosion if the rotation includes row crops only once in 4 or 5 years. Stripcropping, contour tillage, and diversion terraces are needed where 2 years of row crops are included in the rotation, especially on slopes greater than 4 or 5 percent. Slow movement of water through the hardpan causes temporary waterlogging of the lower subsoil. The regularly spaced diversion ditches will not only divert runoff on long slopes but also intercept seepage water. For use and management see group 2–D.

Langford gravelly silt loam, sloping phase (8 to 15 percent slopes) (Ld).—This sloping phase has grayish-brown surface soil, yellowish-brown subsoil, and a compact mottled hardpan like those of the gently sloping phase of Langford gravelly silt loam. Runoff is fairly

rapid and large in volume, especially in spring when the layer above the pan is saturated.

Special practices to control erosion and runoff should be used when intertilled crops are grown. Long slopes should be planted in strips, the strips of intertilled crops alternating with those of hay or small grain. Diversion ditches spaced at regular intervals intercept seepage water and remove excess surface runoff. This soil is well suited to hay, close-growing crops, and pasture. Medium red clover, alsike clover, or Ladino clover are more successful legumes than alfalfa. The soil needs phosphorus and lime and generally needs potassium for good growth of crops. For use and management see group 3–A.

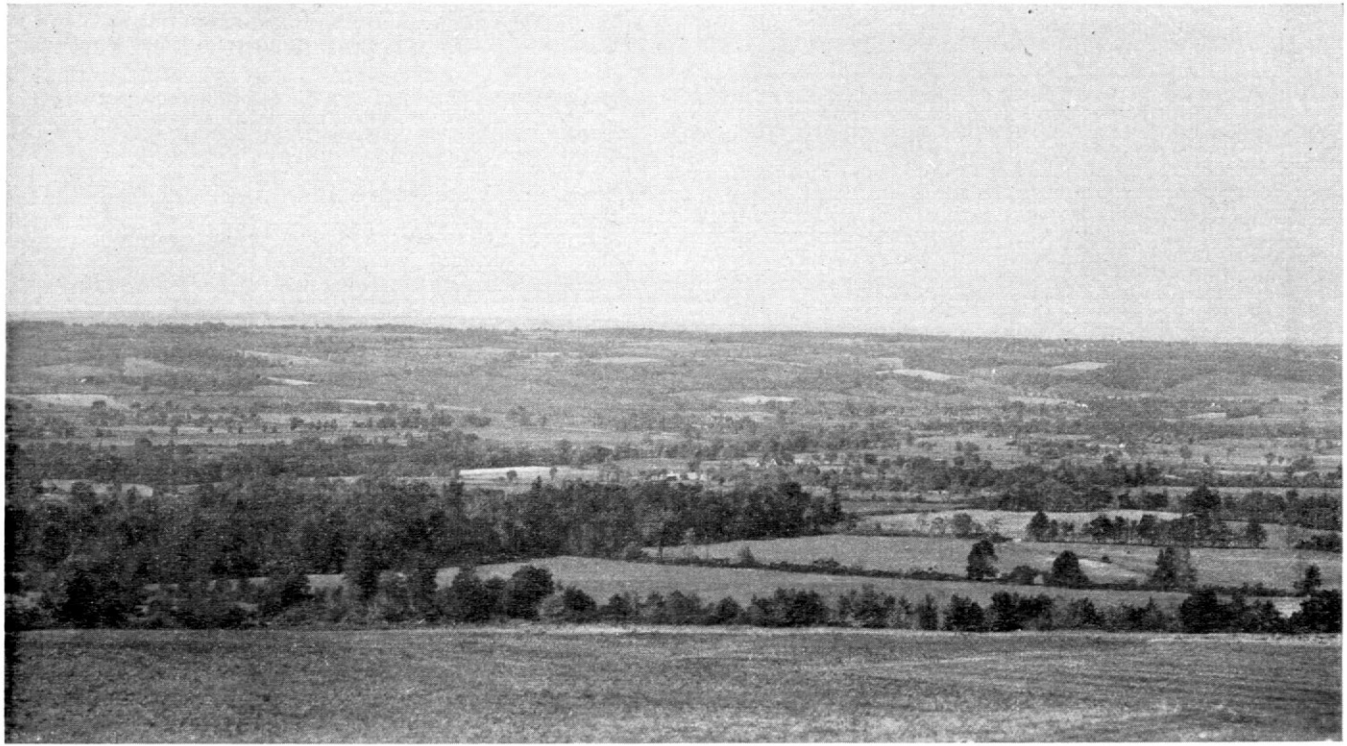
Langford gravelly silt loam, moderately steep phase (15 to 30 percent slopes) (Lc).—The profile of this phase is like that of the gently sloping phase of Langford gravelly silt loam. It is a poor soil for crops. On these moderately steep slopes, tillage is difficult and erosion is hard to control. The soil is best suited to pasture and long-term hay. If it is necessary to use it for other crops, they should be planted only once every 4 or 5 years, and then in narrow strips on the contour between buffer strips of hay. The soil needs lime and phosphorus, but, even when these are used in needed amounts, yields remain low on these moderately steep slopes because of the unfavorable moisture supply. For use and management see group 4–A.

Lansing silt loam, gently sloping phase (0 to 8 percent slopes) (Le).—This well-drained soil formed in calcareous glacial till derived from shale and limestone. It lies between the high- and low-lime areas of the county. All of the free lime has been leached from the surface soil and subsoil.

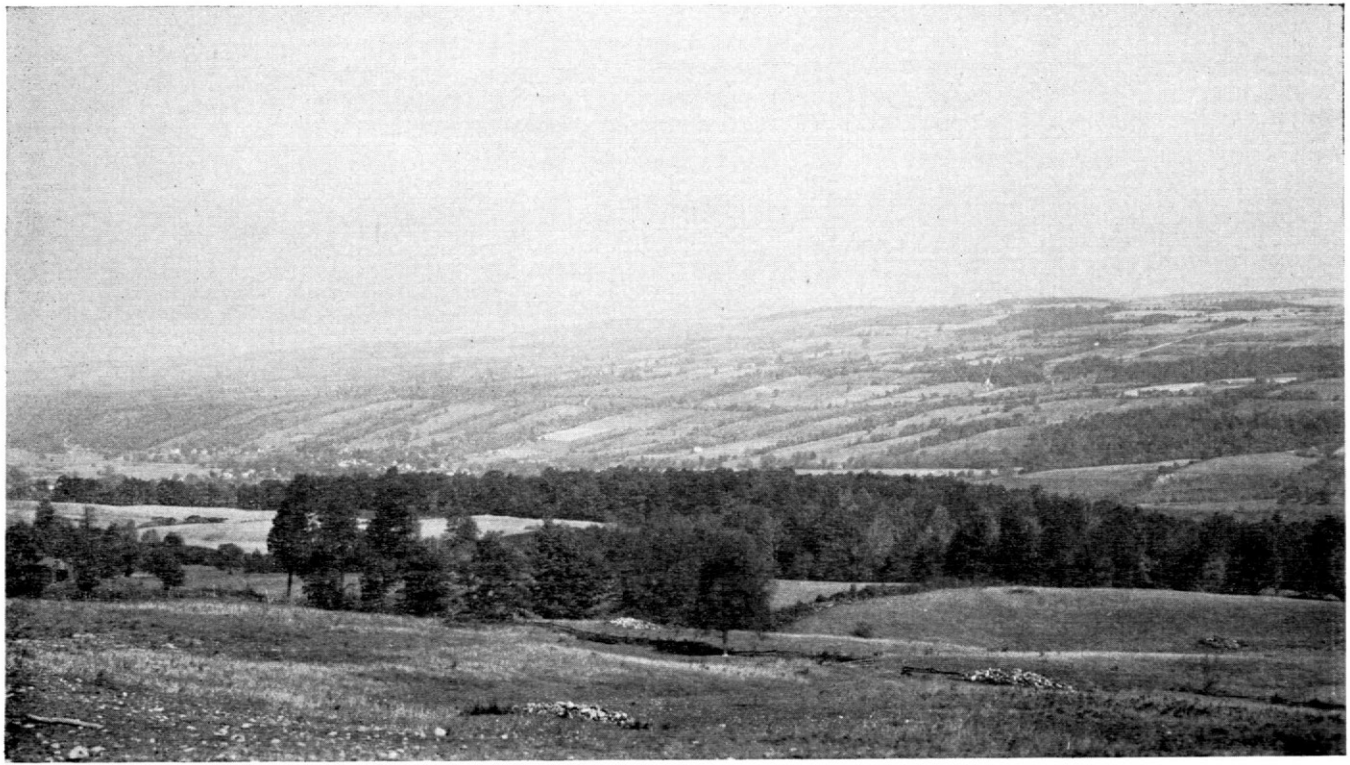
The native hardwood forests consisted of red and white oaks, hickory, ash, black walnut, basswood, hard maple, beech, white pine, and hemlock. Present forests and woodlots are second and third growths of these original species.

The plow layer is about 8 inches of grayish-brown strongly acid friable silt loam that has a good crumb structure and contains some angular gravel and small stones and cobbles. From 8 down to 16 inches the material is a light yellowish-brown friable strongly acid silt loam. Light-brown or light yellowish-brown strongly acid light-textured silt loam begins at 16 inches and continues down to 18 inches; this layer breaks into irregular-shaped slightly firm fragments. Between 22 and 42 inches occurs medium acid to neutral dark-brown or dark yellowish-brown heavy silt loam or silty clay loam in moderately expressed blocky aggregates ½ inch to 2 inches in diameter. The lower part of this layer may be weakly calcareous. The material below 42 inches is grayish-brown moderately firm calcareous silt loam to loam till with a strong fine blocky structure. Thickness of the soil profile over this till may range from 30 to 48 inches. Roots can penetrate to 50 inches or more.

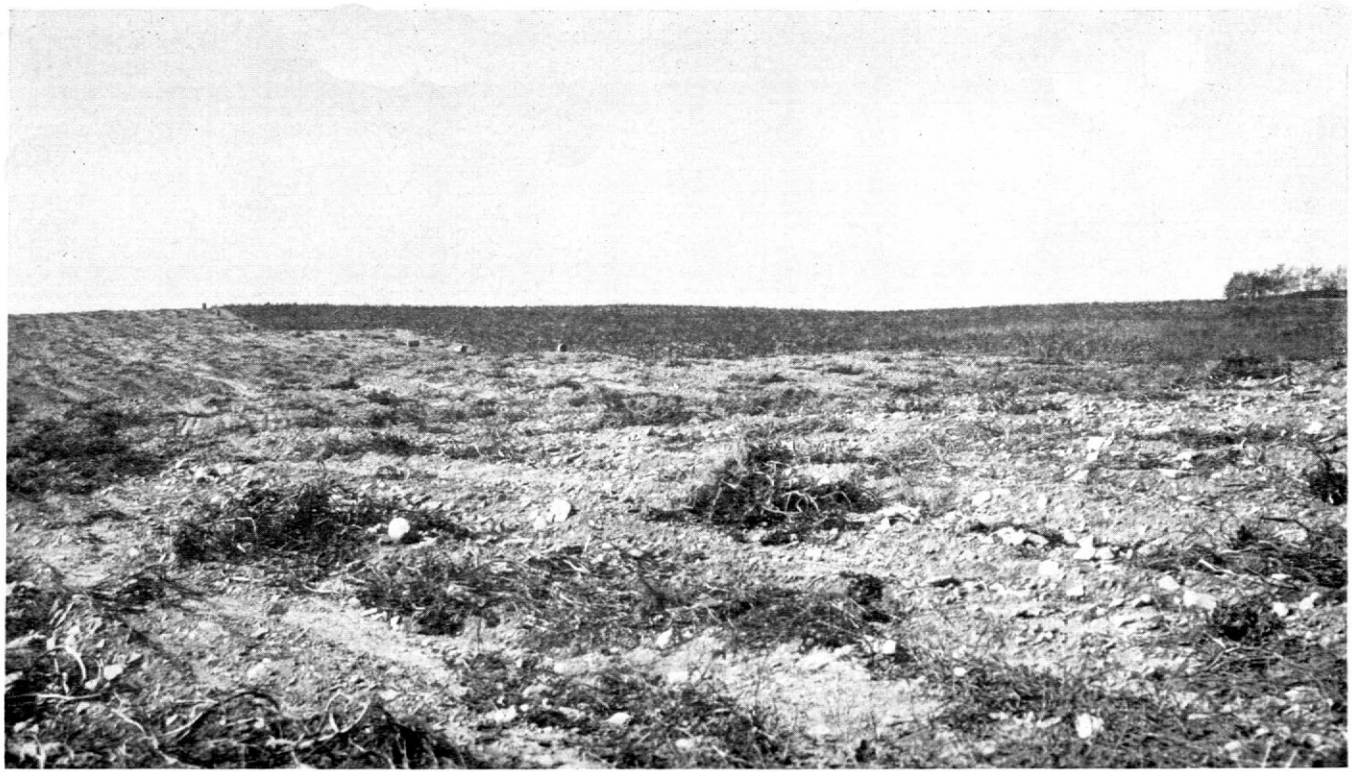
Lansing silt loam, gently sloping phase, is easily maintained in good tilth. Its good water-holding capacity and neutral lower subsoil favor most crops grown in the county. It is used mainly for timothy and red clover, alfalfa, wheat, beans, corn for silage, oats, green peas, and sweet corn. Native pastures are not so good as those on Ontario and Honeoye soils, but excellent pastures can be obtained by good



The broad Nunda valley held a lake after the glacier receded. On the lower slopes in the foreground and background are Caneadea soils formed from materials deposited in quiet waters of this lake. On the valley floor in the middle distance are Tuscarora and Fredon soils that formed from gravelly materials deposited later by free-flowing waters.

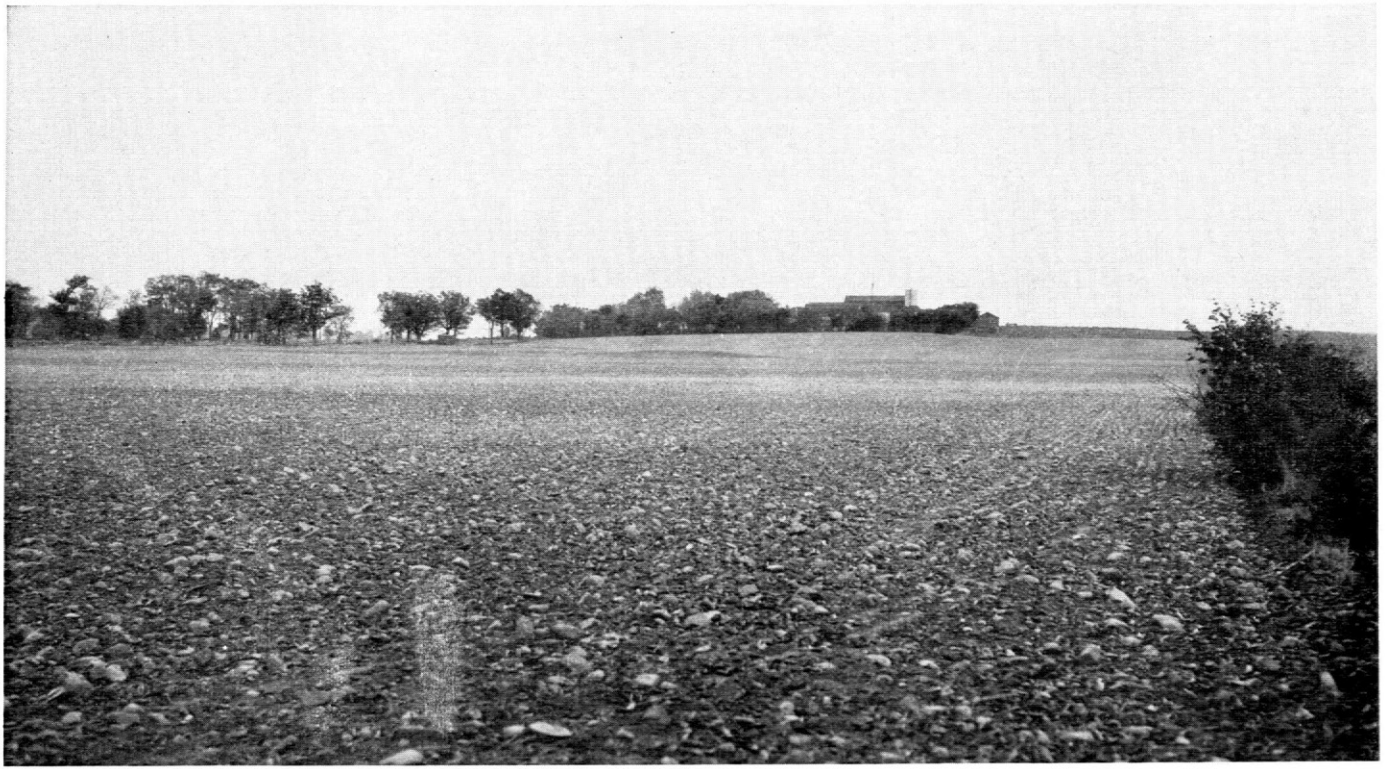


The valley south of Hemlock Lake. Rolling Woostern soils in foreground lie above nearly level Chenango soils on the terraces, which, in turn, are above the Middlebury soils on first bottoms in the valley. In the background are Canfield soils on the lower slopes, then gently sloping Volusia soils on the benchlike uplands, and finally the Bath and Mardin soils in the far distance.



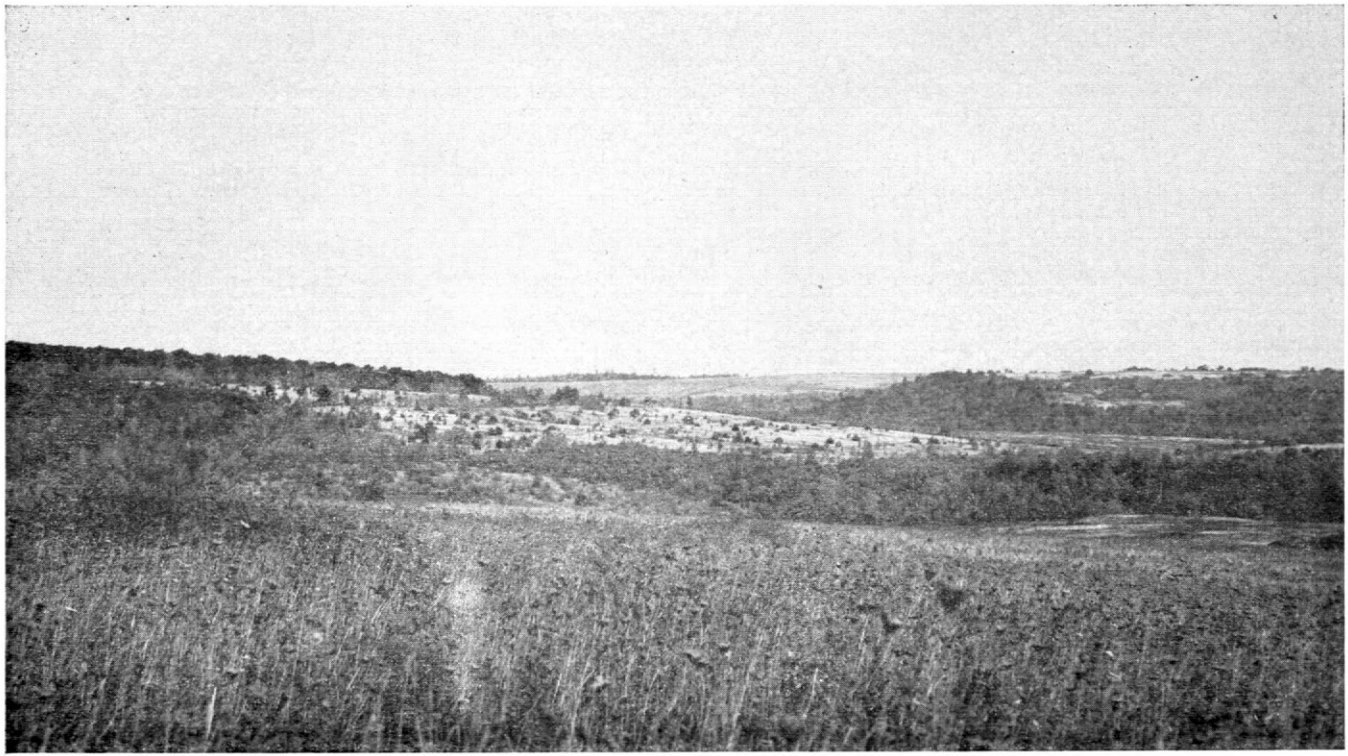
Potatoes on Bath channery silt loam, rolling phase.

Bath-Mardin soils in background need contour stripcropping when planted to crops.



Nearly level Palmyra gravelly loam on glacial outwash in the foreground has been seeded to winter wheat. The farmstead is on a low drumlin of Ontario loam, gently sloping.

Buckwheat is planted as a catch crop when Volusia soils stay wet too long for seeding of other grains in spring.



Large areas dominated by Volusia soils have been abandoned. White pine is reseeding naturally in the old field in the middle distance; weeds cover the old field in the foreground.

The undulating and rolling Woostern soils on acid glacial till support good dairy farms in the southern part of the county.

management. Legumes need lime. Phosphorus is generally deficient, and potassium commonly becomes deficient under heavy cropping. Rotations with 1 year of row crop in 3 or 4 years are best. Under such rotations, cross-slope tillage should be practiced, and widely spaced diversion terraces may be needed on long slopes. If needed, row crops can be grown 2 years in a 4-year rotation. With this intensive use, diversion terraces are essential, and contour tillage as well as stripcropping should be practiced. Manure, crop residues, and legumes are needed to maintain organic matter and nitrogen. For use and management see group 1–D.

Lansing silt loam, sloping phase (8 to 15 percent slopes) (Lg).—Except where erosion has thinned the surface layers and exposed more gravel and stones, the profile of the sloping phase is like that of the gently sloping phase.

This sloping phase is fairly well suited to most crops but needs careful practices to control runoff and erosion. Intertilled crops should be grown only 1 year in a 4 or 5 year rotation, and they are best planted in strips between strips of small grains or hay. Close-growing crops, long-term meadows, or pasture are good uses for this sloping Lansing soil. Phosphorus and lime are essential for good crop growth. Potassium is likely to become deficient under intensive cropping. Practices to maintain or to increase the supply of nitrogen and organic matter should be used. Heavy machinery can be used on this soil, but not so easily as on the gently sloping phase. For use and management see group 2–E.

Lansing silt loam, moderately steep phase (15 to 30 precent slopes) (Lf).—This phase is similar to Lansing silt loam, gently sloping phase, but occurs on greater slopes bordering Conesus Lake.

Very little of this soil is cultivated because machinery is difficult to use and runoff and erosion are difficult to control. Some is used for hay, but most of the cleared soil is in permanent pasture or is idle. If other soils are available for crops, these moderately steep slopes should be kept in pasture or used for long-term hay. Once hay stands are established, they should remain as long as yields are good. Phosphorus and lime should be supplied. For use and management see group 3–G.

Lima silt loam, gently sloping phase (0 to 8 percent slopes) (Lh).—This moderately well drained soil is on slightly convex nearly level to gentle slopes. The underlying high-lime till is similar to that underlying Honeoye soils. Lima silt loam, gently sloping phase, occupies large areas throughout the northern part of the county. It is associated with Honeoye and Ontario soils.

The 6- to 8-inch surface soil is grayish-brown slightly acid friable silt loam of good crumb structure. A subsurface layer is about 4 inches of light grayish-brown moderately acid crumbly silt loam. This grades into light yellowish-brown, firm, medium acid silt loam that is mottled with gray and brown. This mottled layer extends to about 14 inches. From 14 to 20 to 24 inches is neutral heavy silt loam mottled with rust brown and yellow on a brown base color. It breaks into medium-sized slightly firm blocks. Below 24 inches is grayish-brown highly calcareous loam or silt loam glacial till in firm

344679—56——5

angular blocks about ½ to 1 inch across. Depths to this slightly weathered glacial till range from 18 to 30 inches.

This phase of Lima silt loam is used for wheat, oats, corn, alfalfa, timothy and clover, field beans, green peas, sweet corn, and cabbage. Despite need for some drainage, this is a good soil for farming. It is used in much the same way as Honeoye loam, gently sloping phase, and yields reported are only slightly lower. In dry years yields exceed those on Honeoye soils.

This soil is suited to intensive use. The mild slopes favor the use of heavy machinery; runoff and erosion are easy to control. Alfalfa does well if the soil is tiled. The soil does not need lime, but it is low in phosphorus. If intensively used it may need more potassium than it gets from the usual applications of manure. For use and management see group 2–C.

Lordstown flaggy silt loam, sloping phase (0 to 15 percent slopes) (LI).—This soil formed on very low-lime glacial till on hilltops and gentle slopes in the higher southern part of the county. Associated soils are those of the Volusia, Fremont, Chippewa, Bath, and Mardin series. This Lordstown soil is shallow to moderately deep to bedrock.

Virgin areas of this soil usually contain many thin angular sandstone slabs or flagstones from 1 inch to 12 to 14 inches in diameter. Under undisturbed forests, a 1- to 2-inch layer of nearly white soil lies under a surface mat of raw humus.

Where cultivated, this soil has an 8-inch plow layer of very strongly acid grayish-brown silt loam. Where this soil has been cultivated for a long time, most of the flagstones have been removed from the plow layer, but enough remain in many places to interfere moderately with tillage. The upper subsoil, which reaches to a depth of 18 to 20 inches, is yellowish-brown very strongly acid friable silt loam or weak fine crumb structure. The lower subsoil, continuing from 20 inches down to bedrock, is light yellowish-brown slightly firm silt loam which may be faintly mottled immediately above bedrock. Bedrock most commonly lies at 30 to 36 inches, but depth to bedrock may range from 12 to 40 inches.

This soil has a moderate amount of organic matter in the surface layer and a very strongly acid reaction throughout. It is very permeable to air, roots, and water down to bedrock. Where the soil is 30 inches deep, it holds sufficient moisture for crops, but in the areas no deeper than 12 to 20 inches, uncertain moisture supply makes crop production hazardous.

Lordstown flaggy silt loam, sloping phase, is a moderately productive soil. The deeper parts respond well to fertilizers. However, much of the soil is in the more inaccessible parts of the county distant from other crop-suited soils. Large areas are in forests of beech, hard maple, oaks, ash, hickory, and basswood. Cleared areas produce forage crops, beans, wheat, potatoes, and buckwheat. Timothy or timothy and red clover hay is most commonly grown, and oats rank next in importance. Most pastures are unimproved, thin, and weedy. About one-tenth of this soil is idle or abandoned.

The soil absorbs moisture readily but runoff is rapid and the soil erodes to some extent. Diversion terraces are usually not practical on this shallow soil, but excessive runoff and erosion can be controlled

by contour tillage, and stripcropping, in rotations with only 1 year of row crop in 4 or 5 years. Field crops need large amounts of phosphorus fertilizer and manure, and complete fertilizers are essential for good yields of specialized crops. Lime is the most important single need of most crops. Use of legumes, manure, and crop residues is needed to maintain or increase the supply of organic matter and nitrogen and is also helpful in improving tilth and the rate of water absorption. For use and management see group 2–B.

Lordstown flaggy silt loam, moderately steep phase (15 to 25 percent slopes) (Lk).—The profile of this soil is similar to that of the sloping phase of Lordstown flaggy silt loam. The mantle of soil on these slopes is thin, and outcrops and ledges of rock are fairly common. More and larger flagstones are on the surface than on the sloping phase.

This is a poor soil for agriculture. The soil is difficult to work because of steep slopes, shallow depth, and surface stones. When these slopes are planted to small grains and intertilled crops, runoff and erosion are difficult to control. In the present agriculture this soil is probably best used for hay or pasture. It needs large amounts of phosphorus and lime, and potassium is apt to be deficient. Some areas should be reforested. For use and management see group 3–G.

Lordstown flaggy silt loam, steep phase (25 to 35 percent slopes) (Lm).—This phase lies on steep slopes in part, but also on sequences of steplike rock benches having a complex of slopes ranging from 5 to 35 percent in gradient. The soil profile is like that of the sloping phase, but outcrops of rock are much more common. The depth to bedrock is generally less than 20 inches, but deeper pockets occur where soil has washed from higher slopes and accumulated behind rock outcrops.

Although about 40 percent of the soil was cultivated in 1940, it is very poor for crops and should be used for pasture or reforested. For use and management see group 5–B.

Lordstown stony silt loam, steep phase (25 to 45 percent slopes) (Ln).—This phase is in large areas on steep valley sides. It is similar to the steep phase of Lordstown flaggy silt loam but has more and larger stones on the surface. Slopes are steeper, and outcrops and ledges of rock are more closely spaced.

Steepness, stoniness, droughtiness, and numerous rock outcrops make this soil very poor for crops. Pastures are thin and weedy and furnish little grazing. Cover is too sparse to prevent soil washing in many places. However, cost of pasture improvement on this steep soil is very high relative to increased returns that may be expected. Hence improvement is not feasible in most places. Forestry is probably the best use for this soil. For use and management see group 5–B.

Lyons silt loam (0 to 3 percent slopes) (Lo).—This is a very poorly drained high-lime soil formed on glacial till on flats, depressions, and drainageways where there is little or no surface runoff.

The surface soil is about 12 inches of neutral, black, coarsely granular heavy silt loam. It is high in organic matter and normally contains no gravel or stones. Between depths of 12 and 24 inches is gray neutral silt loam that is highly mottled with brown and yellowish-brown below 15 inches. The substratum, beginning at

about 24 inches is gray, compact, mottled, high-lime glacial till. In some extremely poorly drained spots the surface may be mucky.

Much of the soil is forested with soft maple, elm, black ash, beech, willows, and other species tolerant of very poorly drained soils. Undrained cleared areas are used mainly for permanent pasture, and the drained areas for hay and corn. When cleared and drained by tiling or ditching, this soil is highly productive. Many areas, however, cannot be drained for lack of an outlet for excess water. The cropped areas of this soil were mainly very poorly drained wet spots in fields of better drained soils. In order to work these fields as single units, these more poorly drained soils were drained, and then tilled along with the naturally better drained parts. Crops on this soil principally need phosphorus. For use and management see group 5–A for the undrained soil, and group 1–C for the drained soil.

Manlius shaly silt loam, sloping phase (0 to 15 percent slopes) (Mb).—This is shallow to moderately deep friable shaly soil underlain by shale bedrock. It occupies small areas on moderate slopes through the central part of the county.

The 6- to 8-inch plow layer is friable grayish-brown very strongly acid shaly silt loam. Under the plow layer lies yellowish-brown very strongly acid friable shaly silt loam that continues to a depth of 18 inches. From 18 inches down to bedrock, which begins at 24 to 30 inches, is pale yellowish-brown silt loam that contains many fine shale fragments. The bedrock is dark-gray to black, very thin-bedded flaky shale.

Surface drainage is good, and drainage through the soil is good to excessive. The loose friable soil absorbs water readily but the storage capacity in the volume of soil material above bedrock is small.

Most of this soil is cleared and used for pasture or meadow. The thin, weedy pastures furnish little grazing. Meadows consist mainly of timothy and clover. Intertilled crops on slopes above 5 percent need diversion terraces, contour tillage and stripcropping to control erosion. The soil needs lime, phosphorus, and potassium for even fair growth of crops. Legumes require large amounts of lime. For use and management see group 3–E.

Manlius shaly silt loam, moderately steep phase (15 to 25 percent slopes) (Ma).—This phase has a loose open shaly silt loam surface soil over a light yellowish-brown shaly subsoil that rests on shale bedrock at 18 to 24 inches. Many of the steeper slopes consist mainly of a mass of loose fine shale fragments.

These slopes are difficult to work, and runoff and erosion are serious if the soil is plowed. Little of the original surface soil remains on much of the soil that has been cultivated. Where this soil is needed for farming, long-term meadow or pasture are the best uses, but lime and phosphorus are required in large amounts to produce even moderate yields. For use and management see group 4–D.

Mardin channery silt loam, gently sloping phase (0 to 8 percent slopes) (Md).—This is a moderately well drained, very strongly acid soil with a slowly permeable silty "pan" below depths of 18 or 20 inches. It is in the higher parts of southern Livingston County, where it is associated with Fremont, Bath, Lordstown, and Volusia soils. It resembles Canfield gravelly silt loam in the arrangement

and thickness of the profile layers, but is more acid in reaction, browner in surface color, smoother in relief, and lies at higher elevations than the Canfield soil.

Mardin channery silt loam, gently sloping phase, has an 8-inch plow layer of grayish-brown very strongly acid friable silt loam. Many angular fragments of sandstone [10] are on the surface and mixed with the soil. Most of these stone fragments are small, but in a few places they are large enough to interfere with tillage. The soil below the plow layer, to a depth of about 15 inches, is yellowish-brown very strongly acid friable silt loam. Below this is strongly acid friable silt loam, mottled with gray, yellowish-brown, and brown. At a depth of about 20 inches, this rests on a compact layer of very strongly acid silt loam, which is olive brown mottled with brownish-gray and light-yellowish brown. Vertical cracks 8 to 20 inches apart divide this compact layer into hard very coarse prisms that have secondary weak blocky structure. Hardness decreases with depth. Firm olive-brown till lies at depths of 4 to 6 feet.

The soil has a medium amount of organic matter in the surface layer and is very strongly acid to depths of 36 inches or more. The lower part of the hardpan is less acid, and neutral or calcareous material may occur very deep in the substratum. Roots penetrate easily down to the hardpan, but only a few small roots are able to grow into the hardpan, and they follow the cracks between the very coarse prisms. Water penetrates the hardpan very slowly, but the soil has a fair water-holding capacity in the surface soil and upper subsoil layers.

This soil was originally forested with beech and hard maple; minor species were white pine, hemlock, ash, and chestnut. Many areas are still covered with second- and third-growth timber of the original species.

Timothy hay, timothy and clover hay, and oats for feed and forage are the most important crops. Some wheat, beans, and corn for silage are grown. Potatoes are locally important, especially where the soil is associated with the large areas of Bath soils in Springwater town. Buckwheat is a minor crop.

Even though slopes of this Mardin soil are gentle, erosion control practices should be applied if intertilled crops are grown frequently. Runoff may be fairly large during the spring when the 18 to 24 inches of soil above the hardpan is saturated. Some soil loss can be avoided by using contour stripcropping in combination with appropriate crop rotations. Where slopes are long, diversion ditches cut down to the hardpan will take care of surface runoff and intercept seepage water.

Good management requires large amounts of phosphorus fertilizer, enough lime for good growth of clover, and manure and crop residues to maintain the supply of nitrogen and organic matter. Potassium is generally necessary. Large amounts of fertilizer are required to supply additional nitrogen and potassium to potatoes. For use and management see group 2–D.

Mardin channery silt loam, sloping phase (8 to 15 percent slopes) (Mf).—This phase has grayish-brown surface soil, yellowish-brown upper subsoil, and a mottled compact pan like the gently sloping

[10] See footnote 7, p. 30.

phase of Mardin channery silt loam. More thin sandstone fragments are on the surface and mixed in the profile in many places than is typical for the gently sloping phase.

This phase is used for the same crops as the gently sloping phase of Mardin channery silt loam, but more careful management is needed to control runoff and erosion. Row crops should be used only 1 year in a 4- or 5-year rotation; they should be planted in strips that alternate with strips of close-growing crops or hay. The soil needs contour tillage, stripcropping, and regularly spaced diversion terraces on the long slopes. The large amounts of lime and fertilizer and the practices to maintain and increase organic matter and nitrogen described for the gently sloping phase of Mardin channery silt loam are also needed for this phase. For use and management see group 3–A.

Mardin channery silt loam, eroded sloping phase (8 to 15 percent slopes) (Mc).—This phase consists of areas of sloping Mardin channery silt loam, on which erosion has been serious. More than 75 percent of the original surface soil has been lost, and in some places part of the subsoil is gone. Some of the areas are also gullied.

This eroded phase is similar to the uneroded sloping phase of Mardin channery silt loam, except that in many places the plow layer is now entirely within the original subsurface layer and is likely to contain more stones. The productivity has been materially lowered by the loss of soil, and the damage is very difficult to correct because of the small volume of soil remaining above the hardpan. A few fields have been ruined by deep gullies.

Further washing should be prevented if these eroded soils are to remain as farmland. Contour stripcropping and diversion terraces are being used with success in some places, but use of the soil for permanent meadows or pasture is a better practice. The soil needs large amounts of lime, fertilizer, and manure. Adding straw or other crop residues to increase the supply of organic matter is important. For use and management see group 3–A.

Mardin channery silt loam, moderately steep phase (15 to 30 percent slopes) (Me).—Areas of Mardin channery silt loam on slopes exceeding 15 percent are mapped as this moderately steep phase. The soil profile is similar to that of Mardin channery silt loam, gently sloping phase.

Steep slopes and the serious problem of controlling runoff and erosion make this phase poor for crops. It is best used for pasture or long-term hay. In establishing meadows, the soil should be prepared in strips that follow the contour as closely as possible. A mixture of grass and a long lived legume such as birdsfoot trefoil probably will give the best pastures. Lime and phosphorus needs are similar to those of other Mardin soils. For use and management see group 4–A.

Marl pits (Mk).—About 2 miles northeast of Caledonia near the Monroe County line there is a large marl pit that has been abandoned for many years. In the past, large quantities of marl were excavated from deposits in this general region. Part of this marl was used for liming soils, and part was processed at a nearby lime kiln. No marl is now mined in Livingston County.

Mentor fine sandy loam (0 to 5 percent slopes) (Mg).—This well-drained soil developed on nearly level stream terraces from yellowish-brown coarse and fine sands. It occurs near Avon on both sides of the Genesee River. Associated with it are the Arkport soils, which have a higher topographic position. This soil contains more sand than the Arkport soils, especially in the subsoil, and lacks a prominent thick brown subsoil like that of the Arkport soils.

The upper 8 inches of Mentor fine sandy loam is a grayish-brown or dark-brown mellow fine sandy loam. The subsurface layer, extending to a depth of 16 inches, is yellowish-brown to light-brown friable sandy loam. The subsoil, to a depth of about 30 inches, is yellowish-brown slightly firm fine sandy loam mottled with light gray. At 30 inches this material grades into brown sandy loam. Below 50 inches gray calcareous coarse sand and fine gravel are stratified with silt and fine sand.

The surface soil is slightly acid, the subsoil is neutral to alkaline, and the lower subsoil is alkaline to calcareous. This soil is permeable to air, roots, and water and has high to medium water-holding capacity.

Mentor fine sandy loam is used for alfalfa, wheat, beans, oats, corn, green peas, and sweet corn. The soil is easy to work, productive, and responds to good management. It is suited to a wide variety of crops. Under comparable management, crop yields are similar to those on Arkport fine sandy loam. The moisture-holding capacity may be slightly less, but only during an unusually dry season would this effect be noticeable in reduced yields. The soil needs no lime but requires both phosphorus and potassium for good yields. Practices to maintain nitrogen should be used. For use and management see group 1–A.

Middlebury silt loam (0 to 2 percent slopes) (Mh).—This is a moderately well drained soil occupying flats and slightly depressed areas on low first bottoms that are subject to frequent flooding. The parent materials are recently deposited alluvium washed from acid upland regions. Most of this soil is associated with Tioga silt loam and Holly silty clay loam along Keshequa Creek near Nunda.

The surface 8 to 10 inches is grayish-grown strongly acid mellow silt loam. From 8 inches down to 20 inches is light-brown or light yellowish-brown strongly acid friable silty loam. Slightly firm grayish-brown silt loam, mottled with rust brown and gray, extends from 20 inches to about 30 inches. Below 30 inches is medium acid material ranging in texture from silty clay loam or silt loam to sandy loam.

This soil has a naturally high water table because of its low position and level relief. Like other bottom land soils, it is subject to floods in spring and summer. It is moderately well drained, or between the well drained Tioga and the poorly drained Holly soils in drainage. The surface soil is well supplied with organic matter. The upper 18 to 24 inches is friable and permeable to roots and air. The subsoil, however, may be waterlogged for a considerable part of the growing season.

Middlebury silt loam is used for timothy and clover hay, pasture, oats, and corn. Expected yields and management needs are about the same as for the moderately well drained Eel soils. The Middle-

bury soil is strongly acid and needs lime if clover is to be grown successfully. For use and management see group 2–F.

Odessa silt loam, very gently sloping phase (0 to 5 percent slopes) (Oe).—This soil formed in highly calcareous clays and silts that were deposited in glacial lakes. It is the imperfectly drained associate of the well to moderately well drained Schoharie soils. It occupies broad very gentle slopes along the Genesee River northwest of Geneseo and areas of more irregular relief and steeper slopes in the southern part of the county. It occurs in large areas and is one of the most important soils in this county.

The 8-inch surface layer is grayish-brown heavy silt loam, granular when in sod but cloddy under cultivation. The subsurface layer from 8 to 12 inches is light grayish-brown silt loam strongly mottled with yellowish-brown and brown. This layer is firm in place, but moderately friable when crushed, and has a weak fine blocky structure. The upper part of the subsoil, beginning at about 12 inches and extending to 18 or 20 inches, is brown silty clay mottled with gray and yellow; it is fairly firm in place but breaks easily into strong medium blocky aggregates. The lower part of the subsoil, between 20 and 30 inches, is a brown or slightly reddish-brown silty clay, faintly mottled with yellow, brown, and gray and having a strong coarse blocky structure. The substratum is highly calcareous pinkish-gray lake clay containing thin lenses of silt. In the upper part of the substratum, lime is commonly segregated as nodules and as coatings on the structure particles.

The surface soil has a medium supply of organic matter and is medium to slightly acid in reaction. The upper subsoil is neutral, and the lower subsoil, alkaline. Free lime is present at depths ranging from 24 to 36 inches.

This soil has a medium productivity and is used principally for pasture, timothy and clover hay, wheat, alfalfa, corn, and beans. Its best uses are hay, pasture, and small grains. The fine texture makes it difficult to till, and the soil is locally known as "hard ground." The puddled and crusted surface soil reduces germination, and good stands of corn, beans, and peas are difficult to obtain.

Odessa silt loam erodes very easily. Even though slopes are gentle, water-control practices are needed to prevent loss of soil and moisture. The use of hay, pasture, or close-growing crops in the rotation is effective. Where row crops are grown, diversion terraces, contour tillage, and stripcropping are necessary. Soil structure should be maintained by regular additions of manure and crop residues and the use of sod crops. The soil is deficient in phosphorus but rarely needs lime or potassium. Nitrogen commonly brings good response from nonlegumes, especially in spring when the soil is cold. For use and management see group 2–C.

Odessa silt loam, gently sloping phase (5 to 10 percent slopes) (Oc).—This phase has a profile similar to that of the very gently sloping phase of Odessa silt loam, and it is used in much the same way. However, runoff is more rapid on this gently sloping phase, and more practices are needed to conserve water and soil. The soil absorbs water slowly, and under the beating action of rain the surface soil is quickly saturated and flows as a thin mud. Stones or gravel are

lacking to lower the velocity of water flowing over the surface. Pasture or long-term hay will slow the water and hold the soil in place. Long slopes may need diversion terraces to carry away excess runoff, even where the land is in permanent hay or pasture.

Where this soil must be used for crops, contour stripcropping should be practiced. Intertilled crops should be grown only 1 year in a 4-year rotation, and then only between strips of hay or close-growing crops. Closely spaced diversion terraces are needed, and natural waterways should be left in sod, even when the gently sloping Odessa soil is plowed for stripcropping.

The soil needs little or no lime or potassium, but phosphorus fertilizer is required to obtain good growth of crops. Nitrogen may bring good response, especially in the spring when the soil is cold. Practices that increase granulation and add organic matter to the soil help to increase water absorption and make the soil easier to work. For use and management see group 3–D.

Odessa silt loam, sloping phase (10 to 15 percent slopes) (Od).—Much of this sloping soil has a grayish-brown surface soil, a light-gray upper subsurface soil mottled with brown, and a fine-textured brown silty clay subsoil mottled with gray and yellow. In places, the original surface soil has been removed by erosion. In these places the present plow layer is lighter grayish brown and may be faintly mottled, and the mottled subsoil is within 6 or 8 inches of the surface. All of this soil is used for hay.

Because it erodes very easily when cultivated, this soil should be used for long-term meadow or pasture. When these slopes are being established in permanent meadow, they should be plowed in strips and not reseeded as complete units. All tillage should be done on the contour or across the slope, and natural drainageways should be left in sod. When the seeding mixture contains alfalfa, small amounts of ground limestone may be needed. Phosphorus should be applied to the small-grain nurse crop and to the meadow. Potassium is rarely needed. For use and management see group 4–B.

Odessa silt loam-Berrien fine sandy loam, gently sloping phases (0 to 5 percent slopes) (Oa).—This unit consists of small areas of Odessa silt loam and Berrien fine sandy loam so intermingled that they could not be shown separately on the soil map. In these areas, sands were unevenly deposited over silt and clay. Silt and clay may be exposed on the tops of narrow ridges and small knolls, but a few feet down the slope this material may be buried under 24 to 30 inches of fine sandy loam. The soil profiles are the same as described for Berrien fine sandy loam and Odessa silt loam. Typical areas of each soil, as well as all graduations in depth of sand over clay intermediate between the two soils, are present. Figure 4 shows the complex pattern of soils in this unit.

The complex of gently sloping phases is associated with Odessa silt loam, most commonly around the edges of typical Berrien soils. This complex is difficult to farm because the management requirements of the two soils differ. The complex is used for hay, corn, oats, wheat, and field beans. Timing of plowing and cultivating and suitability for crops are determined by the fine texture of the Odessa silt loam. Crops must be fertilized in the same way as for Berrien

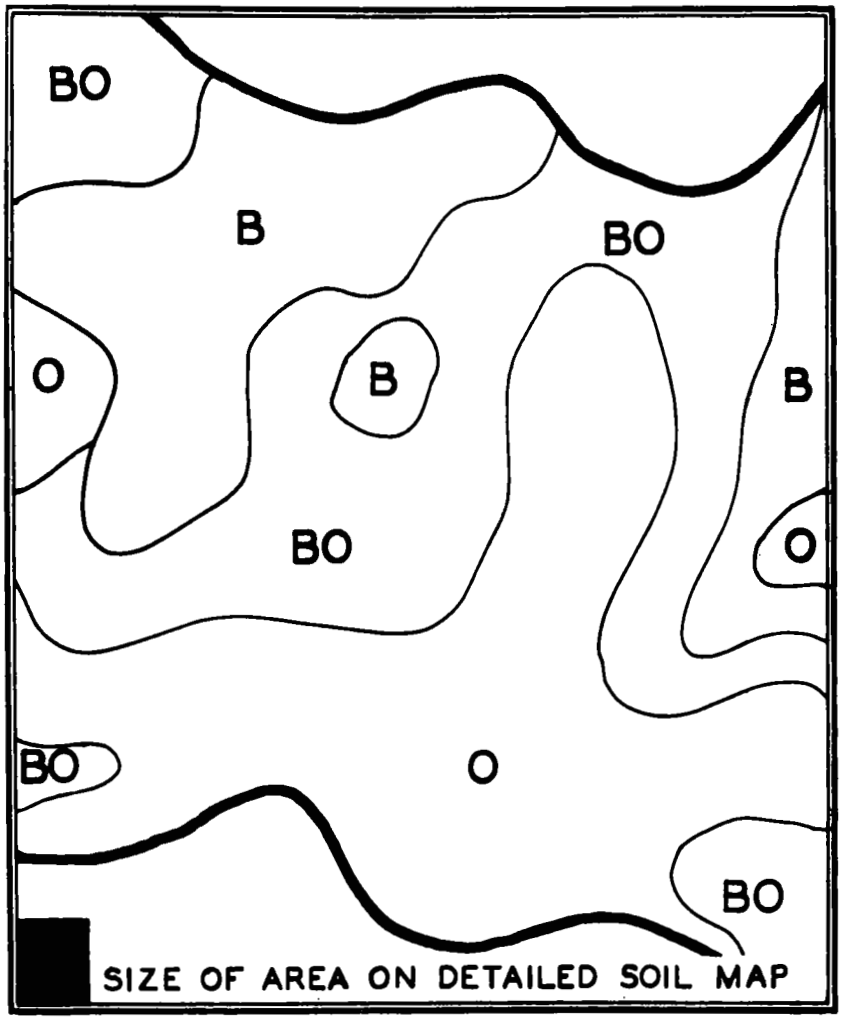


FIGURE 4.—Large-scale map showing about 35 acres of Odessa silt loam-Berrien fine sandy loam, gently sloping phases:
B, Berrien fine sandy loam, gently undulating phase;
BO, Berrien fine sandy loam, gently undulating phase, shallow over Odessa soil material; and
O, Odessa silt loam, very gently sloping phase.

fine sandy loam, the least fertile of the two soils. Lime, phosphorus, and potassium are needed on this complex. Erosion is a moderate problem, and use of sod crops, stripcropping, and contour tillage are needed. For use and management see group 3–D.

Odessa silt loam-Berrien fine sandy loam, sloping phases (5 to 10 percent slopes) (Ob).—The sloping areas of this complex have a detailed pattern of Odessa and Berrien soils similar to that described for the complex of gently sloping phases. These areas are irregular,

rolling, undulating, or sloping in relief. Both Odessa and Berrien soils erode very easily on these slopes, and in this complex the slopes are commonly too irregular to be contour-farmed and stripcropped. These soils are better suited to hay or pasture than to intertilled crops. The entire complex usually must be fertilized and limed to supply the Berrien soil with the lime, potassium, and phosphorus it needs. For use and management see group 4–B.

Ontario fine sandy loam, gently sloping phase (0 to 8 percent slopes) (Of).—This soil normally occurs on long low hills of high-lime glacial till in the northern part of the county. These hills, called drumlins, commonly range from ½ to ¾ of a mile long and ¼ to ½ mile wide at the base. They rise 50 to 100 feet above the general level of the till plain. Gravel and angular fragments of sandstone and crystalline rocks are on the surface and mixed with the soil, but they do not seriously interfere with cultivation.

In some places this soil is on nearly level to gently sloping till plains and resembles Honeoye loam. North of Avon, next to the Monroe County line, a small area included in Ontario fine sandy loam has a surface texture of loamy fine sand. Here, 10 to 18 inches of windblown sand, similar to that of Ottawa soils, was deposited over the typical Ontario soil material. In Monroe County this was mapped as Ontario loamy fine sand, but in Livingston County the area was so small that it was included with Ontario fine sandy loam, gently sloping phase.

The gently sloping phase of Ontario fine sandy loam has an 8-inch plow layer of dark-brown fine sandy loam that is medium to strongly acid where unlimed. A leached layer of light yellowish-brown to pale-brown medium to strongly acid friable fine sandy loam lies between 8 and 20 inches. The subsoil from 20 inches down to 36 to 40 inches is brown heavy loam to fine sandy clay loam that breaks into moderately expressed medium-sized blocks. This layer may be acid in the upper part, but it is neutral in the lower. Firm pinkish-gray highly calcareous fine sandy loam till is below at depths of 36 to 40 inches.

Most of the Ontario fine sandy loam, gently sloping phase, is cleared for farming. About 6 percent of the area remains in forest and farm woodlots. The principal crops are wheat, beans, alfalfa, corn, oats, green peas, and sweet corn. Few potatoes are grown on this soil in Livingston County, though it is an important potato soil in Monroe County. This soil needs phosphorus and may need lime and potassium. Sod crops should be included in the rotations to maintain organic matter. For use and management see group 1–D.

Ontario fine sandy loam, sloping phase (8 to 15 percent slopes) (Oh).—Except for the steeper slopes this soil is similar to the gently sloping phase of Ontario fine sandy loam. It is used for the same crops, but more intensive conservation practices are needed.

These 8- to 15-percent slopes should not be left bare of vegetation during the winter and spring. Intertilled crops should be grown only 1 year in a 4 or 5 year rotation, and they should be planted in strips on the contour. Manure, crop residues, and legumes are important on this phase, both to add organic matter and nitrogen and to increase the water-absorbing capacity of the soil. Lime may be needed,

and both potassium and phosphorus are generally deficient. For use and management see group 2–E.

Ontario fine sandy loam, moderately steep phase (15 to 30 percent slopes) (Og).—This phase occurs on the sides of drumlins and ridges in sandy areas. The soil profile is similar to that of Ontario fine sandy loam, gently sloping phase.

This soil is best used for long-term hay or pasture. It is poorly suited to intertilled crops because of moderately steep slopes and the large amount of runoff and erosion. When these slopes are planted to small grains and row crops, the rapid runoff leaves very little moisture for the crops. The soil may need some lime for legumes and generally needs both phosphorus and potassium. For use and management see group 3–F.

Ontario loam, gently sloping phase (0 to 8 percent slopes) (Ol).—The tops and milder slopes of long elliptical hills, called drumlins, are occupied by this soil. Drumlins are a common feature of the landscape in the northern half of Livingston County where this soil occurs. Like others of the Ontario series, this soil has a brown somewhat gravelly surface layer and a high-lime parent material. The parent material is glacial till derived mostly from limestone but containing also shale, sandstone, and crystalline rocks. The slightly reddish color of the soil is probably from the red shales and sandstone of the Medina formation. The brown or slightly reddish color, deeper profile, and somewhat higher acidity are the principal differences between this Ontario soil and the associated Honeoye soils. Some intergrades between Honeoye and Ontario soils are included in this unit. A few areas with silt loam surface soil and a few that are more gravelly are also included.

The plow layer of Ontario loam, gently sloping phase, is about 8 inches of moderately to slightly acid dark-brown friable granular loam. This surface layer contains a moderate amount of organic matter. The subsurface layer between 8 and 18 inches is light yellowish-brown or pale-brown slightly firm loam or very fine sandy loam. The subsoil, beginning at 18 and continuing to 30 to 36 inches, is a slightly firm brown to reddish-brown clay loam in strong ½- to 1½-inch blocks. These blocks break readily when dry but are somewhat plastic when moist. Below 30 to 36 inches lies the substratum, a highly calcareous brown or pinkish-gray gritty loam glacial till of strong fine blocky structure. The mass readily falls apart, but the blocks are hard and resist crushing when dry. Water and roots penetrate the soil readily; they follow the prominent cracks and cleavage planes in the parent material. In some places free lime is found at depths of 24 to 30 inches.

This soil, like others of the Ontario series, was originally heavily forested with red and white oaks, hard maple, hickory, white ash, basswood, beech, black cherry, and walnut. Nearly all of this soil has been cleared, but a few woodlots of good-quality timber remain.

The principal crops are timothy and clover, alfalfa, wheat, field beans, cabbage, corn, and oats. Green peas, sweet corn, and other vegetable crops are grown on farms near processing plants. Most farms have dairy cattle.

This gently sloping soil is suited to a wide variety of crops. Two years of row crops can be used in a 4-year rotation. Sod crops in the rotation help maintain organic matter. The soil can be worked under a wide range of moisture conditions. Cross-slope cultivation of intertilled crops conserves water and reduces erosion. Very little lime is needed to start new seedlings of alfalfa, except in a few of the more acid areas. Phosphorus is generally deficient, but response to potassium is not consistent among all areas of this soil. For use and management see group 1–D.

Ontario loam, sloping phase (8 to 15 percent slopes) (Op).—The profile of this phase is like that of the gently sloping phase of Ontario loam. However, because of stronger slopes, this phase requires more intensive practices to prevent serious washing and to control runoff.

Most of this soil is cleared and used for pastures and hay. Corn, wheat, and oats are grown on the less sloping parts. Where row crops are grown, the soil needs stripcropping for control of runoff. Rotations should include a high proportion of sod crops. Long-term alfalfa is a common use of areas where the slopes are near 15 percent. Such slopes may remain in meadow from 5 to 15 or 20 years. Permanent pastures on this sloping soil are common, although pastures used as part of a long crop rotation may bring a greater return. The soil needs little lime or potassium but is deficient in phosphorus. For use and management see group 2–E.

Ontario loam, eroded sloping phase (8 to 15 percent slopes) (Ok).—This phase consists of fields or parts of fields of sloping Ontario loam where most of the surface soil, and in places, part of the subsurface material have been removed by erosion. The soil profile is like that of the gently sloping phase of Ontario loam, except that the original surface layer is lacking and the plowed layer is now composed partly or wholly of original subsurface material. Some of the fields are cut by a few shallow gullies.

The original productivity of the soil has been reduced by erosion, but it can be at least partly restored by sod crops, manure, and large amounts of fertilizer. Nitrogen is especially deficient. Although this phase is included with the uneroded equivalent in management group 2–E, management practices should include longer leys of sod and more practices for restoring organic matter and nitrogen.

Ontario loam, moderately steep phase (15 to 30 percent slopes) (On).—This phase occupies long narrow strips on the sides of ridges and drumlins. The profile is similar to that of Ontario loam, gently sloping phase.

A large volume of runoff flows rapidly from these moderately steep slopes, so little moisture is absorbed for crops. The soil is poorly suited to crops other than long-term alfalfa and grass. Small grains can be grown, but low supply of moisture reduces yields, and heavy machinery is difficult to use on these slopes. Areas of this phase often hinder cultivation of surrounding less strongly sloping soils.

This soil requires large amounts of phosphorus fertilizer. Lime and potassium are seldom deficient. Where intertilled crops must be grown on these steep slopes, they should be planted in narrow strips on the contour between buffer strips of hay. For use and management see group 3–F.

Ontario loam, gray subsoil phase (0 to 8 percent slopes) (Om).—This phase occurs principally south of Avon and is associated with Honeoye, Lima, and other Ontario soils. It differs from typical Ontario loam in having a gray, faintly mottled subsurface layer and a somewhat more compact subsoil. The plow layer is about 8 inches of grayish-brown, friable, medium to strongly acid loam containing some gravel and small angular stones. A subsurface layer of leached, firm, pale-brown or light grayish-brown loam extends from 8 inches to 18 inches. This layer, faintly mottled with yellowish brown, rests on a brown medium acid moderately compact clay loam. The parent material which begins below depths of 36 to 40 inches is pinkish-gray highly calcareous gritty and stony loam glacial till. Roots penetrate this subsoil.

This soil apparently stays saturated somewhat longer than normal Ontario loam in early spring. It is not quite so well-drained as the normal Ontario soils, but it is better drained than the associated moderately well drained Lima soils.

This phase is managed like the gently sloping phase of Ontario loam but average yields may be 5 to 10 percent less. The principal crops are wheat, beans, corn, oats, and hay. Most of the hay is timothy and clover, because alfalfa does not do as well as on associated normal Ontario and Honeoye soils. The soil can be used in rotation that has 2 years of row crops in 4 years. Phosphorus fertilizer is essential for good yields and some lime and potassium may be needed. For use and management, see group 1–D.

Ottawa loamy fine sand, undulating phase (0 to 5 percent slopes) (Os).—Deep acid fine sand which was deposited in glacial lakes in the northern part of the county is the parent material for this soil. Relief is uneven to rough and hummocky, partly because of wind action. The soil differs from the Arkport in having uneven surface relief, in lacking a medium to fine textured brown subsoil, and in having a more acid reaction throughout the profile.

The 9-inch plow layer is grayish-brown loose loamy fine sand, very strongly acid where unlimed. Beginning at 9 inches and continuing to 18 inches, is yellowish-brown loose very strongly acid loamy fine sand. Yellowish-brown firm loamy fine sand, mottled with rust-brown streaks, starts at 18 inches and extends to 26 inches. Below 26 inches is loose, fine sand to very fine sand.

Normally this soil is acid, but in a few places it may be alkaline in the subsoil and have free lime at 4 to 5 feet. The soil is very permeable to air, roots, and water. The sandy surface soil, subsoil, and substratum have a low water-holding capacity. The surface soil is low in organic matter.

Ottawa loamy fine sand, undulating phase, is usually managed along with the associated soils. The main crops are hay, beans, wheat, silage corn, green peas, and sweet corn. West of Leicester, small fruits, vegetables, and melons are grown for sale at roadside stands.

This soil is low in natural fertility, and large amounts of fertilizer are required to obtain yields comparable to those of the gently sloping Howard and Palmyra soils. It is a good soil for vegetables and small fruits because it warms early in spring and can be worked under a

wide range of moisture conditions. Because the soil is very porous and has low water-holding capacity, shallow-rooted grasses yield less than deep-rooted birdsfoot trefoil and alfalfa. Lack of moisture during late summer frequently reduces yields of beans and corn.

Erosion is not a serious problem, because this soil rapidly absorbs most of the rain. Many more sloping cultivated areas have lost some surface soil, but not so much as Dunkirk or Arkport soils on similar slopes. Organic matter is rapidly lost from this soil when it is cultivated, and practices that maintain or add to the supply are essential. For use and management, see group 2–A.

Ottawa loamy fine sand, rolling phase (5 to 15 percent slopes) (Or).—Most of this soil is on the break between the bottom lands and silty uplands near Geneseo; it is associated with the undulating phase of Ottawa loamy fine sand and with Berrien fine sandy loam. The soil profile and complex and irregular relief are similar to those of the undulating phase, but slopes are stronger.

Because of rough irregular slopes this rolling phase is poorer for crops than the undulating phase, and the problems of conserving water and soil are much greater. In the present agriculture, the soil can be used best for long-term hay or pasture. Unimproved pastures are poor. The soil needs large amounts of lime, phosphorus, and potassium. For use and management, see group 3–F.

Ovid silt loam, gently sloping phase (3 to 8 percent slopes) (Ot).—This imperfectly drained soil of medium-fine texture developed from glacial till that contains much clay. This glacial till is calcareous, even though most of it lies south of the principal areas of high-lime materials. The glacier, in passing down the central valley, carried much limestone material, which was mixed with clays that were deposited in lakes lying in front of the ice and with material from local acid rocks. The parent material therefore is a mixture of limestone material, clay, and local rock material. Where the content of reworked lacustrine clay is highest, the soil closely resembles the associated Odessa silt loam. Where the Ovid soil is associated with Cayuga silt loam, the subsoil and substratum are coarser in texture and contain more stones and gravel.

The 8-inch plow layer is grayish-brown moderately acid heavy silt loam, cloddy under cultivation but coarsely granular when it has been in sod for several years. From 8 to 17 inches lies pale-brown to light yellowish-brown silt loam, friable in the upper part but becoming slightly firm and mottled with gray and brown in the lower part. The subsoil extending from 17 to 30 inches is brown neutral silty clay loam mottled with brown and gray. The structural units of this layer are strong medium and coarse blocks. Commonly the lower 6 inches of this layer is mildly calcareous. The parent material is blocky calcareous heavy silt loam or silty clay loam glacial till.

Normally, a small amount of gravel, shale fragments, and stones is on the surface and mixed with the soil and subsoil. Roots penetrate the subsoil along the cracks between the structure particles, but apparently they do not penetrate the compact substratum to any extent. Surface drainage is moderate, but internal drainage is slow because of the fairly tight subsoil.

The native forest on Ovid silt loam consisted of mixed hardwoods and some white pine and hemlock. The soil is now used mainly for timothy and clover hay, oats, wheat, field corn, and sweet corn. A fairly large acreage is in pasture. Field beans and alfalfa are also grown, but the soil is only fair for these crops. However, alfalfa does moderately well on the more sloping areas where surface drainage is fairly good. Wheat does well on this soil and in most years apparently is little damaged from frost heaving.

Surface runoff is not rapid on these gentle slopes, but the fine texture and poor structure of the surface soil prevent ready absorption of water, and the amount of runoff is fairly large. Slopes of more than 3 percent need contour tillage and stripcropping to slow the water and allow it to soak into the soil. On long slopes, especially those of more than 5 percent, diversion terraces are needed to reduce the volume of runoff. To increase the amount of organic matter and nitrogen, add barnyard manure and crop residues to the soil and grow legumes. These practices also increase granulation, make the soil easier to work, and allow water to penetrate more readily. The soil needs little lime except in the most acid areas. It needs phosphorus, but potassium is rarely deficient. For use and management see group 2–C.

Ovid silt loam, nearly level phase (0 to 3 percent slopes) (Ou).—This soil has the grayish-brown cloddy surface soil, the grayish mottled silt loam upper subsoil, and the mottled brown silty clay loam subsoil described for the gently sloping phase of Ovid silt loam.

The same crops are grown on this soil as on the gently sloping phase, but alfalfa, field beans, and green peas yield less. On many farms this soil can best be used in the present agriculture for hay or pasture. Surface drainage is slower than on the sloping phase, and the soil dries late in spring. The surface soil puddles and forms clods more easily than that of the sloping phase, and is slightly more difficult to work.

One of the main management problems is drainage of the level areas. Open ditches help, but tile is only partially effective because water moves slowly through the soil. Little lime or potassium is needed, though this soil requires phosphorus fertilizer for good yields. For use and management see group 2–C.

Ovid silt loam, sloping phase (8 to 15 percent slopes) (Ov).—The profile of this phase is similar to that of the gently sloping phase of Ovid silt loam, but the surface layer may be somewhat thinner and the mottling in the subsoil less distinct.

This soil is difficult to work because of a combination of fine texture and moderate slopes. Control of runoff and erosion is a serious management problem. Water is absorbed slowly; hence, the amount of runoff is large. Intertilled crops should be grown only once in 4 or 5 years, and then only in narrow contour strips between strips of hay. Where less sloping areas of other soils are available for intertilled crops and small grains, this phase is better kept in long-term meadows or pastures planted to a mixture of legumes and grasses. Keeping a vigorous sod crop on this soil is the best way of preventing excessive erosion. Applying manure and crop residues in large amounts and plowing under of green-manure crops help to increase the supply

of organic matter and nitrogen. They also improve structure so that the soil absorbs more water and is easier to till. The soil needs phosphorus fertilizer but requires little lime or potassium. For use and management see group 3–D.

Palmyra gravelly loam, nearly level phase (0 to 5 percent slopes) (Pc).—This soil has developed from stratified sand and gravel laid down on outwash plains, deltas, and valley trains. The sand and gravel were derived mainly from limestone, but they contain some material from shale, red and gray sandstone, and crystalline rocks. The relief is level to undulating. The soil is extensive in the northern part of the county west of the Genesee River. Ontario, Honeoye, and Farmington soils are the main soils on the adjacent uplands.

The 8-inch plow layer consists of slightly acid to neutral dark grayish-brown friable gravelly loam well supplied with organic matter. From 8 to 15 inches is pale-yellow, slightly firm, slightly acid or neutral gravelly loam. Neutral brown gravelly silt loam extends from 15 inches to 20 inches. This layer contains a medium amount of clay and is slightly plastic when wet and somewhat hard when dry. It grades into slightly reddish-brown gravelly clay loam that is plastic when wet but breaks into large lumps when dry. The fine soil materials in this layer hold a fairly large amount of moisture. The reaction is most commonly slightly alkaline, although the lower 6 inches may be mildly calcareous. Stratified highly calcareous sand and gravel begin at about 30 inches and extend downward for many feet.

The thickness of the brown silty and clayey subsoil layer is extremely variable. In some places it continues as tongues to depths of 4 feet or more; in others, possibly only a few feet away, the gravel substratum may be within 24 inches of the surface. Likewise, free lime may be 18 inches from the surface in one spot, and 36 inches or more deep only 10 feet away.

Moisture relations are good. Surplus water readily passes through the soil, but the silt and clay in the subsoil layers retain enough moisture for crops except during long dry periods.

The amount of gravel on the surface of typical Palmyra gravelly loam, nearly level phase, is not enough to interfere greatly with cultivation. Some of the gravel on the surface is limestone, but most of it consists of other rock material because much of the limestone has been leached out of the upper part of the soil. This phase contains more chert fragments than is common for the series. A few distinctly cobbly areas have individual stones as much as 4 inches in diameter. In such places tillage is difficult and machinery wears quickly.

This soil, like others of the Palmyra series, was originally covered with mixed hardwood forests but is now almost completely cleared. Cobblestone fences surrounding many fields show that much of this soil was originally cobbly. The principal crops are alfalfa, field beans, wheat, silage corn, oats, green peas, and sweet corn. Good stands of alfalfa are normally obtained without the use of lime. The soil drainage is a little rapid for wheat, but average yields are about the same as those from Ontario or Honeoye soils (pl. 5).

Gravelly loam texture, high lime content, fair moisture-holding capacity, and ease of working under a wide range of moisture make this level phase an excellent soil for crops. To obtain the highest

344679—56——6

yields on this soil, both phosphorus and potassium fertilizer should be applied. Manure, crop residues, and legumes are needed to maintain nitrogen and organic matter. No special practices to control runoff are required. If necessary, row crops can be grown every year. For use and management see group 1–A.

Palmyra gravelly loam, sloping phase (5 to 10 percent slopes) (Pd).—This phase occurs mainly on the narrow slopes between Palmyra terraces of different levels but some is on broader areas of complex slope. The profile is similar to that for Palmyra gravelly loam, nearly level phase, except that erosion has removed the upper 8 or 10 inches in many places.

Many long narrow areas of this soil are cropped with the adjacent nearly level phase of Palmyra gravelly loam. It is not so easy to work as the nearly level phase, but most of it is used for the same crops. Like other Palmyra soils, it absorbs rainfall readily and can be worked under a wide range of moisture. Surface runoff and erosion are commonly small and in most places can be controlled by simple practices. Contour farming the uniform slopes will prevent damaging erosion.

This phase responds to both phosphorus and potassium fertilizer but needs no lime. Response is less than on the nearly level phase because of a lower moisture supply. Deep-rooted legumes for long-term hay or pasture is a good use for many areas. For use and management see group 2–A.

Palmyra fine sandy loam, nearly level phase (0 to 5 percent slopes) (Pa).—The plow layer of this nearly level phase is 8 inches of brown or grayish-brown loose fine sandy loam that contains a little fine gravel and some pebbles. The subsurface layer is light yellowish-brown firm loam or fine sandy loam about 10 inches thick. This layer rests on brown or reddish-brown sandy clay loam subsoil. The substratum, beginning at depths of 24 to 30 inches, is the stratified calcareous sand and gravel common to all phases of Palmyra soils.

This phase is easier to till than the comparable phases of Palmyra gravelly loam. It is much the same in moisture-holding capacity, natural fertility, and lime content. It is also used and managed in much the same way, and yields are about the same. This phase is suited to a wide variety of crops. It can be used for row crops every year, and under such use no special practices other than use of winter cover crops are needed to control erosion. The soil needs phosphorus and potassium but no lime. For use and management see group 1–A.

Palmyra fine sandy loam, sloping phase (5 to 10 percent slopes) (Pb).—This phase occurs mainly on narrow slopes between terraces of different levels, but includes some areas of irregular relief. The soil profile is similar to that of the nearly level phase, but in some places the upper 8 or 10 inches has been removed by erosion.

Where the slopes are regular, this is a good soil for crops. It is moderately droughty. On the less sloping parts surface runoff and erosion are small because the soil usually absorbs water nearly as fast as it falls. Contour or cross-slope tillage and cropping will prevent excessive erosion and allow more water to be absorbed for use by crops. Rotations should include sod crops to maintain organic

matter and nitrogen. Phosphorus and potassium are deficient. For use and management see group 2–A.

Palmyra soils, undifferentiated hilly phases (15 to 25 percent slopes) (Pe).—Included in this unit are soils with hummocky irregular relief that have formed on coarse gravel. They occur in the northern part of the county adjacent to the nearly level Palmyra soils and along the shores of Conesus Lake. In most areas, the soil profile is similar to that described for Palmyra gravelly loam, nearly level phase. In a few places, however, the profile is like that of Palmyra fine sandy loam.

The lower boundary of the clayey subsoil commonly follows irregularities in coarse beds of crossbedded substrata in the kames. This makes the thickness of soil over the gravel substratum extremely variable. A larger part of this unit than of the less strongly sloping phases has been eroded.

Most of the unit has been cleared and is used for pasture or hay. Alfalfa is grown more commonly than timothy and clover. These soils are probably better suited to alfalfa than to any other crop, because this deep-rooted plant survives dry weather better than shallow-rooted crops such as corn and oats.

Unimproved pastures are thin and weedy and have a rather low carrying capacity. They are dry during the summer but furnish some good grazing in the spring and fall. Improvement is difficult because of the poor moisture-retaining capacity of these soils. The less steep areas are used to grow beans, and fair yields are obtained in seasons when moisture is plentiful. Phosphorus and potassium are generally deficient. Droughtiness and steep slopes are major limitations. For use and management see group 3–F.

Poygan silty clay loam (0 to 2 percent slopes) (Pf).—This is a very poorly drained soil derived from the same kind of lake clays and silts as underlie Schoharie, Odessa, and Lakemont soils. It occupies swales and depressions that receive surface runoff from higher lying areas. It has inadequate natural outlets for drainage, which creates problem spots on some farms.

The surface soil is a dark-gray to black silty clay loam about 10 inches thick, which in many places contains enough organic matter to appear mucky in the upper part. The upper subsoil, extending from 10 inches to 15 inches, is gray silty clay loam with a few mottles of gray and rust brown. This layer is divided into 4- to 10-inch prisms that extend into the next layer. The layer from 15 to 24 inches has prisms that are coated with light gray or gray. These prisms break into coarse blocks that are mottled with brown, gray, and yellowish-brown on a base color of pale brown or light reddish brown. This is a very plastic silty clay. Below 24 inches is brown calcareous blocky silty clay. The surface soil and upper subsoil are neutral; free lime is present at depths of 20 to 28 inches.

Parts of the large area north of Geneseo have a fine sandy loam to light silt loam surface layer, but the subsoil and substratum are fine textured and highly mottled like corresponding layers in the typical Poygan silty clay loam.

Most of Poygan silty clay is used for hay or pasture, but about one-fourth is forested or idle. Without artificial drainage, the soil is

too wet for agricultural use. Undrained areas cleared of timber grow sedges, cattails, rushes, swamp grass, and bentgrasses. They furnish little grazing but stay green all summer, even during dry periods. Where the excess water is drained off by open ditches, the soil can be used for meadows of timothy and clover. Most areas are at least partially drained and can be used for pasture. For use and management see group 5–A.

Retsof silt loam, gently sloping phase (0 to 8 percent slopes) (Ra).—This imperfectly drained soil was derived from glacial till containing some material from the underlying dark-colored slightly acid or mildly calcareous shales. Shale bedrock occurs at depths ranging from 24 to 36 inches. The relief is level to gently sloping. This soil, like others of the Retsof series, is associated with the Kendaia, Lima, and Brockport soils in the central part of the county.

The 8-inch plow layer is grayish-brown heavy silt loam, somewhat cloddy when cultivated. Underlying the surface soil is an 8-inch layer of pale-brown heavy shaly silt loam or silty clay loam, firm and highly mottled with brown and gray. The subsoil extending from 16 to 28 inches is dense, shaly silty clay loam, brown in color and mottled with gray and brown. In the deeper parts, this layer grades into soft, highly mottled, partially weathered gray shales that rest on unweathered shale rock at 30 to 36 inches. In some places the parent material is dark-colored calcareous shaly till that lies on the bedrock.

Ordinarily the soil is moderately acid in the upper layers. The reaction of the subsoil ranges from slightly acid to slightly alkaline. The underlying shales are alkaline. The silty and clayey textures give the soil a high water-holding capacity but contribute to its imperfect drainage. Very little water passes out of the soil into the shale substratum. Some areas have been artificially drained, but good underdrainage is difficult to obtain because of the fine texture and the shallow depth over bedrock. The soil tends to puddle and form clods if worked when wet. It dries rather slowly in the spring, and this prevents early seedbed preparation and planting. The soil becomes dry in late summer. As it dries the surface bakes hard and cracks are formed.

Retsof silt loam, gently sloping phase, is used mainly for pasture and hay. Unimproved pastures are composed mainly of Canada bluegrass and redtop and have fair carrying capacity. The soil is fairly well suited to timothy and clover, and hay is an important crop. Wheat does fairly well on the better drained areas but it heaves and winterkills in the less well-drained spots. Germinating beans push through the crusted surface with difficulty.

Controlling runoff and erosion is not a serious problem on this gently sloping phase. The soil absorbs water slowly, and the volume of soil for moisture storage is small. The gentle slopes, however, prevent rapid runoff. Diversion terraces can be used to remove excess surface water, or to prevent erosion on the stronger slopes. Contour tillage and stripcropping will adequately protect most fields. Good management practices include using phosphorus fertilizer, liming, growing red clover or Ladino clover to maintain nitrogen, and using manure and crop residues to increase the supply of organic matter. For use and management see group 3–C.

Retsof silt loam, sloping phase (8 to 15 percent slopes) (Rb).—This phase is shallower and a little better drained, but in other respects it is similar to the gently sloping phase of Retsof silt loam. Machinery is more difficult to use on these stronger slopes.

This phase is used for the same crops as the gently sloping phase, but average yields are lower. Lack of moisture frequently limits crop yields because the moisture-storage capacity of this soil is small and much water is lost through rapid runoff. The problem of erosion is serious and calls for intensive conservation practices. If intertilled crops or small grains are grown, they should be plowed and cultivated on the contour and planted in narrow strips. Where feasible, diversion terraces should be built. The soil can well be used for long-term hay or pasture. It needs lime, phosphorus fertilizer, and use of legumes or manure to maintain nitrogen and organic matter. For use and management see group 3–E.

Riverwash (0 to 5 percent slopes) (Rc).—This land type consists of gravel bars and other areas where coarse gravel and stones have been deposited by streams during flood. It is found along the channel of the Genesee River from Mount Morris southward and along other streams of the county. Riverwash also includes a few areas of coarse gravelly material deposited by intermittent streams as alluvial fans at the base of steep slopes.

This is nonagricultural land and is mainly wooded. Cleared areas are either wasteland or are included in pastures. They support very little vegetation besides weeds or brush. Riverwash is in management group 5–B.

Ross silt loam (0 to 5 percent slopes) (Rd).—The parent material for this soil is recent alluvium washed from uplands where the glacial drift is alkaline or calcareous. It occupies level first-bottom positions somewhat higher than those where Genesee and Eel soils are found. It is subject to flooding, but only when the water is unusually high. In this county, Ross silt loam is found only on the flats along the Genesee River and Canaseraga Creek.

The surface soil is a very dark grayish-brown very friable finely granular silt loam 12 to 14 inches thick. It rests on pale-brown friable silt loam that continues to a depth of 48 inches in most places. In a few places, layers of yellowish-brown very fine sandy loam are found below 24 inches.

The deep surface layer, with high content of organic matter, is the outstanding feature of this soil. It is friable and freely permeable to air, roots, and moisture. The normal soil is well drained, but a few small included areas have a mottled subsoil and are only moderately well drained.

This soil is very productive, and more than 95 percent is in crops. The principal crops are vegetables, sweet corn, field beans, nursery stock, oats, alfalfa, and mixed hay. The high content of organic matter, excellent workability, and good moisture-holding capacity are highly favorable for crops. Crops on the soil respond well to large amounts of fertilizer, and the soil can be used for row crops year after year. Fertilizer and management needs are the same as for Genesee soils. For use and management see group 1–B.

Rough stony land, Lordstown soil material (45+ percent slopes) (Re).—This miscellaneous land type occupies very steep slopes of 45 percent or more. The soil is very thin, stony, and very strongly acid. Rock outcrops are many, and there are some perpendicular ledges or cliffs 8 to 15 feet high. The largest areas of this land type are on the steep slopes bordering the Genesee River and on the walls of the valley south of Nunda.

Probably 95 percent or more of the total area is covered with second- and third-growth timber. The land is suited only to forestry. The trees appear to do best on the north-facing slopes where moisture is more plentiful. For use and management see group 5–B.

Salt dumps (S).—Near Retsof are dumps of salty waste from the Retsof salt mine and older abandoned mines. These are shown on the soil map. They are bare of vegetation or support only weeds and brush.

Schoharie silty clay loam, undulating phase (0 to 5 percent slopes) (Sk).—This well drained to moderately well drained fine-textured soil has formed from reddish-brown or pinkish lake-laid sediments. Southwest of Lima Town it is associated with Cayuga and Cazenovia soils. On the slopes along the valley of Canaseraga Creek it is associated mainly with Odessa and Ovid soils.

Schoharie silty clay loam, undulating phase, has a 4- to 6-inch surface layer of grayish-brown silty clay loam that has a fairly high organic-matter content and a strong crumb structure. Between 5 and 10 to 12 inches is a layer of lighter grayish-brown silty clay loam of weak medium blocky structure. The subsoil between 12 and 24 inches is reddish-brown silty clay with strong coarse blocky structure. The lower part contains lime nodules and concretions. The substratum is pinkish-gray stratified clay and silt. The surface soil is slightly acid, and the subsoil is neutral. Free lime is found at depths of 18 to 24 inches.

This soil was originally covered with mixed hardwood forests of oaks, hickory, ash, and basswood. The small scattered woodlots that remain are made up of second- and third-growth trees of these species. The soil is now cleared and used for pasture and crops. It is fine textured and difficult to work and is better suited to sod crops than to intertilled crops. Pastures are fair; they consist mainly of Canada bluegrass, redtop, and povertygrass. Some of the soil is used for alfalfa, which appears to do well. Wheat produces well. The soil is less well suited to corn and beans. No lime is needed, because the surface is nearly neutral and free lime occurs at 24 inches. The soil needs phosphorus everywhere but potassium is normally not required.

Surface drainage is good, and water moves slowly but readily through the subsoil and substratum. Although this soil is at least moderately well drained, the fine silty clay texture prevents rapid absorption of water. The volume of runoff is therefore rather large, even on gentle slopes. Where the slope is more than 3 percent, the soil should be worked on the contour if the slopes are regular enough to permit. Liberal use of manure and crop residues helps to improve the water-absorbing capacity of the soil and to increase the supply of organic matter. For use and management see group 2–C.

Schoharie silty clay loam, gently rolling phase (5 to 10 percent slopes) (Sg).—Except for slope, this phase is similar to the undulating phase of Schoharie silty clay loam. The fine texture, slow absorption of water, and lack of gravel or stones make this an erodible soil.

Nearly all of this soil is used for pasture. If conservation practices are followed, it can be used for long-term meadows and for close-growing crops without great loss of soil. All cultivating and the seeding of small grains should be done as nearly as possible on the contour. If intertilled crops are grown, stripcropping, contour tillage, and diversion terraces are advisable. The soil needs phosphorus, but rarely responds to lime or potassium. For use and management see group 3–D.

Schoharie silty clay loam, eroded gently rolling phase (5 to 10 percent slopes) (Sd).—This phase consists of areas which formerly were Schoharie silty clay loam, gently rolling phase. Through erosion they have lost most of their original surface soil and in some places part of the upper subsoil as well. The present plow layer, a reddish-brown cloddy silty clay loam, rests on the reddish-brown blocky silty clay subsoil common to all soils of the series. This phase is low in organic matter and is nearly neutral in reaction from the surface down.

This phase is more difficult to work than the uneroded phase of Schoharie silty clay loam, and its productivity is considerably less. Control of runoff and erosion, rebuilding the supply of organic matter and nitrogen, and raising fertility are necessary to conserve this soil. This can be accomplished most readily by large amounts of phosphorus fertilizer, liberal use of manure and crop residues, and by keeping the soil in legumes and grasses for hay or permanent pastures. Where continued use of the soil for intertilled crops is necessary, contour cultivation and stripcropping are important. On slopes of moderate length diversion ditches may be needed to remove excess surface runoff. For use and management see group 3–D.

Schoharie silty clay loam, rolling phase (10 to 15 percent slopes) (Sh).—The profile of this phase is like that of the undulating phase of Schoharie silty clay loam. This phase has been used mainly for pasture or is still forested.

This phase does not need special conservation practices when used for long-term meadows of alfalfa and grass that are cut for hay or used for pasture. If intertilled crops must be grown, they should be stripcropped in a rotation that includes sod crops. The soil needs phosphorus but rarely needs lime or potassium. For use and management see group 4–B.

Schoharie silty clay loam, eroded rolling phase (10 to 15 percent slopes) (Sf).—This eroded phase has lost all of the original surface soil through erosion; the plowed layer is now in the upper part of the original subsoil. Fertility has been lowered and the soil is difficult to work. It puddles and clods easily, absorbs water very slowly, and the volume of runoff is large. Yields of most crops are low but the soil will support fair meadows of alfalfa and grass.

The main problems of management are improving soil tilth and building soil fertility. This can best be done by keeping the soil in long-term meadows or pasture and adding enough phosphorus fer-

tilizer. On long slopes, regularly spaced diversion terraces should be built to remove excess surface water. For use and management see group 4–C.

Schoharie silty clay loam, eroded hilly phase (15 to 30 percent slopes) (Se).—This phase has a profile similar to that of the undulating phase of Schoharie silty clay loam, except that all of the original surface soil is lacking. Included with this eroded phase are a few small areas of eroded Odessa soils on 15 to 30 percent slopes. These areas have been badly eroded, and gullies have formed in some fields.

Difficulty of cultivation and serious erosion make this phase poor for crops. It can be used for long-term pasture. Some of the less steep fields will produce fair crops of legume-and-grass hay. Meadows should be plowed only when necessary to reseed a legume-grass mixture. A small grain should be used as a nurse crop for the legume-grass seeding. The soil does not need lime or potassium but requires phosphorus. For use and management see group 4–C.

Schoharie silt loam, undulating phase (0 to 5 percent slopes) (Sc).—Most of this phase occurs on the slopes of the valley of Canaseraga Creek north of Dansville.

The 8-inch grayish-brown silt loam plow layer is highly granular when it has been in sod but tends to become cloddy when cultivated. A layer of firm pale-brown platy silt loam lies between 8 and 12 inches. Extending from 12 inches to 16 inches is reddish-brown firm silty clay loam having a strong medium blocky structure. Pale-brown silty material from the layer above coats these blocks. Between 16 and 24 or 36 inches is reddish-brown blocky silty clay. Lime nodules and coatings are abundant in the lower 4 inches. The substratum begins below depths of 24 to 36 inches; it is laminated highly calcareous light reddish clay and silt.

The soil contains a moderate quantity of organic matter. The surface and subsurface layers are slightly acid, and the upper subsoil is neutral. Free lime is present at depths ranging from 24 to 36 inches. The soil is normally free of stones and gravel, but a few medium-sized stones may be seen on the surface where this phase borders areas of soil derived from glacial till or from outwash materials.

The soil is permeable to roots; they apparently grow downward through the fine-textured subsoil readily. The pronounced cleavage planes between the structural aggregates appear to permit moderately easy passage to both roots and moisture. The soil absorbs water slowly, but it holds large amounts of moisture. Much of this moisture is tightly held and not readily available to plants. Surface drainage is good, and drainage through the soil is fairly good even though the soil is very fine textured.

The soil is used principally for hay or pasture, mostly timothy and clover. Alfalfa produces well. Oats, sown alone or with barley, do well on the soil. Good yields of wheat are common. Not much corn or beans is grown, because surface crusts hinder emergence of seedlings. The soil is very erodible, and severe washing is apt to occur where the soil is planted to row crops.

Row crops should be grown only once every 4 or 5 years, and sod crops should make up as much of the remainder of the rotation as possible. Cross-slope or contour cultivation is needed to reduce runoff.

On long slopes near 5 percent, stripcropping and diversion terraces are needed if intertilled crops are grown. However, the irregular slopes in some areas prevent the use of stripcropping. The soil is deficient in phosphorus but rarely needs lime or potassium for the crops commonly grown. For use and management see group 2–C.

Schoharie silt loam, gently rolling phase (5 to 10 percent slopes) (Sa).—This phase has a silty surface soil, free of gravel and stones, and a reddish-brown blocky silty clay subsoil similar to those of the undulating phase of Schoharie silt loam. It is more sloping, however, and more likely to erode seriously.

Most of the gently rolling phase of Schoharie silt loam is on the valley slope between Dansville and Sonyea. It is well suited to legume-and-grass hay, is moderately suited to small grains, and will produce fair crops of corn. The surface crust that forms after rains interferes with emergence of field bean seedlings. Although this soil absorbs water slowly and erodes easily, it can be protected under sod crops by contour tillage and planting across the slope. Where intertilled crops are grown, diversion terraces, stripcropping, and contour tillage are needed to prevent erosion and conserve water. Phosphorus is deficient, but lime and potassium are rarely needed. For use and management see group 3–D.

Schoharie silt loam, rolling phase (10 to 15 percent slopes) (Sb).—The profile of this phase is similar to that of Schoharie silt loam, undulating phase. This phase is difficult to work and highly erodible. Under intertilled crops serious erosion occurs unless they are grown in narrow strips planted on the contour between strips of hay. The soil can be used for close-growing crops such as small grains, but it is best suited to long-term meadows and permanent pasture. Crops need phosphorus but rarely need lime or potassium. For use and management see group 4–B.

Steep broken land, Caneadea soil material (15 to 45 percent slopes) (Sl).—This unit is mapped on steep, broken slopes where the principal parent materials are lacustrine clays like those of the Caneadea soils. This land type occurs in long narrow strips on the slopes bordering gullies, gorges, and minor stream valleys.

In most places, no definite soil profile exists. The heavy clays and sands include large slabs of sandstone, rock outcrops, and many slips and landslides of clayey material intermixed with stones. In many places the topmost 4 to 6 inches is light brownish-gray silty clay loam, and the underlying material is dense gray clay.

This is very poor land for crops, as it is too steep and rough to till. Most of the area is still forested, but some parts are cleared and used for pasture. These pastures furnish only a little grazing and cannot be much improved because of the rough surface, springs, seepy spots, slips, and rock outcrops. For use and management see group 5–B.

Steep Chenango soils, undifferentiated (25 to 45 percent slopes) (Sm).—These are strongly acid coarse gravelly soils, droughty and too steep for cropland. They are on steep breaks between Chenango terraces of different levels and on steep kames.

Much of these soils is in pastures, although they are poor for this use. The grass cover is thin and weedy and furnishes little grazing.

The soils are deficient in lime and phosphorus. They will respond to lime and phosphorus fertilizer, but they are so steep and rough that application of these amendments is not feasible in many places. These soils should be planted to trees or allowed to reforest naturally. For use and management see group 5–B.

Steep Langford, Canfield, and Mardin soils, undifferentiated (30 to 45 percent slopes) (Sn).—The profiles of these steep moderately well drained acid soils are mostly like those of the Langford, Canfield, and Mardin soils. A few small areas of steep Volusia, Erie, and Burdett soils are included. Because steep slopes outweigh all other factors in determining use of these soils, mapping them into different steep phases was not justified.

These steep soils are very poor for cropland, but a few of the less steep areas are used for hay. More of the soils are in pastures, but these are thin, weedy, and badly eroded. Pastures can be improved by fertilization, but greater returns can be obtained by spending the time and money on improvement of less sloping soils. About 60 percent of this unit is in forest, its best use. Planting with seedlings is the quickest way to reforest these soils, but they can be allowed to reforest by natural seeding from nearby forested areas. For use and management see group 5–B.

Steep ledgy land (25 to 60 percent slopes) (Sp).—These areas are rough, steep, and stony. Rock outcrops and low bluffs or cliffs are common. Most of the soil material is similar to that of the Lordstown series. The cliffs along the Portageville Canyon and the Mount Morris High Banks are examples of the kind of area included. Other smaller areas are on the sides of gullies, gorges, and deep washes, mainly in the rougher southern part of the county.

About 95 percent of the total area is still forested. Some bare cliffs or shale and sandstone slides are too steep to support vegetation. This land has no agricultural value but furnishes some forest products and cover for game animals. For use and management see group 5–B.

Steep Lansing, Ontario, and Honeoye soils, undifferentiated (30 to 45 percent slopes) (So).—Soils formed from high-lime materials on slopes greater than 30 percent have been mapped in this undifferentiated unit. Besides the soils named above, some steep areas of Cazenovia, Cayuga, Conesus, and Ovid soils are included.

These soils are poorly suited to crops because of steepness. Some of the smoother slopes are used for hay. They will produce fair yields of legume-and-grass hay if manure and phosphorus are applied. They are steep high-lime soils that have a higher fertility than steep low-lime soils. Permanent pastures will support a fair stand of palatable grasses without fertilization. If less sloping soil is available for pasture, greater returns can be obtained by concentrating pasture improvement on it rather than on these soils. For use and management see group 5–B.

Steep Manlius, Allis, and Hornell soils, undifferentiated (25 to 45 percent slopes) (Sr).—These are very poor soils for either crops or pasture. The Allis and Hornell soils are poorly to imperfectly drained and shallow. The Manlius soil is well drained but very shallow. All absorb water slowly, and the volume of runoff is large.

Erosion has been serious wherever the soils have been cleared. The soils are strongly acid. They require fertilization with phosphorus and heavy liming before good pasture grasses can be established. Expenditures for pasture improvement should be applied to better soils. These steep areas are better used for forestry. For use and management see group 5–B.

Steep Palmyra and Howard soils, undifferentiated (25 to 45 percent slopes) (Ss).—The steep Palmyra and Howard soils (called Schodack and Groton soils in earlier reports) are droughty and have a complex kame-and-kettle relief. The surface layer is a loose, open, slightly acid gravelly loam. It overlies deep stratified calcareous gravel and sand. Though the soils have little agricultural use, they are a valuable source of commercial sand and gravel. The largest area of these steep gravelly soils is in the southwestern part of the county.

Pastures are thin and weedy and furnish little grazing. The water-holding capacity of the soils is so low that grass can grow only during the spring and late in fall. Pastures can be improved by adding phosphorus and by sowing deep-rooted legumes such as birdsfoot trefoil and alfalfa, but use of machinery is difficult on the steep, complex slopes. Some of the more uniform steep areas are used for alfalfa, but the steepness makes harvesting difficult. Forestry appears to be the best use for much of these soils. For use and management see group 5–B.

Steep Woostern, Valois, and Bath soils, undifferentiated (25 to 50 percent slopes) (St).—Areas of strongly acid, well-drained soils on slopes steeper than 25 percent are mapped in this undifferentiated unit. The soils are generally very stony and thin. Runoff is rapid and in large volume.

The difficulty of using machinery on steep slopes and the droughtiness resulting from excessive runoff make these soils poorly suited to crops. Pastures are thin and weedy and offer little protection against erosion. Improvement is not feasible because of steep slopes. Crops, principally hay, are grown on some of the smoother, less steep slopes. Yields are low, and increasing them would require heavy liming and fertilization. Lime and fertilizer will bring greater returns on soils easier to work and less subject to serious washing. Planting to trees or allowing natural reforestation to take place seems to be the best use of these steep slopes. For use and management see group 5–B.

Tioga silt loam (0 to 2 percent slopes) (Ta).—This well-drained strongly acid soil developed on alluvium consisting of materials from acid sandstone and shale. It occupies level first bottom lands in the southern part of the county and is subject to overflow.

The 9-inch plow layer is grayish-brown friable strongly acid silt loam. This is underlain by friable pale-brown silt loam that continues to a depth of 14 inches. A slightly firm pale-brown silt loam, loam, or fine sandy loam begins at 14 inches and extends downward to about 40 inches. Below 40 inches the material ranges from fine sandy loam or silt loam to a mixture of fine, medium, and coarse sand stratified with silt. Some faint mottling may occur below 36 inches. The soil is fairly well supplied with organic matter and is strongly acid in reaction from the surface downward.

Tioga silt loam is used mainly for hay, pasture, oats, silage corn, and beans. The soil can be used for row crops every year if fertilizer and lime needs are met and organic matter is maintained at a fairly high level. Lime and phosphorus are both needed. Potassium requirements vary with the intensity of cropping. For use and management see group 1–B.

Toledo silt loam (0 to 5 percent slopes) (Tb).—This soil occupies very poorly drained swales and depressions in areas of Caneadea, Fulton, and Dunkirk soils. It is a very poorly drained fine-textured soil, unsuited to cropping unless artificially drained.

The 8- to 10-inch surface is slightly acid, dark-gray to black, sticky, heavy silt loam. In many places it contains enough organic matter to make the topmost few inches mucky. The upper part of the subsoil between 9 and 15 inches is neutral silty clay loam that breaks into very coarse weak prisms. The interiors of the prisms are weakly mottled with brown. From 15 inches to 30 inches is plastic silty clay made up of gray-coated very coarse prisms like those in the horizon above. At this depth the interiors of the prisms have many prominent mottles of strong brown. The substratum is grayish, laminated, calcareous silt and clays, commonly mottled in the upper parts and becoming gray or light gray below 40 inches.

Surface drainage is very slow, and the soil is under water for long periods each year. The tight silty clay subsoil restricts movement of water through the soil. This soil has low natural productivity. Most areas are forested, but some are cleared for pasture. The vegetation is mainly swampgrass, sedges, and rushes—plants of low nutritive value and generally unpalatable to livestock. These plants furnish some grazing, however, during seasons when other pastures are brown and dry.

When Toledo silt loam is artificially drained, excellent yields of common field crops can be obtained. However returns from drainage of many small, irregular areas of the soil do not justify the expense of drainage ditches unless these very poorly drained spots interfere with use of otherwise well-drained fields. For use and management see group 5–A. The small drained areas are used and managed like the adjoining Caneadea, Fulton, and Dunkirk soils.

Tuscarora sandy loam (0 to 5 percent slopes) (Tc).—This level or nearly level, moderately well drained, strongly acid sandy soil is moderately deep over gray clay similar to that underlying the Caneadea soils.

The surface 8 inches is grayish-brown friable strongly acid sandy loam. The upper subsoil, between 8 and 18 inches, is yellowish-brown friable strongly acid sandy loam. Light yellowish-brown strongly acid sandy loam, mottled with brown and gray, begins at 18 inches and reaches a depth of 28 inches. Below 28 inches is mottled gray plastic clay that becomes calcareous at 36 inches. The depth to mottling ranges from 12 to 24 inches. Small areas having gravelly loam surface soils and gravelly loam to gravelly silt loam subsoils have been included with this soil.

Tuscarora sandy loam is used for hay, pasture, corn, and oats. Erosion is not a problem, but crop growth may be retarded by restricted drainage. The soil is very low in fertility and needs lime,

phosphorus, and potassium. In addition, practices that supply nitrogen and organic matter should be followed.

The gravelly areas are generally slightly better drained and better suited for crops. They are farmed much like the associated Howard and Fredon soils, though average yields are less. For use and management of Tuscarora sandy loam see group 2–G.

Valois gravelly loam, rolling phase (0 to 15 percent slopes) (Vb).—This is a gravelly, strongly acid, well-drained soil with a neutral substratum. It has developed on medium-textured glacial till in the area between high-lime materials of the northern part of the county and acid materials of the southern part. It resembles the associated Lansing soils but is coarser textured and more gravelly.

The surface 8 inches of Valois gravelly loam, rolling phase, is grayish-brown, friable, strongly acid gravelly loam. Some nongravelly soil is included. The upper subsoil, extending downward from 8 to 18 inches, is strongly acid yellowish-brown very friable gravelly loam. Between depths of 18 and 30 inches is friable light yellowish-brown strongly acid gravelly loam. It grades into brown gravelly loam that is slightly compact but breaks out into fairly large, irregular, firm blocks. A few vertical cracks between blocks are filled with gray silty material. This compact layer is strongly acid at the top but becomes less acid and less firm with depth. It is generally neutral at depths of 42 to 50 inches. Below 50 to 60 inches lies the grayish-brown gravelly loam glacial till, neutral in the upper part and calcareous at variable depths below. This substratum varies from moderately firm till to loose crudely water-worked material containing some definite strata of sorted gravel or sand.

This soil was originally forested with mixed hardwoods, white pine, and hemlock. It is now used for wheat, beans, timothy and clover, alfalfa, corn, and oats. It is well suited to these crops. Erosion is a moderate problem. Most of the soil not in permanent pastures or forested has lost some of the original plow layer, but very little has been so seriously eroded that its productive capacity is greatly lowered. Rotations should include sod-forming crops as much of the time as is feasible. Special practices to retard runoff are needed if row crops are grown. The soil needs lime and phosphorus. Response to potassium has not been consistent. Available information indicates that soil potassium is released rapidly enough for moderate yields, but that it quickly becomes deficient as other practices increase yields to high levels. For use and management see group 2–B.

Valois gravelly loam, hilly phase (15 to 25 percent slopes) (Va).—This phase has the same profile as the rolling phase of Valois gravelly loam except that it may have more stones and gravel on the surface. In most places the surface soil is a little thinner and contains less organic matter. This phase is less suitable for crops because machinery is difficult to use, runoff is greater, and more of the soil is eroded.

Most of the cropland is used for hay, corn, and oats. Maintaining fertility is a major problem. For good yields, the soil needs lime and phosphorus, and usually potassium. Controlling erosion and conserving moisture for crops are also important. This can be done by using the soil for sod crops as much of the time as feasible and by

stripcropping if intertilled crops are grown. The supply of organic matter and nitrogen should be maintained by applying manure or growing legumes. For use and management see group 3–G.

Volusia channery silt loam, gently sloping phase (3 to 8 percent slopes) (Vc).—This is a poorly drained strongly acid soil with a compact very slowly permeable subsoil. It is on smooth slopes throughout the southern upland of the county, where it is associated with Lordstown, Fremont, Mardin, and Canfield soils. The parent material is glacial till, mainly from the local shale and sandstone rocks but to small extent from crystalline rocks.

The dark brownish-gray silt loam plow layer is 8 inches thick. Many flat sandstone fragments 1 to 4 inches across may be on the surface and mixed with the soil material.[11] The surface normally has a good supply of organic matter and a strongly or very strongly acid reaction. Between 8 and 13 inches is light brownish-gray strongly acid slightly firm silt loam or loam showing strong mottles of yellowish brown. Olive-brown strongly acid dense silt loam begins at 18 inches and continues to 50. This layer is extremely hard when dry and very firm when moist. Pore spaces are small, and the layer holds little water. Hardness decreases somewhat with depth. Vertical cracks, filled by gray or light brownish-gray silty material, divide this hardpan into very large prisms 12 to 36 inches across. Below 50 inches lies strongly acid compact stony silt loam glacial till, olive-brown in color and less firm than the hardpan above. The soil material generally becomes less acid in this substratum, and the material may be calcareous very deep in the profile.

Few roots penetrate the hardpan. Those that do find their way down along the vertical cracks between the prisms. Water moves through the tight compact subsoil very slowly; the water-holding capacity is low. The 12 inches of soil above the compact layer remains saturated and cold in the spring, but when this moisture is lost by evaporation and through use by plants the surface becomes very dry.

The original forest on this poorly drained soil was white pine, hemlock, hard maple, beech, oaks, hickory, cherry, and ash. Many cleared areas are now idle and are growing up to brush. A fairly large acreage has been reforested by the State Department of Conservation. The main crops grown on this soil are timothy, timothy and clover hay, oats, oats and barley mixed, corn for silage, and buckwheat.

Surface drainage is fair on these gentle slopes, but seepy spots are common. The soil is difficult to drain artificially. Interception of seepage and runoff by diversion terraces has been effective in improving drainage. The most poorly drained parts of the fields control their use, and drainage of seep spots by tile may improve ease of working for much larger areas. The soil can be used safely in rotations consisting of 1 year of intertilled crop and at least 2 years of a sod crop. Only simple erosion control practices are needed for such a rotation.

This soil is cold and wet in the spring, and most crops respond to nitrogen at that time (pl. 6). Lime and phosphorus are generally

[11] See footnote 7, page 30.

deficient. Potassium becomes limiting as yields are increased. Practices that maintain organic matter and nitrogen should be followed. For use and management see group 3–B.

Volusia channery silt loam, nearly level phase (0 to 3 percent slopes) (Ve).—This poorly drained hardpan soil occupies level or nearly level areas. It is less productive than Volusia channery silt loam on more sloping topography because runoff removes excess water more slowly, the soil dries more slowly in the spring, and the surface is more likely to puddle and clod when cultivated. This phase differs from the gently sloping phase of Volusia channery silt loam mainly in being more grayish in the surface soil and upper subsoil and having slightly finer textures in the upper 20 inches.

Timothy hay, oats, and oats and barley mixed are the principal crops on this soil. Less corn is grown than on the gently sloping phase. Buckwheat is a fairly common crop because it will mature even when sown as late as July. Most of the meadows are thin and poor. Much of this soil is in pasture. Drainage is a major problem. Both lime and phosphorus are essential for even moderate yields of most crops. Potassium is needed for best yields. For use and management see group 3–B.

Volusia channery silt loam, sloping phase (8 to 15 percent slopes) (Vf).—Except for stronger slopes, more rapid runoff, and greater hazard of erosion, this phase is similar to the gently sloping phase of Volusia channery silt loam. When the 8 to 10 inches of soil above the hardpan is saturated, the rest of the water is rapidly lost as runoff.

This phase is better suited to hay and pasture than to most intertilled crops. Nevertheless, corn can be used in feed crop rotations in which sod crops dominate. Contour cultivation and stripcropping are needed for rotations that include intertilled crops. Lime and phosphorus must be applied for even fair yields. Potassium is needed for best production. Diversion terraces to carry away both runoff and seepage above the pan may improve drainage. Seepy spots can be drained by tile. For use and management see group 3–E.

Volusia channery silt loam, moderately steep phase (15 to 30 percent slopes) (Vd).—The profile of this phase is like that of the gently sloping phase of Volusia channery silt loam. Some eroded areas have only 6 to 8 inches of permeable soil above the pan. This phase is somewhat stony, and springs and seepy spots are common.

The soil is poorly suited to crops because of its slopes and poor drainage. Erosion is a constant hazard. Machinery is difficult to use, and productivity is low. This phase is best suited to pasture or forest (pl. 7). Some of the steep areas can be used for long-term meadows, but if fair yields are to be obtained, they will require adequate liming and fertilization with phosphorus and potassium. For use and management see group 4–D.

Wallkill silt loam (0 to 2 percent slopes (Wa).—This dark-colored poorly to very poorly drained soil developed on level relief from recent alluvial sediments that overlie organic material at relatively shallow depths. Surface drainage is poor, and the soil is subject to periodic flooding.

The surface soil to a depth of 16 inches is very dark-gray granular silt loam to silty clay loam. Between 16 and 24 inches is dark grayish-brown coarsely granular silt loam that has a high content of organic matter. This layer rests on brown fibrous peat in which the plant structure is still recognizable. The peat appears to have been formed from cattails, rushes, and other coarse swamp vegetation. Between depths of 29 and 42 inches is very dark-brown peat; it is more decomposed than the material above, as the structure of the plant tissues cannot be distinguished. In most places the soil is slightly acid to neutral at the surface, and slightly alkaline just above the peat. The peat is acid everywhere.

At one time all of this soil was very poorly drained, but open drainage ditches have greatly improved the drainage of parts of it. These parts can be cropped with the drained phases of Wayland, Eel, and Carlisle muck soils. This is a good soil for vegetables when adequately drained. Yields compare favorably with those obtained on Genesee and Eel soils. The cultivated part is used for sweet corn, peas, beets, onions, and other vegetable crops for canning.

The Wallkill silt loam in the valley of Canaseraga creek is more often damaged by floodwater than the part lying farther south. Heavy summer rains over the Canaseraga watershed will usually flood this section of the valley. The soil is low and at times it is covered by water for weeks. In some years crops have been replanted as many as three times. If these floods occur during late July or August, the crops are usually a complete failure.

Maintaining fertility and protecting against flooding are the major problems in use of this soil. Lime may be needed for some crops in some areas. Phosphorous is generally deficient. The soil shows small response to potassium, but the response may increase as available supplies are reduced by intensive cropping. For use and management of drained areas of this soil see group 2–F. Undrained Wallkill silt loam is managed like soils of group 5–A.

Wayland silty clay loam (0 to 1 percent slopes) (Wc).—This dark-colored, poorly to very poorly drained soil occurs in depressions on first bottoms. The parent materials are alluvium washed from the uplands. The soil resembles Holly silty clay loam but is less acid. Typically it is neutral or mildly alkaline and is associated with Chagrin soils. In Livingston County, however, some mildly to moderately alkaline soils associated with Genesee and Eel soils have been included. Some large areas are on the level lands of the Genesee Valley extending from the Monroe County line south to Mount Morris. Some areas of Wayland silt loam may occur within this unit.

The surface layer of Wayland silty clay loam is very dark-gray sticky silty clay loam 8 to 10 inches thick. Where drainage is very poor, the soil is higher in organic matter. This mucky surface layer is less sticky and plastic than that of the silty clay loam. The upper subsoil, extending to a depth of 18 or 20 inches, is strongly mottled gray and brown silt loam or silty clay loam. This layer grades into gray-mottled silty clay. The soil is normally moderately acid in the surface layer and neutral in the subsoil. Near Genesee soils, the surface soil may be neutral.

Most of Wayland silty clay loam is undrained and too wet for crops. Some areas are still forested with elm, soft maple, white cedar, willows, and alder. Bentgrass, sedges, rushes, and cattails grow on cleared areas. The best parts may grow timothy or timothy and alsike clover hay, but in most places the soil is so wet it can be used only for pasture. The pastures provide only fair grazing, but during dry seasons they produce more grass than those on better drained soils.

If properly drained, Wayland silty clay loam becomes a productive soil well suited to vegetable crops, but because of the low depressed position, an adequate outlet for excess water cannot be found on many areas. Only 13 percent of this soil is drained by open ditches and used for crops. Some drained areas along Canaseraga Creek are used for the same crops as the Eel soils.

Crops rarely need lime on this soil, but they require phosphorus. Intensively grown vegetable crops respond to a complete fertilizer. This soil is more often flooded than either Eel or Genesee soils. For use and management of the drained soil see group 2–F; for the undrained soil, see group 5–A.

Wayland silt loam (0 to 5 percent slopes) (Wb).—This soil is not so fine textured as Wayland silty clay loam and is derived from local alluvial materials consisting mainly of silt that has moved off the surrounding higher lying soils. It occupies narrow strips along small or intermittent streams rather than first bottom of large streams.

The surface soil is dark-gray moderately acid heavy silt loam, puddled and cloddy in places. It averages 8 to 10 inches thick and overlies mottled gray and brown firm neutral silt loam. The lower subsoil is gray-and-brown mottled neutral silty clay loam. Below 36 inches the material is crudely stratified silt, clay, and sand.

The areas of Wayland silt loam are long and narrow. Where surface water or seepage water moves along these drainageways, they are too wet to plow and are included in pastures or remain idle. The individual areas are too small to be used in fields by themselves. They may interfere with tillage of surrounding soils. In some places drainage can be improved by open ditches or tile, but commonly little can be done. For use and management see group 5–A.

Westland silt loam (0 to 5 percent slopes) (Wd).—This very poorly drained soil occupies small irregular depressions and level areas. It has received considerable wash from the surrounding better drained Howard and Palmyra soils. Included are a few small areas of Atherton soils that are associated with Chenango soils. These Atherton soils would have been shown separately on the map if the total area had been larger.

The 10- to 14-inch surface soil of Westland silt loam is very dark-gray slightly acid silt loam, very high in organic matter. The upper subsoil is compact neutral silt loam, gray in color and highly mottled with light gray and yellow. It rests on compact, gravelly, mottled clay loam that grades to the underlying calcareous mixed sands, gravel, and clay of the parent material. The small areas of included Atherton soils differ in being moderately acid throughout.

344679—56——7

Cleared areas of Westland silt loam are too wet for cropping and are used mainly for pasture. The vegetation is coarse and unpalatable. Much of the soil is wasteland covered by a dense growth of willows and alder brush. For use and management see group 5–A.

Woostern gravelly loam, rolling phase (5 to 15 percent slopes) (Wg).—This deep well-drained strongly acid soil occurs on glacial moraines. It lies on lower slopes in the main valleys and on rolling upland in the southern part of the county. It is irregularly rolling to hummocky. The parent material is glacial till, which came mainly from local gray acid shales and sandstone but to some extent from red sandstone and crystalline rocks from areas to the north.

The plow layer is grayish-brown strongly acid friable gravelly loam 6 to 8 inches thick. It has a strong crumb structure and can be worked under a wide range of moisture conditions without puddling. The subsoil extends from 8 to 16 inches; it is a yellowish-brown friable strongly acid silt loam of weak fine crumb structure. Between 16 and 30 inches is light yellowish-brown strongly acid gritty loam or gravelly loam; this material is firmer than that above but is not compact. The substratum is grayish-brown strongly acid stony or gravelly glacial till, generally permeable to roots and water.

The typical soil contains much rounded and angular gravel. In some places the substratum shows distinct stratification and has a high content of rounded waterworn gravel. Many irregular fragments of shale and sandstone are on the surface and mixed through the soil. The stones make tillage difficult and shorten the life of machinery to some extent but not enough to prevent use of the soil for crops. Many stones have been removed from the surface of cultivated fields.

The surface soil, subsoil, and parent material of this soil are strongly acid. The supply of organic matter in the surface soil is moderate except where erosion has been serious. The loose, open, gravelly soil permits free movement of roots, air, and moisture. Most of this soil has good water-holding capacity, but the more gravelly areas are medium to low in capacity. In abnormally dry seasons crop yields may be reduced somewhat by lack of water.

This soil supported a mixed forest of beech, hard maple, ash, basswood, red and white oaks, hickory, chestnut, white pine, and hemlock. It is one of the better soils of the southern part of the county. Farming is based mainly on production of milk. Most of the crops are grown to provide feed and forage for the dairy herds (pl. 8). Timothy and clover hay, alfalfa, oats, and corn for silage are grown. Beans, wheat, and potatoes are important cash crops.

This Woostern soil, like others of its series, is somewhat less erodible than Ontario and Honeoye soils on comparable slopes, because the porous surface soil absorbs water more rapidly. The problem of controlling runoff and erosion is moderate. Growing-season rainfall must be held on the land for maximum yields, especially where potatoes are grown. The irregular slopes prevent effective stripcropping in many places, so water control must be achieved by growing sod crops in the rotation, manuring to maintain organic matter, cultivating across the slope, and growing winter cover crops. Diversion terraces, stripcropping, and contour tillage are possible in some areas. Liming

is essential for good yields of most crops. Phosphorus is uniformly deficient, and potassium becomes limiting when large yields deplete the normal supply. For use and management see group 2–B.

Woostern gravelly loam, hilly phase (15 to 25 percent slopes) (Wf).—This well-drained strongly acid hilly soil has a profile similar to that for the rolling phase of Woostern gravelly loam, but the surface layer may be somewhat thinner. Most slopes are irregular but a few are uniform.

Only a small part of this phase is cultivated. The soil erodes very easily, and water needed for crops runs off the complex hilly slopes before it can be absorbed. Where the slopes are uniform enough for contour cultivation they can be farmed safely, but machinery is difficult to use on them.

Most of this soil not in forest is used for pasture and long-term meadows. Native pastures are only fair but they respond moderately well to fertilizer and lime. The meadows consist principally of timothy and clover, but alfalfa can be grown if lime is used to establish new seedings. Phosphorus is also required, and potassium becomes deficient when yields are increased. For use and management see group 3–G.

Woostern gravelly loam, eroded hilly phase (15 to 25 percent slopes) (We).—This soil differs from the hilly phase in having lost the original plow layer. The present surface layer is thinner, lighter colored, and lower in organic matter, and the unweathered parent material is 8 to 12 inches closer to the surface. A few fields have been cut up by deep gullies that cannot be crossed with farm machinery.

The productive capacity of this phase has been greatly reduced by serious erosion, but it can be restored to a productivity nearly as high as that of uneroded hilly Woostern gravelly loam. The chief management problems are restoring the organic-matter content of the soil and preventing further erosion. This can be accomplished most readily by keeping the soil covered with long-term meadows of legume-and-grass hay or in permanent pasture. Heavy applications of both-lime and phosphorus are essential, and liberal use of manure will help to increase the organic-matter content. The rougher gullied areas having slopes near 25 percent should be planted to trees or be allowed to reforest naturally. For use and management see group 3–G.

Woostern gravelly loam, undulating phase (0 to 5 percent slopes) (Wh).—The surface 8 to 10 inches of this soil is grayish-brown strongly acid friable gravelly loam. The upper part of the subsoil, which goes to a depth of 20 inches, is yellowish-brown strongly acid firm but friable gravelly loam. The lower subsoil, extending to 36 inches, is strongly acid friable gravelly loam, light yellowish brown in color. The parent material is a light grayish-brown strongly acid loose open gravelly and stony glacial till.

This phase of Woostern gravelly loam has good moisture-holding capacity and is strongly acid from the surface downward. It is more intensively cropped than other Woostern soils. It is used for crops to feed dairy cows and for cash crops of wheat and potatoes (pl. 9). It is an excellent soil for potatoes and is often reserved for this use.

Runoff and erosion are easily controlled on this phase. Row crops can be grown 2 out of 4 years on all of this soil and they can be grown

every year on the broader nearly level areas. Under this intensive cropping, practices to maintain organic matter are essential. On the more sloping parts widely spaced diversion terraces, contour tillage, and stripcropping should be practiced. Lime and phosphorus are deficient and must be supplied in large amounts to obtain good yields. Potassium deficiency appears under intensive use. For use and management see group 2–B.

PRINCIPLES OF SOIL MANAGEMENT

Crops grow by using the energy of sunlight to manufacture from simple materials the complex compounds which make up plant tissues. These simple building materials are carbon dioxide from the air, and water, nitrogen, and minerals from the soil. The minerals and nitrogen from the soil, although used in small amounts, are essential parts of the plant tissues. To absorb these nutrients from the soil, the plant roots need air as well as water. If any one of the factors required for growth is deficient, whether it be sunlight, water, air, or any one of the nutrients, growth of plants is limited mainly by the amount that factor is deficient.

A farmer has little or no control over the amount of sunlight or carbon dioxide that reaches his crop; they are gifts of nature. To manage his soils most wisely, the farmer must provide those things needed to enable the plant to make the most efficient use of the free factors. The chief factors of plant growth that a farmer can control, at least in part, are the amount of water, the amount of available soil minerals, and the physical condition or tilth of the soil.

PLANNING A SOIL MANAGEMENT SYSTEM

A farmer can plan his soil management practices in three main steps. First, he should choose the kinds of crops needed for the type of farming he wishes to practice and fit these crops to the kinds of soil he has on his farm. The rotations he chooses for his cropland should be planned to maintain or improve the soil tilth and fertility. Particular attention should be given to sod-forming legumes that add nitrogen and help maintain good tilth.

Second, he should consider fertilizing and liming, not for a specific crop in a given year, but for the entire rotation. By fertilizing and liming legume crops adequately in a rotation suited to the soil, he can obtain a vigorous sod growth that will help maintain soil fertility and control runoff and erosion.

Third, the farmer should decide what additional practices are necessary to control water and prevent erosion. These may include contour cultivation, stripcropping, diversion ditches, drains, and winter cover crops. These practices should fit the individual soil types and phases and the rotations that are to be used on them.

Rotations.—Crops vary in the demands they make on the soil. Row crops, if completely removed, take much fertility out of the soil. By removing organic matter and by leaving the soil surface unprotected between rows, they expose the soil to serious washing. In order of soil depletion, close-growing crops that do not form a sod rank next to row crops. Small grains, Sudangrass, and peas for

canning are important close-growing crops grown in Livingston County. Their nutrient drain upon the soil is moderate, but they return little fertility to it. They do protect the soil from washing while they are growing, but they leave it exposed to erosion during fall, winter, and spring.

Sod-forming crops, sometimes called soil-improving crops, form a mat of roots that bind the soil and prevent washing. The fibrous roots help to make the soil porous and add organic matter. Sod-forming crops that contain inoculated alfalfa, clovers, or other perennial legumes add nitrogen to the soil. As the nitrogen and organic matter in the soil are built up, the legumes add less of both each succeeding year. Finally, the amount of nitrogen removed in the legume crop each year is about equal to the amount added by the bacteria on the roots of the legume. The bacteria fix nitrogen in large amounts only when the nitrogen supply in the soil is low. Growing grasses with legumes is a good practice, because grasses draw upon the soil nitrogen fixed by the legume bacteria and cause the bacteria to increase their rate of nitrogen fixation.

On soils suited to cultivated use it may pay to grow other crops in rotation with legumes, in order to "cash in" on the nitrogen and minerals that have been stored in the organic matter. By alternating legume sods with cash crops in short rotations on soils suited to them, a farmer makes efficient use of the legume. Some soils, however, erode so easily that frequent plowing is not advisable. On these soils the sod-forming crops can best remain for as long as the legume persists in the stand. The hay or pasture can then be fed to animals. The manure from those animals can be used on more nearly level land, where the needed row crops can be grown several years in succession. In this way the advantages from growing legumes on one soil are beneficial to the cash crop on another.

How easily a soil washes is one factor in determining the intensity of rotation that can safely be used on it. Continuous row cropping, which exposes the soil to washing all of the time, presents the greatest erosion hazard. A row crop for 2 years, followed by a close-growing crop for one year and 2 or more years of a sod-forming crop, reduces the erosion hazard. A rotation consisting of a row crop 1 year, a small grain for 1 year, and 2 years of hay has an even lower erosion hazard, because the soil is exposed to erosion for a shorter period and the sod-forming crops are on the land for a greater part of the time. In the section Use and Management of Important Groups of Soils, table 9 lists the rotations suited to major groups of soils in this county.

Liming and fertilization.—If the rotation is to be most effective in soil improvement, the crops must grow vigorously. This means that minerals must be added in fertilizer and lime if the supply in the soil is too small for good plant growth. Lime and phosphorus are very important for legumes, because vigorously growing legumes fix large amounts of nitrogen that can be used by crops following in the rotation. Legumes are very sensitive to acid soils.

Table 8 gives the amounts of nitrogen, phosphorus, and potassium that correspond to low, medium, and high applications for the more important crops of Livingston County. In general, low amounts are

not adequate to meet crop needs and maintain soil fertility, whereas medium amounts will meet crop needs and maintain fertility. High amounts are those that have been found, by some of the better farmers and on experimental plots, to give very high yields that are profitable under the economic conditions of recent years. The amounts of manure, fertilizer, and lime corresponding to the "high" level may change from year to year, depending upon the relative prices of crops and fertilizers. In contrast, the amounts at the medium and low levels will not change unless significant changes in agricultural technology occur.

TABLE 8.—*Rates of fertilization for crops commonly grown in Livingston County, N. Y., expressed in pounds of the nutrient per acre per year*

Crop	Nitrogen			P_2O_5[1]		K_2O		
	Low	Medium	High	Medium	High	Low	Medium	High
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Field corn	10–15	20–40	40+	[2] 20–30	[3] 20–30	0–10	15–20	30+
Oats	5–15	20–30	30+	[2] 20–30	[3] 20–30	0–10	20–30	40+
Wheat	10–15	30–40	40+	[2] 20–30	[3] 20–30	0–10	20–30	40+
Legume hay	0	0	0	[2] 20–30	[3] 20–30	0–10	20–30	40+
Grass hay	0–10	20–30	30+	[2] 20–30	[3] 20–30	0–10	10–15	20+
Potatoes	50	75–100	150	75–125	150–200	40–60	75–125	150–200
Beans	10–15	20–30	40+	20–30	50–70	0–10	20–40	40–60
Sweet corn	10–15	20–30	40+	20–30	50–70	0–10	15–20	30+
Peas	10–20	40–50	50+	20–30	50–90	10–20	30–50	50+
Cabbage	30–50	75–100	150	75–125	150–200	30–50	75–100	100+
Tomatoes	20–40	50–75	80	50–100	125–175	30–50	75–100	100+

[1] On most Livingston County farms superphosphate is added to manure in the barn, and most cropland receives at least enough phosphorus for maintenance, so no figures are given for low rate of phosphorus application.

[2] This is the average amount that should be added per acre per year of the rotation. Since phosphorus does not readily leach from the soil, the entire amount for the rotation can be added at one time, usually just before the sod crop is planted. If the crop shown is grown in rotation with a vegetable crop heavily fertilized with phosphorus, additional phosphorus may not be necessary in the rotation.

[3] In the corn-grain-hay rotation followed on dairy farms no additional response is ordinarily obtained from applications of phosphorus beyond those needed for maintenance.

Fertilizing practices that will meet the soil needs on most dairy farms in Livingston County are described below. However, to obtain high yields of vegetables or other high-value crops, large amounts of a complete commercial fertilizer that meets the needs of the specific crop are required. If the vegetable crop is grown in a rotation with sod-farming crops, the amounts used on the vegetable crop may be ample to fertilize the entire rotation.

Lime.—Need for lime varies widely among the soils of Livingston County, but based on liming needs three broad groups of soils can be considered. Nearly one-fifth of the soils, mainly in the northern part of the county, are derived from materials rich in lime. Natural lime lies at depths of less than 3 feet, and the layers above the lime zone are

neutral to only medium acid. These soils have low lime requirements.

Concentrated in a belt in the central part of the country are other soils, also derived from materials at least fairly rich in lime. They have free lime at depths of 30 to 42 inches, but because of severe leaching they are strongly to very strongly acid above those depths. These soils have medium lime requirements.

The remaining soils, covering slightly less than two-thirds of the county and concentrated in the southern part, are derived from acid materials or are leached to great depth. They are strongly to very strongly acid throughout. Lime requirements of these soils are high.

The terms, low, medium, and high lime requirements as used in this report are defined as follows:

LOW LIME REQUIREMENT: 0 to 1½ tons of lime per acre to correct initial acidity of the plowed layer; 0 to 1 ton per acre every 4 years to maintain a soil reaction near pH 6.5 in the plowed layer; no liming necessary for established legumes.

MEDIUM LIME REQUIREMENT: 2 to 6 tons of lime per acre to correct initial acidity of the plowed layer; 1 ton per acre every 4 years to maintain a soil reaction near pH 6.5 in the plowed layer. Lime is needed for most shallow-rooted crops and to start new seedings of deep-rooted legumes. Established deep-rooted legumes can obtain sufficient lime from the lower subsoil layers.

HIGH LIME REQUIREMENTS: Initial and maintenance applications to the plowed layer same as for soils having medium lime requirements. However, because lime is lacking in the subsoil, more lime is needed to maintain deep-rooted legumes for long periods than on the other two groups.

These terms defined above show general lime requirements. Amounts given are not intended as liming recommendations. Lime needs of a particular soil depend upon the crop to be grown, and on past cropping and liming history. To determine lime needs for a given field, the farmer should have his soil tested. Then, his county agent or other agricultural advisor can tell him how much lime to use for the crop and soil. After the initial requirements are met, about 1 ton to the acre every 4 years will maintain a soil reaction near pH 6.5 on most Livingston County soils. However, soil tests are not expensive, and they should be repeated at intervals, especially if continued high yields are expected.

Phosphorus. This nutrient is a limiting factor in plant growth for most soils in Livingston County. It must be added in commercial fertilizers; superphosphate is one of the cheapest sources. On dairy farms, 150 pounds to the acre of 20 percent superphosphate annually, or its equivalent in other materials, will normally supply enough phosphorus for the usual crops. Phosphorus does not leach readily from the soil. All of the phosphorus needed for a 4- or 5-year rotation therefore can be applied at one time, preferably when the sod-forming legume is seeded.

Nitrogen.—This is the nutrient most likely to be deficient in the soils of Livingston County. It is held in the soil principally as a part of the organic matter. Hence, as organic matter is depleted by intensive cropping, less nitrogen is available for plants. One of the best ways to add nitrogen on most farms in Livingston County is by growing inoculated legumes, as described in the discussion of rotations.

Another valuable source of nitrogen, on dairy farms and other farms that have large numbers of livestock, is manure. More than half of the nitrogen in feed eaten by animals is excreted in manure. By applying manure to the soil, the farmer returns part of the nitrogen taken from it by the crops. On most dairy farms, the nitrogen returned in manure and by legumes supplies a large proportion of the requirements. However, nitrogen in the form of commercial fertilizer commonly results in increased yields when applied to sod crops low in legumes, to winter wheat in spring, to corn and oats at planting time, and to corn as a side dressing. This nitrogen may be applied alone or in mixed fertilizers, depending upon the need for other nutrients.

Potassium.—In the soils of Livingston County, potassium is usually more plentiful than either phosphorus or nitrogen. However, under heavy cropping, deficiencies may develop. The fine- and medium-textured soils have reserves of potassium, largely held on the clay particles. Reserves are much lower in the coarse-textured soils with low clay content. In general, available potassium is lower in the low- and medium-lime soils than in the high-lime soils. On dairy farms, potassium needs are largely met by the large amounts of manure returned to the soil. However, extra potassium from commercial fertilizer will increase yields of heavy potassium feeders like alfalfa, other legumes, and many vegetable crops. Potassium should be applied in small to medium amounts at planting time to meet the needs of each crop, rather than in large amounts for a whole rotation.

Supporting practices for control of water on the land.—After choosing a rotation suited to the soil and using enough fertilizer for the kind of crops grown, additional practices may be needed to slow runoff, control erosion, or improve drainage.

If water runs off too rapidly, little sinks into the soil where roots can reach it, and little is stored for future use. Even in a humid region like Livingston County, lack of water during part of the growing season is an important limitation on crop growth. The practices required to conserve soil and water depend upon how easily the soil erodes and upon how much of the time the rotation leaves the soil without protective plant cover. Easily applied practices, as tillage across the slope or on the contour, leaving drainageways in sod, and using winter cover after row crops are effective on soils where erosion is easy to control. These practices can be applied by most farmers, with some technical aid, and at moderate cost. On soils where erosion is difficult to control, stripcropping and constructing diversion terraces, check dams, and other structures are required. Most farmers will need much help from technicians in planning and building these structures, and costs are fairly high.

Some soils retain surplus water too long. During the normally wet spring months, much of the water soaks into the soil and saturates both the surface layers and subsoil. This water drives out air, stunts root growth, and prevents the roots from absorbing nutrients. Then, when the surface layer dries in midsummer, the crops on these soils are quickly injured by drought because the stunted root systems do not reach the subsoil moisture supply. Hence, on poorly drained soils, crops are injured by too much water in spring and by too little in summer.

In Livingston County, tile drainage systems, open ditches, and diversion terraces are the principal devices suitable for drainage of poorly drained soils. The drainage system selected should remove the surplus water in spring and provide enough moisture for the crops during summer. Because costs are high and the problems complex, most farmers will need help from technicians in designing and building drainage systems. In the section, Use and Management of Important Groups of Soils, the practices needed for water control under suited rotations are given for the groups of soils shown (table 9). The need for such practices on individual soil types and phases is also given in the description of each mapping unit.

USE AND MANAGEMENT OF IMPORTANT GROUPS OF SOILS

In this part of the report the soils are grouped in five classes on the basis of their relative suitability for crops and pasture. These 5 classes are subdivided into 24 management groups on the basis of similarities in the management they need.

First-class soils are the best in the county for agricultural use, and Fifth-class are the poorest. Classes 1, 2, and 3 are generally suited to crops; Class 4 is poor for crops but fair for pasture; and Class 5 is poor for both crops and pasture but can be used for forest. This classification can be used to evaluate the relative quality of each soil in the county. [12]

In placing the soils in the five classes these factors were considered: (1) The general productivity of each soil for the crops commonly grown; (2) the difficulty and cost of management required to obtain medium to high yields and at the same time maintain the productivity of soil; and (3) the ease with which the soil can be worked.

Each of the five classes contains soils that need different kinds of management and that are suited to different kinds of crops. Therefore, each class is subdivided into management groups. These groups contain soils that are similar in properties that affect management and that need the same general kind of practices. These management groups are indicated by a letter added to the number of the soil-quality class. To illustrate, management groups 1–A and 1–B both consist of very good soils, but the two groups differ in management needs. Of the 24 management groups, 18 consist of soils suited to crops, 4 of soils better used for pasture, and 2 of soils best used for forest.

The management groups are listed in table 9. Suitable rotations are shown for each group, and practices for controlling water, preventing erosion, and maintaining organic matter are listed. Fertilizer and lime applications at three levels are also shown in relative terms—low, medium, and high. The amounts of lime and fertilizers corresponding to low, medium, and high are given in the section on management principles (see table 8).

[12] These soil quality classes are similar to but not the same as the Land Capability classes used by the Soil Conservation Service in farm planning. The first 3 classes in the 2 schemes would include approximately the same soils. Class 4 soils, as used here, would include most soils of Capability Group IV and those of Capability Groups V, VI, and VII that are suitable for pastures; Class 5 soils would include soils of Capability Groups V, VI, and VII that cannot be used for pastures and all soils of Capability Group VIII.

Applications of amendments at level A in table 9 are too low to maintain soil fertility and meet the needs of crops. If the farmer applies these amounts over a period of years, the yields of crops will gradually decline. At level B, amounts are high enough to meet crop needs and maintain the soil, so that over a period of years crop yields will be maintained at a fairly high level. At level C, soil fertility is gradually increased and high to very high yields of crops are obtained. The experience of better farmers and results on experimental plots show that fertilizing and liming at level C are about as high as will be profitable at prices current in recent years. The absolute amounts of amendments that can be profitably used at the high level may vary from year to year, depending upon relative prices of crops and amendments. In contrast, the absolute amounts at levels A and B will change only with major changes in agricultural technology.

In the following pages each management group is described in terms that reflect management needs, and additional suggestions for good management are given. The information given in the text and table 9 are intended as a general guide for farmers in planning soil-management systems. They are not to be interpreted as specific management recommendations, because nearly every field or farm has somewhat different management needs. The farmer should design his management system to meet his particular needs. Where his problems are complex he should seek the aid of the County Agent, Soil Conservation Service technician, or other agricultural advisor. These people are familiar with the soils of the area and are informed about the most recent research results that have bearing on managing the soils and crops of Livingston County.

FIRST-CLASS SOILS—GOOD TO EXCELLENT FOR CROPS OR PASTURE

All First-class soils give high yields of a wide variety of crops, or of special high-value crops. All are easy to till and are well suited to crops that require tillage. All are fairly fertile. None is more than slightly eroded, and none is subject to damaging erosion. Roots penetrate the soils readily. Air and water move easily, but at least fairly large supplies of moisture are retained. Plants grow vigorously, and management needs are quite simple.

Crops well suited to the soils, and management needs of these crops, vary widely among soils of this class. The First-class soils therefore have been divided into four management groups. All the soils in one management group need about the same kind of management.

MANAGEMENT GROUP 1-A—DEEP WELL-DRAINED SOILS FROM GLACIAL OUTWASH AND TERRACE DEPOSITS ON NEARLY LEVEL SLOPES

The soils of management group 1–A, like those of group 1–D, are among the best in the county for general farming, but they range from low to high in lime. Water runs off slowly, soaks into the deep porous soils rapidly, and is held available to plants. Slopes are less than 5 percent and are well suited to use of heavy farm machinery.

The soils are well-drained but not droughty. They are even less erodible than soils of management group 1–D and require only simple practices for control of runoff.

The Chenango and Howard soils need lime for most crops, and lime is essential to obtain good stands of alfalfa and clover. Initially, as

much as 6 tons of ground limestone an acre may be needed to neutralize the plow layer of unlimed soils. The Palmyra and Mentor soils require little or no lime.

All of the soils need fertilization with phosphorus and with potassium, as well as the use of legumes, barnyard manure, or crop residues to maintain organic matter and nitrogen.

Soils of this group are very good for clover and alfalfa if limed as needed. The Chenango and Howard soils are excellent for potatoes. High yields of potatoes can be obtained also on the Palmyra and Mentor soils, but the quality is poorer because of scab. These are very good soils for small grains, corn for silage, sweet corn, dry beans, peas, root crops, and tomatoes. Cabbage produces well where lime is plentiful but it may have clubroot on Chenango and Howard soils that are not limed. In general, these soils require slightly more intensive practices for maintaining organic matter and soil fertility than do the soils of management group 1–D.

MANAGEMENT GROUP 1-B—DEEP WELL-DRAINED SOILS ON BOTTOM LANDS

The soils of management group 1–B are very good for intensive cash crops. They are level to gently sloping, friable, and fertile. They are easy to keep in good tilth and are very easy to cultivate. Water runs off slowly but soaks in rapidly and does not waterlog the soil.

Almost every spring these soils are flooded by streams. These floods deposit fresh soil material that is high in most plant nutrients, but in spite of this, the soils respond markedly to fertilizers. On these soils large amounts of complete commercial fertilizer will bring very high yields of intensive cash crops. The Chagrin and Tioga soils need lime for most crops.

Row crops can be grown for several years in succession without seriously depleting the supply of organic matter and nitrogen, but a legume hay or green-manure crop at intervals of 4 or 5 years is needed to maintain organic matter and good tilth. Winter cover will help to prevent damage by spring floods. Water-control structures are needed to prevent streambank cutting and harmful deposition of material from adjacent slopes, and to divert or rapidly remove water during the infrequent summer floods.

These are excellent soils for peas, sweet corn, spinach, beets, carrots, green beans, and other intensive annual cash crops, and also for silage corn. The Genesee and Ross soils are excellent for both alfalfa and clover. The Chagrin and Tioga soils are very good for those crops but require lime. Soils of this group are only fair for small grains, which tend to lodge, and for potatoes, which are subject to disease.

MANAGEMENT GROUP 1-C—DEEP MUCKS AND POORLY TO VERY POORLY DRAINED HIGH-LIME SOILS, ARTIFICIALLY DRAINED

The mucks of management group 1–C produce large yields of high-value crops under intensive management. Very heavy fertilization, up to 1,000 pounds an acre of a complete mixture high in potassium, is needed to obtain the high yields possible on these soils. The water table must be controlled throughout the growing season. Hedges, rows of trees, or picket fences, are needed for windbreaks to prevent drifting of the mucks. A winter cover crop of rye, turned under in the spring, helps prevent wind erosion.

These mucks are exceptionally well suited to such intensive cash crops as potatoes, celery, onions, sweet corn, green beans, and cut flowers.

Areas of Kendaia and Lyons soils that are associated with the mucks can be used and managed with them, if drained. Where the Kendaia and Lyons soils occur in small spots associated with the well-drained gently sloping Ontario and Honeoye soils, use and management can be the same as for management group 1–D, assuming that these poorly and very poorly drained soils are drained.

Where undrained, the Kendaia soils are poorly suited for all crops that require tillage, but they can be used for hay or pasture. Mixtures of Ladino clover or red clover with grasses do well on the undrained Kendaia soils. Phosphorus fertilizer is required for a high yield of good quality forage, but the supply of lime is generally ample. Potassium deficiency may develop if all of the forage is removed for hay.

The undrained Lyons soils, suited only to native pasture or forest, are included in management group 5–A.

MANAGEMENT GROUP 1-D—DEEP WELL-DRAINED, HIGH-LIME SOILS FROM GLACIAL TILL AND LACUSTRINE DEPOSITS ON GENTLE SLOPES

These are among the best soils of the county for general farming. They are deep and friable, absorb water easily, and hold it available to plants. They dry early in the spring, are easy to work, and can be worked under a wide range of moisture conditions. The gentle slopes of less than 8 percent are well suited to heavy farm machinery.

The soils are well-drained but not droughty. They do not erode easily, particularly if organic matter is maintained, and they require only simple practices to control runoff.

Rotations that contain legume hays, the use of manure, or the return of crop residues will help maintain the naturally high content of organic matter and nitrogen. Most of the soils need little lime, even for alfalfa. However, Lansing silt loam generally needs some lime to start legumes. All these soils need phosphorus fertilizer, and if manure is not used, they also require potassium.

These are excellent soils for alfalfa, clover, small grains, corn for silage, soybeans, cabbage, tomatoes, dry beans, peas, sweet corn, and root crops. They are good for potatoes, but potato scab injures the quality of the tubers on these high-lime soils.

SECOND-CLASS SOILS—FAIR TO GOOD FOR CROPS AND FAIR TO EXCELLENT FOR PASTURE

Productivity, ease of working, and ease of conserving soils of this class vary widely. Some one, or some combination, of the factors affecting productivity or ease of working and conserving these soils is sufficiently unfavorable that each soil is less suitable for crops than any First-class soil. None of the soils of this class is so bad that it can be considered poorly suited to crops. Each soil is at least moderately productive of some important crops, although some soils in this class are suited to only a few crops. Erosion can be controlled and fertility can be maintained under cultivation by the use of a few special practices.

MANAGEMENT GROUP 2-A—DEEP WELL-DRAINED SOILS FROM GLACIAL OUTWASH AND TERRACE DEPOSITS, MAINLY ON SLOPING TOPOGRAPHY

Soils of this group are similar to those of group 1–A, but because of stronger slopes they cannot be used so intensively. Although these deep soils are porous and absorb water rapidly, the supply available for plants is somewhat less than for soils of group 1–A because more water is lost as runoff. The coarse-textured Ottawa soil is apt to be deficient in moisture during dry years, especially where organic matter has been depleted. Slopes, which range up to 15 percent and may be very irregular or complex in places, are not so well suited to use of heavy machinery as those for soils of group 1–A. Nevertheless, slopes are nowhere steep enough to prevent use of machinery normally found on Livingston County farms.

A rotation consisting of a row crop for 2 years, a close-growing crop for 1 year, and a sod crop for 1 year is the most intensive one that will conserve soil material and maintain organic matter. Where feasible, tillage across the slope and stripcropping should be practiced both to prevent erosion and to conserve moisture. Except for limitations imposed by need for a longer rotation, the soils of group 2–A are suited to the same crops as those of group 1–A. They also have the same needs for lime, fertilizer, and organic matter.

MANAGEMENT GROUP 2-B—MAINLY DEEP, WELL-DRAINED, LOW-LIME SOILS FROM GLACIAL TILL ON ROLLING SLOPES

These soils have slopes ranging from less than 3 to 15 percent. Heavy farm machinery can be used, but with moderate difficulty on the steeper slopes. Gravel and stones may interfere somewhat with cultivation.

The soils are porous throughout and absorb water rapidly. They do not erode easily, but the slopes cause moderately rapid runoff. Practices that slow the rate of runoff are needed to let the water soak into the soil and to reduce erosion. Water conservation is especially important on the shallow to moderately deep Lordstown soil.

Good management for general farm crops should include use of a rotation in which not more than 1 year out of 4 is for row crops and at least 2 years out of 4 are for an alfalfa-clover-grass mixture or other hay crop. Contour tillage, contour stripcropping, and diversion terraces should be used with such a rotation. If needed, row crops can be grown 2 out of 4 years and sod crops only 1 year out of 4. With this rotation very narrow strips are required and diversion terraces are essential. These practices, plus large amounts of fertilizer and much organic matter, are needed to restore the few seriously eroded areas included.

Most crops respond to lime, and lime is essential for success with alfalfa or clover. The soils are deficient in phosphorus. Potassium is commonly needed after lime and phosphorus are applied, especially if the soils are cropped heavily. Practices to maintain organic matter and nitrogen are needed.

These soils are suited to potatoes, corn, sweet corn, peas, and beans, if they are not grown more than twice in a 4-year rotation. They are well suited to small grains. If limed heavily, the soils are also well suited to clover and moderately well suited to alfalfa.

MANAGEMENT GROUP 2-C—MODERATELY WELL DRAINED AND IMPERFECTLY DRAINED HIGH-LIME SILTY AND CLAYEY SOILS, MAINLY ON NEARLY LEVEL AND VERY GENTLE SLOPES

The gentle slopes of the soils of group 2–C are well suited to use of heavy farm machinery. However, the soils are hard to till and to keep in good tilth. Unless tillage is performed only when soils are moderately moist, they are likely to puddle and bake into hard crusts and clods. Runoff is not rapid on the gentle slopes of these soils, but amounts are large because the subsoils are only moderately permeable to water. Because of the medium to fine texture, water soaks into the soils very slowly and part of it is held unavailable to plants.

If rotations include 2 or more years of well-fertilized legume-grass hay, and 1 year of intertilled crop that is manured, no special methods of runoff control are generally required on slopes of less than 2 percent. On slopes greater than 2 percent, stripcropping and diversion terraces are needed to reduce the rate of runoff. This will allow water to soak into the soil for plant use, and will reduce erosion if row crops are on the land much of the time. On nearly level or depressional areas, especially of the Fulton soils, drainage may be needed.

All of these soils require phosphorus fertilizer. As a group, they contain more potassium than most other soils of the county, but some potassium fertilizer may be required, especially on legumes and vegetable crops. Except for the Caneadea soils, little or no lime is needed by this group of soils, even for alfalfa. They need legumes, manure, crop residues, or green manure to maintain or increase organic matter and nitrogen. All practices that add organic matter will help to bind soil particles together, increase water absorption, and reduce erosion.

All of the soils of group 2–C are at least moderately well suited to most crops grown in Livingston County. Alfalfa is well suited to the moderately well drained Schoharie soils. It does fairly well for 2 years on the other soils, but stands commonly thin rapidly after 2 years. Mixtures of alfalfa, red clover, or Ladino clover with grass yield large amounts of high-quality hay on the imperfectly drained and moderately well drained soils.

These soils are well suited to wheat, but oats commonly cannot be seeded until slightly too late for highest yields. Corn, sweet corn, beans, and peas generally produce moderately well, but bean seedlings may not be able to emerge through the crust that forms after rains in some seasons. In very dry years, yields of common field crops on Lima and Conesus soils are likely to be greater than on the better drained soils of group 1–D. In wet years most crops are likely to be damaged and yields will be less than on the better drained soils.

MANAGEMENT GROUP 2-D—MODERATELY WELL-DRAINED, LOW-LIME SOILS FROM GLACIAL TILL ON GENTLE SLOPES

All soils in management group 2–D have hardpans below 18 inches. Although their slopes are mild, the volume of runoff is large because of slow internal drainage. Plants must root almost entirely in the 18-inch zone above the hardpan, and measures to retard runoff are important both to keep that zone well supplied with water and to reduce erosion. During wet weather, the soil above the hardpan is

waterlogged for short periods, and crops sensitive to too much water are damaged. Diversion ditches cut down to the hardpan may protect areas below them from seepage water and from excessive runoff.

These soils are deficient in phosphorus and rapidly become deficient in nitrogen and organic matter unless management includes practices to maintain them. Most crops respond to liming; lime is essential for legume hay. Potassium deficiency may appear after liming.

These soils are poorly suited to alfalfa because of acidity and only moderate drainage. However, alfalfa, which usually survives 1 or 2 years, may be used to good advantage in mixtures with timothy and clovers. Birdsfoot trefoil is probably the best long-lived legume for hay; red and alsike clovers are suitable as short-lived legumes. All clovers require much lime and phosphorus fertilizer.

These are fair soils for corn, small grains, beans, and potatoes; they are poor for cabbage and most root crops. They can be used with good success for rotations of corn, small grain, and 2 years of hay, provided large amounts of lime and fertilizer are applied and contour tillage and diversion ditches are used, especially on the longer or steeper slopes. Where needed, a rotation with 2 years of row crops and only 1 year of hay can be used. Under this rotation, strip-cropping is required in addition to practices listed above, and more organic matter needs to be added to the soils.

MANAGEMENT GROUP 2-E—DEEP WELL DRAINED AND MODERATELY WELL DRAINED HIGH-LIME SOILS FROM GLACIAL TILL AND LACUSTRINE DEPOSITS, MAINLY ON SLOPING TOPOGRAPHY

Slopes for most soils of this group range from 8 to 15 percent. Heavy farm machinery can be used on them with some difficulty.

All of these soils have at least moderately porous subsoils and absorb water at least moderately rapidly, but the slopes cause rapid runoff and loss of water needed by plants, as well as serious erosion. This problem is most serious on the Cayuga and Cazenovia soils, which have moderately fine textured subsoils. A few badly eroded areas of soils in the group require intensive water-control practices, as little tillage as possible, and addition of large amounts of organic matter and plant nutrients.

These soils should be covered by vegetation as much of the time as possible. Hay and small grains should make up a large part of the rotation. Not more than 1 year of an intertilled crop should be included in the rotation, and that should be planted in narrow contour strips and tilled on the contour. Diversion terraces and winter cover crops are important needs of these soils. As on soils of management group 1–D, manure, green manure, crop residues, or long periods of legume hay are important to maintain organic matter and nitrogen. These practices also improve the tilth of the soil, increase the rate of water absorption, and reduce erosion.

Large amounts of phosphorus are required for good yields, as well as to encourage the growth of adequate cover to help control runoff. Lime is generally needed on Lansing and Conesus soils for legume hay, but is less commonly required on the other soils of the group.

These soils are well suited to alfalfa, clover, grasses and small grains. Row crops such as corn, beans, and cabbage yield fairly well but should be grown at long intervals.

MANAGEMENT GROUP 2-F—MODERATELY WELL DRAINED SOILS AND POORLY DRAINED SOILS WITH ARTIFICIAL DRAINAGE, MAINLY ON FIRST BOTTOM LANDS

These are level fertile soils that are easily maintained in good tilth. All are subject to overflow in the spring, and crops on them may be damaged by flash floods in summer. The Wayland, Wallkill, and Colwood soils require artificial drainage before they can be used as cropland.

Row crops may be grown several years in succession without seriously depleting soil organic matter, but winter cover should be provided. Cash crops on these soils respond to large amounts of complete fertilizer, even though the soils are naturally fertile.

Except in wet years, these soils give high yields of peas, sweet corn, spinach, beets, carrots, green beans, and other intensive cash crops. Corn is well suited to the soils, and Ladino clover, alsike clover, and grasses for hay produce well. Alfalfa, small grains, and potatoes are poorly suited.

MANAGEMENT GROUP 2-G—MODERATELY WELL DRAINED TO POORLY DRAINED MEDIUM LOW- TO LOW-LIME SOILS WITH SANDY OR SILTY SURFACE LAYERS, ON NEARLY LEVEL AND GENTLY UNDULATING TOPOGRAPHY

These soils generally occur in small areas of nearly level to gently undulating relief. They are usually farmed like the surrounding better drained soils. They are easy to till and to maintain in good tilth.

Runoff is not rapid, and water soaks in readily until it reaches the fine-textured material of the deep subsoil. Depressional areas may be improved by open-ditch drainage. Slopes of 2 percent or more may need contour cultivation and stripcropping to retard runoff.

Most crops respond to lime, and lime is essential for alfalfa and clover on all except the Fredon soils. Phosphorus and potassium fertilizers are usually necessary. Nitrogen and organic matter should be supplied by legumes or manure, although these soils normally contain more of these materials than the associated soils.

In most areas of these soils drainage is not quite good enough for long life of alfalfa. Mixtures of alfalfa, Ladino clover, and grasses yield well if limed and fertilized with phosphorus. Unless they are drained artificially, the soils are only fairly well suited to corn, small grains, sweet corn, peas, and beans. Berrien fine sandy loam is better for these crops than the other soils of the group when undrained and, in addition, is moderately well suited to cabbage, small fruits, and other intensive cash crops.

THIRD-CLASS SOILS—POOR TO FAIR FOR CROPS AND FAIR TO EXCELLENT FOR PASTURE

For these soils, productivity, ease of working, and ease of conserving range within very wide limits. Some one, or some combination, of these factors makes each soil of this class generally less suitable for crops than soils of the second class. Some Third-class soils, however, are as good for pasture as some Second-class soils. Each soil can be cultivated, and each produces fair yields of at least some crops commonly grown in the county. Each soil of this class can be conserved when used as cropland, although conservation may require constant attention to highly intensive management practices. Although soils

better suited to crops should be used where available, on a large number of farms it is feasible to crop soils of this group, maintain their fertility, and control erosion.

MANAGEMENT GROUP 3-A—DEEP MODERATELY WELL DRAINED LOW-LIME SOILS FROM GLACIAL TILL ON SLOPING TOPOGRAPHY

These soils have hardpans below 18 inches. Because of the small volume of soil above the hardpan, a large part of the water runs off. Loss of water and erosion are serious problems. During wet weather these soils become saturated by water that accumulates above the hardpan.

Practices that retard runoff and remove excess seepage water during wet weather are needed. Runoff can be controlled by use of close-growing crops or hay at least 2 of 4 years in a rotation, by diversion terraces, and by contour stripcropping when the row crop is grown. Where row crops are grown 2 years in succession, diversion terraces should be spaced at 300 feet or less.

The long uniform slopes of these soils lend themselves well to stripcropping. Diversion ditches, cut to the hardpan, protect areas down hill from them from seepage and carry away excess runoff. Heavy liming, fertilizing with phosphorus, the use of manure, and growing of legumes are necessary for continued good yields of crops and to provide adequate soil cover.

Corn, small grains, and hay are moderately well suited to these soils. The legumes of the hay crop should be dominated by red clover, the longer-lived Ladino clover, or birdsfoot trefoil. Alfalfa usually dies after 1 or 2 years, but it can be used to good advantage in mixture with other legumes. Potatoes are only moderately well suited to these soils, but give high yields in seasons when water is plentiful but not in excess supply. Potatoes require large amounts of complete fertilizer and should be grown only 1 year in a 4- or 5-year rotation.

MANAGEMENT GROUP 3-B—POORLY DRAINED AND IMPERFECTLY DRAINED LOW-LIME HARDPAN SOILS FROM GLACIAL TILL, ON NEARLY LEVEL AND GENTLE SLOPES

All of these soils have slopes of less than 8 percent. Generally, only 10 or 12 inches of permeable soil lies above the almost impervious hardpan.

Disposal of surplus water is a serious problem on these soils. Although slopes are mild, runoff is relatively great. Diversion ditches, cut to the hardpan, are moderately effective on slopes greater than 3 percent. Close-growing crops and contour stripcropping on these slopes will help to control excess water. On nearly level areas little can be done about drainage except to divert seepage from higher lying areas. Tile is generally not effective, except to drain seep spots.

These soils need lime, phosphorus, and in places potassium for even fair yields of crops. Red clover, alsike clover, and Ladino clover in mixtures with grasses produce fair yields of hay, help maintain organic matter, and retard runoff. Birdsfoot trefoil shows promise as a perennial legume for these soils. Corn and small grain produce fair yields in years when water is plentiful but not in excess supply. Buckwheat is often grown when the soils dry too late in the spring for planting small grains. These soils are poor for potatoes and alfalfa.

344679—56——8

Moderate yields of the crops commonly grown on dairy farms can be obtained, if enough lime and fertilizer are used and the most poorly drained areas are partially drained.

MANAGEMENT GROUP 3-C—MOSTLY SHALLOW HIGH-LIME AND MEDIUM-LIME SOILS ON NEARLY LEVEL AND GENTLE SLOPES

On this group of soils, the volume of soil in which plants can feed and obtain moisture is small. Hence, during dry seasons yields are seriously lowered. Bedrock is commonly 24 to 36 inches below the surface, and, except in the Farmington soils, the moisture available for plants is restricted to even shallower depths by a dense subsoil. Runoff is moderately slow and not difficult to control.

None of the soils require large amounts of lime, but Retsof silt loam is moderately acid in the upper layers. All require phosphorus for good yields in years of favorable moisture, and all need legumes or manure to maintain nitrogen and organic matter.

Hay crops, including alfalfa, red clover, and Ladino clover mixed with grasses, are moderately well suited to the soils. Nevertheless, yields are low in dry years. Corn, dry beans, and small grains are also moderately well suited. The soils can be conserved in a 4-year rotation that includes 1 or 2 years of row crops, provided diversion terracing, stripcropping, and contour tillage are practiced for controlling runoff and erosion. On many farms terracing these shallow soils may be impractical for engineering reasons, or returns from row crops may be too low to justify the cost of terracing. In these places, sod crops for hay or pasture are the most economical use for these soils.

MANAGEMENT GROUP 3-D—MODERATELY WELL DRAINED AND IMPERFECTLY DRAINED, MAINLY HIGH-LIME SILTY AND CLAYEY SOILS, ON GENTLY ROLLING AND GENTLY SLOPING TOPOGRAPHY

All of these soils are derived from lake-laid silts and clays. These materials are very uniform in texture and erode very easily.

Generally, the most intensive rotation well suited to these soils consists of a row crop followed by a close-growing crop, such as small grains, with 1 or more years of a sod-forming crop for hay or pasture. When the soils are used this intensively, diversion terraces at 300 feet spacing, contour tillage, and stripcropping are needed to conserve water and soil. Without terracing, only close-growing crops and sod crops can be safely grown.

Although these soils are commonly wet in the spring, they may become extremely dry in midsummer. For this reason, deep-rooted legumes are better suited to these soils than Ladino clover. On the moderately well drained Schoharie soils alfalfa can be grown. However, on the other soils of the group, restricted internal drainage is unfavorable for alfalfa; hence, birdsfoot trefoil is a better deep-rooted legume. For most of the soils little lime is required to establish legumes, but on the Caneadea soils some lime may be needed. All of these soils need phosphorus fertilizer at regular intervals, but none should require potassium unless yields are increased to high levels.

Corn for silage can be grown, but yields are commonly fairly low. Wheat is probably the most productive small grain on these soils. Oats is poorly suited to the more sloping areas because it exposes the

soil to erosion in the spring. Late planting may seriously reduce oat yields after wet springs. The soils are poor for potatoes and most vegetable crops.

MANAGEMENT GROUP 3-E—DEEP POORLY DRAINED SOILS AND SHALLOW WELL-DRAINED TO POORLY DRAINED SOILS, MAINLY LOW IN LIME, ON SLOPING TOPOGRAPHY

Bedrock at about 18 inches or a hardpan at 12 inches or less limits seriously the volume of soil available for moisture storage and root development for all soils of this group. Runoff is rapid and in large volume on the fairly strong slopes, and erosion is difficult to control.

Diversion terracing and very narrow stripcropping, combined with rotations that include not more than 1 year of intertilled crop in 4, is needed to retard runoff. The use of legumes or manure is needed to maintain organic matter, and large amounts of lime and phosphorus are needed for even fair yields of crops or pasture. Potassium is commonly needed for good yields. The slopes of these soils are usually long and uniform and are well suited to the use of narrow contour stripcropping and diversion ditches. However, because of shallow depth, diversions may not be practical on the Manlius, Aurora, and Retsof soils.

Few crops are suited to these soils. Potatoes are very poorly suited. Corn and small grains give fair yields in favorable years under good management, but in some years the soil stays wet too late in the spring for them to be planted. Buckwheat, which is usually grown in their place in such years, yields moderately well but offers little protection against washing. Mixtures of red clover, alsike clover, or Ladino clover with grasses produce fair yields of hay and help conserve soil and maintain fertility. Alfalfa can be used in the seeding mixture on the Manlius soil if it is heavily limed. Birdsfoot trefoil has been used successfully on most of the soils of the group. If better soils are available for row crops or grains, soils of this group can be used best for long-term hay or permanent pasture.

MANAGEMENT GROUP 3-F—DEEP, WELL-DRAINED, MEDIUM-TEXTURED, HIGH-LIME SOILS ON MODERATELY STEEP OR HILLY SLOPES

Heavy farm machinery can be used only with great difficulty on these soils. Although the soils are at least moderately permeable to water, runoff is rapid and in large volume. Loss of water and soil erosion are serious problems on all soils of this management group, but are most serious on a few severely eroded areas.

If row crops must be grown in the rotation, very narrow stripcropping on the contour should be practiced. Terracing should be used also, if possible, but it may not be feasible on much of this steep land. Hay or pasture should be on the soils at least 3 years in 5, and for even more of the time if possible.

These soils give moderate yields of corn, cabbage, beans, and other row crops, if properly fertilized. Nevertheless, the uncertain supply of moisture, the very serious problem of runoff control, and difficulty of using heavy machinery make growing of these crops inadvisable. Small grains yield fairly well and allow less runoff, but the heavy machinery needed in sowing and harvesting is difficult to use. Deep-rooted legumes give good yields. On most farms these soils are

probably best used for long-term alfalfa-grass mixtures, seeded in a small grain and fertilized regularly with phosphorus and potassium. Some farmers will have to use these soils for cultivated crops because they do not have enough better land.

Except for the Ottawa soil, these soils require little or no lime for alfalfa. The acid Ottawa soil needs large amounts of lime for all legumes. All soils of this group require phosphorus for good crop yields, and all require legumes, barnyard manure, or green manuring to maintain organic matter and nitrogen.

MANAGEMENT GROUP 3-G—DEEP, WELL-DRAINED, LOW-LIME AND MEDIUM-LIME SOILS ON HILLY OR MODERATELY STEEP SLOPES

Although these soils are porous, water runs off so rapidly that relatively small amounts soak into the soil. Lack of moisture is the main limitation to crop production. Slowing of runoff, both to conserve water and reduce erosion, is one of the most important management needs. The use of heavy farm machinery on these slopes is difficult.

If better cropland is available, these soils are used to best advantage for long-term hay or permanent pasture. If row crops must be grown, very narrow stripcropping on the contour is needed and winter cover should be provided. Diversion terraces are needed also to conserve soil and water, but costs may be too high to justify their construction on these soils of fairly low productivity.

All of these soils need large amounts of lime for both crops and pasture. On the Howard and Lansing soils, however, once deep-rooted legumes are established, they will persist for long periods without additional lime. All of these soils also need phosphorus. They may need potassium for continued good yields after liming. Legumes, barnyard manure, or green manuring are necessary to maintain organic matter and nitrogen.

When properly fertilized, these soils are moderately productive of corn, potatoes, and other acid-tolerant row crops. Such crops should be avoided as much as feasible, because they create a serious problem of runoff control. This problem is less serious with small grains, but the heavy machinery needed for producing small grains is very difficult to use. Hay crops present a minimum problem of runoff control. Mixtures of alfalfa, Ladino clover, and grasses give medium to high yields when limed and supplied with phosphorus and potassium. Birdsfoot trefoil is a promising legume for long-term hay on such soils. Some of the more strongly sloping parts of the soils of this group are best used for forestry.

FOURTH-CLASS SOILS—VERY POOR FOR CROPS AND FAIR TO GOOD FOR PASTURE

On Fourth-class soils the use of farm machinery and the control of erosion on tilled land are so difficult, or yields of most common field crops are so low, that few areas are suited to cropping. However, water-holding capacity, drainage, and fertility are adequate to produce at least fair pasture. Although all of these soils are poorly suited to crops, some of them can be cropped with considerable difficulty or with low returns. On some farms where enough better soils are not available to produce needed crops, these soils may have to be cropped.

MANAGEMENT GROUP 4-A—DEEP MODERATELY WELL DRAINED LOW-LIME SOILS FROM GLACIAL TILL ON HILLY OR MODERATELY STEEP SLOPES

These are poor soils for crops because of strong slopes and restricted internal drainage. Few crops will produce even fair yields, and erosion control is a serious problem. On most farms they are best used for pasture. If they must be used for crops, long-term hay is generally best. Ladino clover mixed with grasses is probably best suited. Pastures and hay meadows require large amounts of lime and phosphorus.

If corn or other row crops must be grown, a long rotation that includes a row crop not oftener than once in 5 years should be used. Furthermore, the row crop should be planted in narrow strips on the contour, and diversion ditches should be provided to carry away both seepage water and excessive runoff.

MANAGEMENT GROUP 4-B—DEEP WELL DRAINED AND IMPERFECTLY DRAINED, MAINLY HIGH-LIME SILTY AND CLAYEY SOILS, ON SLOPING AND ROLLING TOPOGRAPHY

These silty and clayey soils are similar to those of group 3-D, but because slopes are stronger they erode even more easily. If possible, these soils should be used entirely for close-growing and sod crops. Where needed, row crops can be grown 1 year in 4, but closely spaced diversion terraces, contour tillage, and stripcropping are essential to conserve soil material and water on these very erosive soils. This intensive management for those soils may not pay on many farms; therefore, use for hay and pasture may be best.

Because these soils are derived from high-lime materials they are well suited to legumes. However, all except the Schoharie soils are acid in the surface, and some lime may be needed to establish legumes. The soils commonly become dry in the upper layers during summer; hence a deep-rooted legume such as alfalfa or birdsfoot trefoil, which can reach and use the deep subsoil moisture supply, is better suited than the shallow-rooted clovers. Alfalfa does well on the moderately well drained Schoharie soils, but birdsfoot trefoil is better for the imperfectly drained Caneadea and Odessa soils.

Phosphorus fertilizer is required to establish and maintain good stands of legumes. Potassium supplies are high, and additional amounts from fertilizers are not generally needed. Where all the forage is removed and no manure is returned, however, potassium fertilizers may give increased yields.

MANAGEMENT GROUP 4-C—DEEP WELL-DRAINED TO IMPERFECTLY DRAINED HIGH-LIME SILTY AND CLAYEY SOILS, ERODED IN PART, ON SLOPING, ROLLING, MODERATELY STEEP, OR HILLY TOPOGRAPHY

These soils are highly erodible because they have strong slopes and are made up of materials that are mostly of fine particle size. All of these silty and clayey soils absorb water slowly. All soils of the group have rapid runoff and are highly erodible when bare of vegetation.

These soils are all deficient in phosphorus. Only the Caneadea soils need much lime, and only the Dunkirk soil may be expected to need potassium. These soils are so difficult to work and conserve that they are very poor for either row crops or small grains. Where needed they can be used for permanent meadow for hay and pasture.

These meadows may be seeded to a small grain when the stand becomes poor. Where more productive and more easily conserved soils are available for meadow, these soils should revert to forest.

MANAGEMENT GROUP 4-D—DEEP POORLY DRAINED LOW-LIME SOILS AND SHALLOW POORLY DRAINED OR WELL-DRAINED LOW-LIME SOILS, MAINLY ON MODERATELY STEEP SLOPES

These soils commonly have less than 12 inches of permeable soil material above an impermeable hardpan layer. Because of this small water-storage capacity and strong slopes, runoff is rapid and in large amounts and the soils erode very easily. Root development of most crop plants is confined to the upper permeable layer. Plant nutrients and moisture needed must be obtained from this small volume of soil material.

Where needed for farming, continuous sod for hay or pasture is the best use for these soils. Grass-Ladino clover mixtures are probably the best for these poorly drained soils, although birdsfoot trefoil may do fairly well. Lime and phosphorus in large amounts are needed to establish and maintain meadows on these soils. Where manure is not returned, potassium also is apt to be deficient.

Grazing must be carefully controlled on pastures to maintain good stands. If grazed in spring when the soils are wet, the pastures are likely to be damaged by trampling. In midsummer these soils commonly become very dry, and pastures are easily overgrazed. On farms where enough better soil is available for pasture or meadow, these soils are best used for forestry or wildlife purposes.

FIFTH-CLASS SOILS—POOR FOR CROPS AND POOR FOR PASTURE

Steepness of slope, ease of erosion, poor drainage, shallow soil, low fertility, or some combination of these factors makes the Fifth-class soils poor for crops. Excessive drainage, very poor drainage, or low fertility makes them poor for permanent pasture. The best use of these soils is for forest, though some cleared areas produce a little pasture.

MANAGEMENT GROUP 5-A—DEEP VERY POORLY DRAINED SOILS ON NEARLY LEVEL TO GENTLY SLOPING TOPOGRAPHY

In their natural state, the soils of management group 5–A are too wet to produce much pasture. The vegetation in cleared areas consists mainly of coarse sedges, from which cattle can obtain some feed when other pastures fail in dry weather.

Areas of these soils that can be drained adequately produce fair to good pastures. Some of these soils are good or even excellent for crops when artificially drained. Drained areas of these soils have been included in other management groups.

MANAGEMENT GROUP 5-B—STEEP SOILS AND MISCELLANEOUS LAND TYPES

Soils of management group 5–B are steep, shallow, or very coarse-textured. All of them are deficient in phosphorus, and many are low in lime. Even fair pastures cannot be produced without heavy applications of one, or both, of these amendments. The mechanical difficulties of applying such materials are very great.

Although they are poorly suited to pasture, large areas of these soils are in poor permanent pasture that furnishes little feed for cattle and provides little cover for the land. Because pasture sods

are thin, large areas of these soils are eroding seriously and becoming poorer.

Generally these soils are best used for forest, and most of the cleared areas should revert to forest. Where grazing is stopped, natural seeding from nearby woodlands will soon cover many of these soils with young trees. Where erosion is severe, and on some of the shallow or coarse-textured soils, planting of trees may be necessary. On such sites some soil preparation may be required. Mulches to hold moisture and to prevent soil washing will help insure survival of seedlings. Some fertilizer may be needed on the coarse-textured or severely eroded soils to obtain good growth of the young trees.

SOIL PRODUCTIVITY UNDER DIFFERENT SYSTEMS OF MANAGEMENT

Table 10 at the end of this report gives the long-term acre yields a farmer can expect from the soils of Livingston County. For most soils, three lines of yields are shown—A, B, and C. These three lines give yields that can be expected when lime and fertilizer are applied at levels A, B, and C, as shown in table 9. For all three levels of liming and fertilizing, it is assumed that tillage and other operations are accomplished as needed, and that reasonable care is taken to prevent excessive erosion and to maintain organic matter. Nevertheless, farmers who apply lime and fetrilizer at level C probably exercise more care in tillage, erosion control, and maintenance of organic matter than those who fertilize and lime at level B. Likewise, those using amendments at the B level are likely more careful in these respects than those at A level. In short, even though the differences in yield are shown as primarily the result of differences in liming and fertilization, these differences probably reflect some differences in supporting practices also.

For some soils, yields are not shown for the C level of liming and fertilizing. These are mostly soils that have poor drainage, stoniness, steep slope, coarse texture, or other features so unfavorable to plant growth that little or no response would be expected if additional lime and fertilizer were applied.

The estimates in the yield table are based on the following sources:

(1) Four-year average yields of corn, oats, wheat, and field beans on Honeoye, Lima, Ontario, and Odessa soils in Livingston, and Ontario Counties, as reported by farmers.

(2) Eleven-year average yields of corn, mixed hay, and wheat and five-year average yields of oats under five fertility levels, all on Mardin and Volusia soils in an experiment on Mount Pleasant near Ithaca, N. Y.

(3) Ten-year average yields of potatoes, cabbage, corn, wheat, oats, peas, alfalfa, timothy hay, and red clover-timothy hay under each of two fertility levels on Palmyragravelly loam at Tully, N. Y.

(4) Four-year average yields of sweet corn, seven-year average yields of peas, eleven-year average yields of cabbage, and twelve-year average yields of tomatoes under three fertility levels on Honeoye and Ovid silt loams at Geneva, N. Y.

(5) Comparisons of yields farmers have obtained on slopes of 0 to 3 percent, 3 to 8 percent, and 8 to 15 percent on Honeoye, Ontario, Lansing, Cayuga, Lima, Ovid, Conesus, and Fredon soils in Livingston County. Yields from 220 fields were compared.

Yields for soils not studied in experiments or records were obtained by inference. It was first considered how the soils not studied were like or different from those that were studied. Then, after taking into account how these similarities or differences would influence productivity, yields were estimated for the soils not studied.

A farmer can use table 9 and table 10 in deciding what management he should use for a soil on his farm. Suppose he consults the soil map and finds that most of his cropland is Bath channery silt loam, rolling phase. Then suppose he wants to know what management practices are needed for this soil. First he will note in table 9 that Bath channery silt loam is in management group 2–B. He will see in column 4 that any one of 4 rotations is suitable for this soil. Suppose he is a dairy farmer and selects the second of the 4 rotations, which is 1 year of row crop, 2 years of a close-growing crop, and 1 year of hay. He will then note in column 5 that terraces spaced not more than 600 feet apart, with cross-slope tillage and strip-cropping, are needed to control erosion and conserve moisture. He will note from column 6 that 6 to 12 tons of manure an acre per rotation is needed to maintain organic matter. Then, in column 3, he will note the relative amounts of lime and fertilizer needed at 3 levels. By referring to table 8 and by reading the text in the management section, he can determine the amounts, in pounds, of nitrogen, phosphorus and potassium, needed for different crops, and the tons of lime per rotation at these levels.

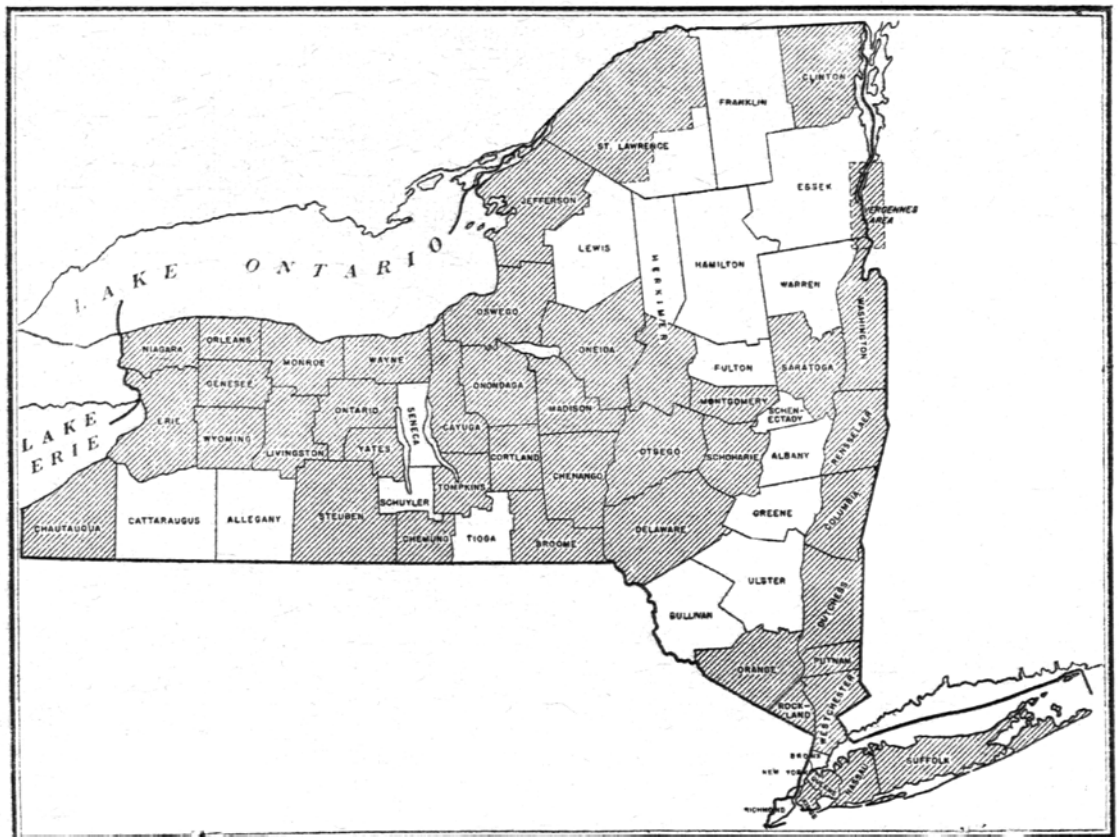
Suppose then that the farmer wants to decide whether "medium" or "high" levels of fertilizing and liming will give the greatest returns. He will find from table 10 that at "high" levels he can obtain 2 more tons of corn silage, 2 more bushels of oats, 5 more bushels of wheat and only an additional 0.1 ton of hay per acre. He can then decide if the added yields will pay for the extra amendments.

Another farmer, having the same soil on a potato farm, would select the first rotation in column 4, table 9. He would note that practices needed to control erosion and to maintain organic matter on a potato farm are somewhat different from those needed on the dairy farm. Again, by referring to table 8 and the text, he can find the amounts of fertilizer and lime needed at the three levels. From table 10 he learns that he can obtain an additional 95 bushels of potatoes an acre per year, or 190 bushels per rotation, by using "high," or C, levels of fertilization. He can then determine if the extra fertilizer will pay.

Thus we can see that the amount of lime and fertilizer a farmer can afford to apply and the supporting practices that he can use differ from farm to farm. His own interests, needs, and resources, the costs of the things he buys, and the prices he receives for the things he sells help to determine the practices he can profitably use. Nevertheless, by studying the long-time average yields, along with the soil management section of this report, a farmer can judge which level of fertilizing and liming will be best for his soils under a given rotation, over the period of years required to carry out the rotation.

U. S. GOVERNMENT PRINTING OFFICE: 1956

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.
Price $3


LAKE ONTARIO
LAKE ERIE
CLINTON
FRANKLIN
ST. LAWRENCE
ESSEX
JEFFERSON
LEWIS
HERKIMER
HAMILTON
WARREN
WASHINGTON
OSWEGO
ONEIDA
FULTON
SARATOGA
NIAGARA
ORLEANS
MONROE
WAYNE
GENESEE
ONONDAGA
MADISON
MONTGOMERY
SCHENECTADY
ERIE
WYOMING
ONTARIO
SENECA
CAYUGA
LIVINGSTON
YATES
CORTLAND
OTSEGO
SCHOHARIE
ALBANY
RENSSELAER
CHENANGO
TOMPKINS
SCHUYLER
GREENE
COLUMBIA
CHAUTAUQUA
CATTARAUGUS
ALLEGANY
STEUBEN
CHEMUNG
TIOGA
BROOME
DELAWARE
ULSTER
DUTCHESS
GULLIVAN
ORANGE
PUTNAM
ROCKLAND
WESTCHESTER
BRONX
NEW YORK
RICHMOND
NASSAU
SUFFOLK

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.