

# SOIL SURVEY

---

## **Dutchess County New York**

---



Series 1939, No. 23

Issued December 1955

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

# How to Use THE SOIL SURVEY REPORT

---

**F**ARMERS who have worked with their soils for a long time know about soil differences on their own farms, and perhaps about differences among soils on the farms of their immediate neighbors. What they do not know, unless a soil survey has been made, is how nearly their soils are like those on experiment stations or other farms, either in their State or other States, where farmers have gained experience with new or different farming practices or enterprises. Farmers of Dutchess County can avoid some of the risk and uncertainty involved in trying new crops and soil management practices by using this soil survey report, for it maps and describes the soils in their county and therefore allows them to compare the soils on their farms with soils on which new developments have proved successful.

## SOILS OF A PARTICULAR FARM

All the soils in Dutchess County are shown on the map that accompanies this report. To learn what soils are on a farm (or any tract of land) it is first necessary to locate it on the map. To do this find the general locality of the farm and then use roads, streams, villages, dwellings, and other landmarks to locate its boundaries. Remember that an inch on the map equals half a mile on the ground.

The next step is to identify the soils on the farm. Suppose, for instance, one finds on a farm an area marked with the symbol Bp. Look at the Color Grouping and Legend on the map and find Bp. This symbol identifies a soil—Boynton gravelly silt loam. All areas of this soil, wherever they occur on the map, will have the same symbol and the same color.

What is Boynton gravelly silt loam like, for what is it used, and to what uses is it suited? For this information turn to the section on Descriptions of Soil Units. How productive is this soil? The answer will be found in table 8. Find in the left-hand column of this table Boynton gravelly silt loam and read, in the columns opposite, the yields of different crops it can be expected to produce. Compare these yields

with those given in the table for other soils of the county.

What uses and management practices are recommended for Boynton gravelly silt loam? For this information read what is said about this soil in the section on Descriptions of Soil Units. Refer also to the section on Soil Use, Management, and Productivity, in which soils suited to about the same management are grouped together. It will be found that Boynton gravelly silt loam is in management group 3E. What is said about crops, crop rotations, liming, fertilizing, drainage, erosion control, and other management practices for soils of group 3E will apply to Boynton gravelly silt loam.

## SOILS OF THE COUNTY AS A WHOLE

A general idea of the soils of the county is given in the introductory part of the section on The Soils of Dutchess County, which tells about the principal kinds of soils, where they are found, and how they are related. At the same time 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 to be associated with well-recognized differences in type of farming, land use, and land use problems.

A newcomer to the county, especially if he considers purchasing 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 and conditions of farm tenure, including tenancy; kinds of farm buildings, equipment, and machinery; availability of churches, schools, roads, railroads, telephone and electric services, and water supplies; the industries of the county; and the cities, villages, and population characteristics. Information on all of these will be found in the section on General Nature of the Area and in the section on Agriculture.

Those interested in how the soils of the county were formed and how they are related to the great soil groups of the world should read the section on Morphology and Genesis of Soils.

This publication on the soil survey of Dutchess County, N. Y., is a cooperative contribution from the—

SOIL CONSERVATION SERVICE  
and the  
CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

# SOIL SURVEY OF DUTCHESS COUNTY, NEW YORK

By **WILBER SECOR**, in Charge, **L. F. KOEHLER**, **D. F. KINSMAN**, and **W. E. BENSON**, Cornell University Agricultural Experiment Station, and **M. G. CLINE**, **W. J. MORAN**, **R. G. LEIGHTY**, **G. A. JOHNSGARD**, and **I. L. MARTIN**, **H. L. DONNER**, **J. S. HARDESTY**, **J. D. RUFFNER**, **J. D. SHEETZ**, and **L. P. KELSEY**, Soil Survey,<sup>1</sup> United States Department of Agriculture

Area inspected by **W. J. LATIMER**, Soil Scientist, United States Department of Agriculture  
 United States Department of Agriculture in cooperation with the Cornell University  
 Agricultural Experiment Station

## CONTENTS

	Page		Page
General nature of the area.....	4	The soils of Dutchess County—	
Location and extent.....	4	Continued	
Physiography, relief, and drainage.....	4	Soil series and their relations—	
Climate.....	7	Continued	
Water supply.....	8	Soils from limestone.....	30
Vegetation.....	8	Soils developed from lake-laid sediments.....	30
Organization and population..	10	Soils from calcareous silt and clay.....	30
Industries.....	11	Soils from sand and gravel over clay.....	30
Transportation facilities.....	12	Soils derived from recent alluvium.....	31
Social facilities and farm improvements.....	13	Soils from acid material..	31
Agriculture.....	13	Soils from neutral or alkaline material.....	31
Agricultural history.....	13	Soils developed from organic material.....	32
Crops.....	14	Descriptions of soil units.....	32
Agricultural practices.....	16	Albia gravelly silt loam:	
Pasture.....	17	Gently sloping phase.....	32
Livestock and livestock products.....	17	Sloping phase.....	37
Types of farms.....	19	Alluvial soils, undifferentiated.....	38
Land use and farm tenure.....	19	Amenia silt loam.....	38
Farm equipment.....	20	Atherton silt loam.....	39
Soil survey methods and definitions.....	21	Bernardston gravelly silt loam:	
The soils of Dutchess County...	22	Sloping phase.....	39
Soil series and their relations..	23	Moderately steep phase..	40
Soils developed from glacial till and weathered rock..	23	Eroded moderately steep phase.....	41
Soils from schist.....	26	Boynton gravelly silt loam..	42
Soils from granite and gneiss.....	26	Braceville, Hero, and Phelps silt loams, undifferentiated.....	43
Soils from acid shale and slate.....	27	Carlisle muck.....	44
Soils from calcareous sandstone and slate.....	27	Chagrin silt loam.....	44
Soils from limestone and slate.....	28	Chagrin gravelly loam, alluvial fan phase.....	45
Soils from limestone.....	28	Charlton gravelly loam:	
Soils developed from glacial outwash.....	28	Undulating and sloping phases.....	46
Soils from granite and gneiss.....	29	Moderately steep phase..	47
Soils from acid shale and slate.....	29	Steep phase.....	48
Soils from calcareous sandstone, limestone, and slate.....	29	Charlton stony loam, moderately steep phase.....	48

<sup>1</sup> Field work for this survey was done and the manuscript prepared while the Division of Soil Survey was a part of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration.

	Page		Page
The soils of Dutchess County—		The soils of Dutchess County—	
Continued		Continued	
Descriptions of soil units—		Descriptions of soil units—	
Continued		Continued	
Chatfield stony loam:		Hoosic gravelly loam:	
Ledgy rolling phase.....	49	Nearly level and undu-	
Ledgy hilly phase.....	50	lating phases.....	80
Claverack gravelly loam...	50	Rolling phase.....	81
Colonie fine sandy loam:		Hilly phase.....	82
Nearly level phase.....	51	Steep phase.....	83
Rolling phase.....	52	Hoosic gravelly sandy loam,	
Hilly and steep phases..	53	nearly level and undu-	
Copake fine sandy loam,		lating phases.....	83
nearly level and undulat-		Hoosic loam, nearly level	
ing phases.....	53	and undulating phases...	84
Copake gravelly loam:		Housatonic silt loam.....	85
Nearly level and undu-		Hudson fine sandy loam,	
lating phases.....	54	gently sloping phase....	86
Rolling phase.....	55	Hudson silt loam:	
Hilly phase.....	56	Gently sloping phase....	87
Steep phase.....	57	Hilly phase.....	88
Cossayuna fine sandy loam,		Rolling phase.....	89
undulating and rolling		Hudson silty clay loam:	
phases.....	57	Gently sloping phase....	89
Cossayuna gravelly loam:		Eroded rolling phase....	90
Undulating and rolling		Hilly phase.....	91
phases.....	58	Steep phase.....	92
Eroded undulating and		Kendaia silt loam.....	92
rolling phases.....	60	Livingston silty clay loam..	93
Hilly phase.....	61	Lyons silt loam.....	93
Eroded hilly phase....	62	Madalin silt loam.....	94
Cossayuna stony silt loam:		Madalin silty clay loam...	95
Rolling phase.....	63	Made land.....	95
Hilly phase.....	64	Mansfield silt loam.....	96
Dover fine sandy loam:		Merrimac gravelly fine sandy	
Rolling phase.....	64	loam, nearly level and	
Hilly phase.....	65	undulating phases....	96
Ledgy rolling phase....	66	Merrimac gravelly sandy	
Ledgy hilly phase....	67	loam, hilly phase.....	97
Ledgy steep phase.....	67	Muck:	
Dutchess gravelly silt loam:		Acid deep phase.....	98
Undulating and rolling		Acid shallow phase....	98
phases.....	68	Nassau-Cossayuna gravelly	
Eroded undulating and		loams:	
rolling phases.....	69	Undulating and rolling	
Hilly phase.....	70	phases.....	99
Eroded hilly phase....	70	Eroded undulating and	
Eel and Lobdell silt loams,		rolling phases.....	101
undifferentiated.....	71	Eroded hilly phases....	101
Elmwood fine sandy loam..	72	Nassau slaty silt loam:	
Genesee fine sandy loam...	73	Undulating and rolling	
Gloucester gravelly loam:		phases.....	102
Rolling phase.....	74	Eroded undulating and	
Hilly phase.....	75	rolling phases.....	103
Steep phase.....	76	Ledgy undulating and roll-	
Gloucester stony loam:		ing phases.....	104
Rolling phase.....	76	Ledgy hilly phase.....	104
Hilly phase.....	77	Ondawa gravelly loam, al-	
Steep phase.....	77	luvial fan phase.....	105
Hollis channery loam:		Palmyra gravelly loam:	
Rolling phase.....	77	Nearly level and undulat-	
Eroded rolling phase....	78	ing phases.....	105
Eroded hilly phase....	79	Hilly phase.....	106
Ledgy hilly phase....	79	Steep phase.....	107
Hoosic fine sandy loam,			
nearly level and undu-			
lating phases.....	79		

Page	The soils of Dutchess County—	Page	The soils of Dutchess County—	
	Continued		Continued	
	Descriptions of soil units—		Descriptions of soil units—	
	Continued		Continued	
	Pawlet silt loam.....	107	Troy gravelly loam—Con.	
	Paxton gravelly loam:		Eroded moderately steep	
	Gently sloping and slop-		phase.....	130
	ing phases.....	108	Steep phase.....	130
	Moderately steep phase..	110	Urban land, undifferentiated..	131
	Pittsfield gravelly loam:		Wassaic gravelly loam:	
	Sloping phase.....	110	Rolling phase.....	131
	Moderately steep phase..	111	Hilly phase.....	132
	Pittsfield-Wassaic gravelly		Ledgy rolling phase.....	132
	loams:		Ledgy hilly phase.....	133
	Undulating and rolling		Wayland silt loam.....	133
	phases.....	112	Whitman stony silt loam..	134
	Hilly phases.....	113	Woodbridge silt loam.....	134
	Stony and ledgy rolling		Soil use, management, and pro-	
	phases.....	113	ductivity.....	136
	Stony and ledgy hilly		Soil quality and management..	136
	phases.....	114	Group 1.—Good to excellent	
	Pittstown gravelly silt loam,		soils for crops, pasture, or	
	nearly level and gently		forest.....	148
	sloping phases.....	114	Group 2.—Fair to good soils	
	Poultney loam.....	116	for crops; good to excel-	
	Poultney silt loam.....	116	lent soils for pasture or	
	Red Hook silt loam.....	117	forest.....	150
	Rhinebeck silt loam.....	118	Group 3.—Poor to fair soils	
	Rhinebeck silty clay loam..	119	for crops; poor to good soils	
	Rough stony land (Gloucester,		for pasture; fair to good	
	Hollis, and Chat-		soils for forest.....	153
	field soil materials).....	120	Group 4.—Very poor soils	
	Saco silty clay loam.....	120	for crops; fair to good soils	
	Staatsburg gravelly loam:		for pasture; fair to good	
	Ledgy undulating and roll-		soils for forest.....	156
	ing phases.....	121	Group 5.—Very poor soils	
	Very ledgy rolling phase..	122	for crops or pasture; poor	
	Very ledgy hilly phase....	122	to good soils for forest....	157
	Steep ledgy land:		Group 6.—Land types un-	
	Nassau soil material.....	122	suited to crops, pasture,	
	Wassaic and Staatsburg		or forest.....	158
	soil materials.....	122	Estimated yields.....	158
	Stissing gravelly silt loam..	123	Soil associations.....	158
	Stockbridge gravelly loam:		Associations dominated by	
	Gently sloping and sloping		good cropland.....	159
	phases.....	124	Associations dominated by fair	
	Moderately steep phase..	125	cropland and land better	
	Eroded moderately steep		suited to pasture than to	
	phase.....	125	crops.....	168
	Stockbridge stony loam,		Associations dominated by land	
	sloping phase.....	126	better suited to pasture than	
	Tidal marsh, fresh-water		to crops.....	170
	phase.....	127	Associations dominated by	
	Troy gravelly loam:		land best suited to forest..	170
	Gently sloping phase.....	127	Morphology and genesis of soils..	171
	Sloping phase.....	127	Literature cited.....	178
	Moderately steep phase..	129		

TABLES

Table 1.—Normal monthly, seasonal, and annual temperature and precipitation at Poughkeepsie, Dutchess County, N. Y. (p. 9).

Table 2.—Acreage of the principal crops and number of fruit trees and grapevines of bearing age in Dutchess County, N. Y., in stated years (p. 14).

Table 3.—Number of livestock on farms of Dutchess County, N. Y., in stated years (p. 18).

Table 4.—Relations among the soil series of Dutchess County, N. Y. (p. 24).

Table 5.—Approximate acreage, proportionate extent, and use of soils of Dutchess County, N. Y. (p. 33).

Table 6.—Mechanical analysis of Troy gravelly loam, sloping phase (p. 128).

Table 7.—Quality, management needs, and suitability of selected crops for the soils of Dutchess County, N. Y. (p. 138).

Table 8.—Estimated acre yields of principal crops under common and good management practices on the soils of Dutchess County, N. Y. (p. 160).

Table 9.—General quality of soil associations and relative percentages of soils of different quality in each (p. 165).

Table 10.—Catenas and natural classification of soil series in Dutchess County, N. Y. (p. 174).

---

**A**GRICULTURE and manufacturing are both important in Dutchess County. Dairying is the leading agricultural enterprise; poultry raising and fruit growing are also important. The principal field crops are those needed on dairy farms—hay, corn, and oats. The chief fruits are apples, peaches, and pears, most of which are marketed outside the county. Much of the land is occupied by summer camps, homes, resorts, large estates, and parks. Tools, machinery, woolen and leather goods, clothing, millinery, cough drops, and wood products are manufactured. To provide a basis for the best agricultural use of the land, a cooperative soil survey was made in 1939 by the United States Department of Agriculture and the Cornell University Agricultural Experiment Station. This report sets forth the findings of the survey. Unless otherwise specifically mentioned, all statements pertain to conditions in the county at the time of survey.

## GENERAL NATURE OF THE AREA

### LOCATION AND EXTENT

Dutchess County, covering a land area of about 816 square miles, is situated in southeastern New York, between the Hudson River and the State of Connecticut (fig. 1). The New York-Connecticut State line forms its eastern boundary, the Hudson River its western, Putnam County its southern, and Columbia County its northern. The New York-Massachusetts State line is its extreme northeastern boundary for less than a mile. The county lies midway between New York City and Albany, the State capital. Poughkeepsie, the county seat, in the western part of the county along the Hudson River, is 65 miles north of New York City and 65 miles south of Albany.

### PHYSIOGRAPHY, RELIEF, AND DRAINAGE

Dutchess County lies in the Hudson Valley of New York State. This valley, looked upon in a broad way, is a depression lying between the western highlands of New England and the eastern highlands of New York. It is a northern extension of the Great Appalachian Valley of the Ridge and Valley province (3).<sup>1a</sup> Toward the southern and eastern parts the relief is somewhat changed by such elevated masses as the Hudson Highlands and the Housatonic Mountains of New England. Thus, the county possesses an uneven or diversified

<sup>1a</sup> Italic numbers in parentheses refer to Literature Cited, p. 178.

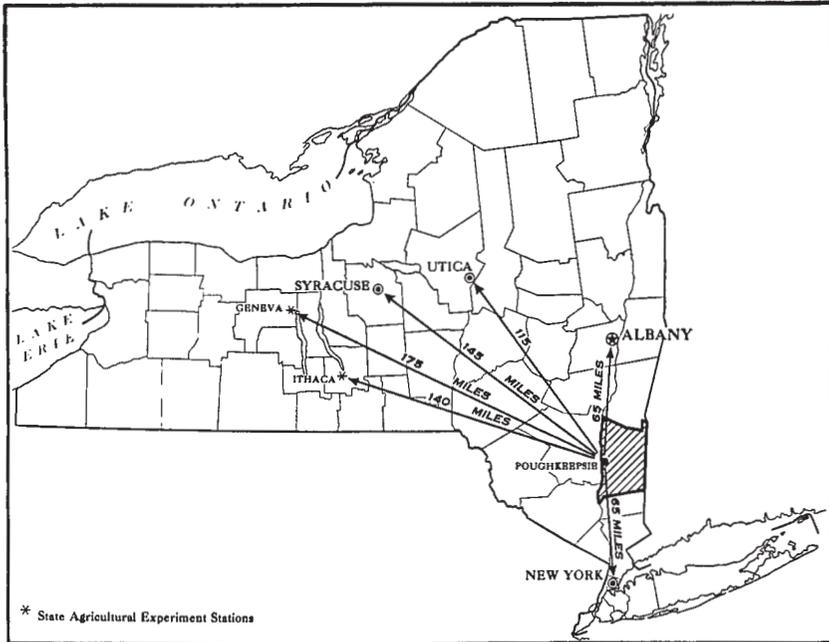


FIGURE 1.—Location of Dutchess County in New York.

surface and does not have large level or undulating areas. Hills and ridges of varying elevations are common; some are more than 1,000 feet in height, rugged and mountainous, and cut by a number of troughlike valleys. The topography was modified to some extent by glaciation; evidence of this is the rounded or smooth contour characteristic of the hills, ridges, and even the mountains. Preglacial and postglacial erosion also caused some modification.

The Hudson River lies at tidewater level and has practically no flood plain. It really occupies a gorge, for the bluff between it and the Hudson lowland, which lies to the east, is comparatively steep and broken. The height (or level) of the terraces or lowlands above the river varies from 100 to 200 feet. The terraces are eroded to some extent and are marked by rocky or stony knolls and ridges ranging from 25 to 300 feet in height. The lowland forms a belt of varying width that follows the river all the way through the county. On this lowland are such important cities and villages as Poughkeepsie, Beacon, Wappingers Falls, Hyde Park, Rhinebeck, and Red Hook. The lowland is widest at Red Hook (slightly more than 5 miles) and tapers to a point in the extreme southern part of the county.

To the east of the lowland the relief becomes increasingly more rugged. Hills or ridges rise from the edge of the lowland to an average elevation of 500 feet above sea level; some are higher. A broad area of rough broken country with occasional well rounded hills extends from Hyde Park, Pleasant Valley, and La Grange north through the central part of the county to and beyond the county line. East of this rough area, the hills are more smoothed and rounded and often of drumloid shape. This smoothed area, which has undergone marked

glaciation, extends diagonally in a gradually widening belt from Pine Plains in the northeast to Fishkill and East Fishkill in the southwest. In the southeastern part of the county, the hills gradually increase in elevation to 1,200 feet or more.

The mountainous part of the county lies along the southern and eastern boundaries. The northern extension of the Hudson Highlands begins at the extreme southwestern corner of the county. At this point Breakneck Ridge rises abruptly from the Hudson River as a bold promontory and extends northeast from the river in Putnam County. South Beacon Mountain, the highest point, has an elevation of 1,635 feet.<sup>2</sup> The mountains in the area of Fishkill extend in a northeast-southwest direction, break into precipitous cliffs or steep slopes on their southern sides, and are comparatively smooth, though steep, on their northern slopes. These mountains extend eastward along the southern boundary of the county into the town of Pawling. They become less rugged to the east, and are replaced to the north by a high broad ridge, known in part as Chestnut Ridge. The eastern sides of Chestnut Ridge are steep and, in many places, precipitous.

Brace Mountain, a part of the rugged mountain ridges extending north from Tenmile River along the eastern border to the Massachusetts-New York State line, rises about 2,340 feet above sea level and is the highest point in the county. South of the Tenmile River and along the State line, the topography consists of a high, broad, smoothly rolling glaciated ridge that rises more than 1,000 feet and is locally known as Quaker Hill.

Two main valleys within the county extend from northeast to southwest: the valley of Wappinger Creek stretches from the northern boundary near Pine Plains southwest to the Hudson River at New Hamburg; the valley of Fishkill Creek, with tributary valleys, makes up the most extensive valley area. The well-defined valley paralleling the eastern boundary of the county and drained by Tenmile River and its tributaries is the third main valley. This last-mentioned valley, known locally as the Pawling Valley, Dover Valley, or Harlem Valley, runs the entire length of the county and is only a few miles from its eastern boundary.

Several smaller valleys, probably preglacial, extend in a northeast-southwest direction. They are drained by the smaller streams. Extending from the city of Poughkeepsie northeastward to the county line is an irregular small valley drained by several small streams. All these valleys are characterized by flat gravelly terraces that lie contiguous to the stream courses and are for the most part continuous but irregularly shaped.

The county is drained by a number of important creeks and their numerous tributaries. The larger creeks flowing southwestward into the Hudson River are Fishkill, Wappinger, Fallkill, Crum Elbow, Little Wappinger, Landsman Kill, Fallsburg, Stony, and Sprout. Roecliff Jansen Kill, which barely enters the northern part of Pine Plains and Milan Towns, drains a small area of the north-central part of the county and flows northwestward through Columbia County to the Hudson. Drainage of the eastern part of the county flows into the Tenmile River and its tributaries—Webatuck Creek from the north and the Swamp River from the south—and then into the

---

<sup>2</sup> Elevations from U. S. Geological Survey topographic maps.

Housatonic River in Connecticut. An area southwest of Pawling is drained by small streams, tributaries to the Croton and East Croton Rivers. Most of the streams are swift and have rocky floors, numerous rapids, and a few falls. The Swamp River, probably the most sluggish of all the streams, meanders for about 8 miles through swamps from the southern tip of Corbin Hill northward to Dover Furnace.

A number of small lakes and ponds are the sources of the larger streams. Their drainage has been obstructed by glacial action or artificial damming. The principal ones are Whaley Lake, Stissing Pond, Indian Pond, Sylvan Lake, and Rudd Pond. Dams have been built along Wappinger and Fishkill Creeks to store water for power.

### CLIMATE

Dutchess County is about 70 miles from the Atlantic Ocean, but the western edge along the Hudson River lies at tide level. The climate, however, is more continental than oceanic, for the prevailing wind is from the continent to the ocean. The climate is characterized by moderately cold winters and warm humid summers.

The average summer and winter temperatures are 71.2° F. and 27.7°, respectively. The absolute maximum recorded is 103°; the absolute minimum, -21°; and the extreme range, 124°. The highest temperatures occur during July and August, and the lowest during January and February. Long periods of subzero weather in winter are not common; minimums below -20° seldom occur. Temperatures above 90° are common during July and August and are usually accompanied by a high relative humidity, which contributes to a hot, moist summer climate, especially in the Hudson Valley lowlands.

The length of the growing season ranges from 150 to 167 days; it is just as long in the interior valleys as it is along the Hudson River. Frosts have occurred later in spring and earlier in fall along the Hudson River than they have at Honeymead Brook in the north-central part of the county.

At Rhinebeck the average date of the last killing frost in spring is May 3, but frost has occurred as late as May 26. In fall, the average date of the first severe frost is October 5, but the earliest reported was on September 11.

Late spring frosts are more serious than early fall frosts, for they injure fruit buds. Such damaging frosts, however, are not frequent in Dutchess County. Winter injury resulting from excessively low temperatures also is rare.

The pasture period begins about April 15 in the Hudson valley lowlands and in the interior valleys and 2 to 3 weeks later at the higher elevations. In fall, little pasturage is available after October 15.

The yearly precipitation is well distributed. About half of it falls during the growing season, or from May 1 to September 30. Most of the rainfall comes as steady rains, but 20 or 30 thunderstorms a year occur in the Hudson Valley. The annual precipitation ranges from 30 to 40 inches in the northern part of the county, and from 40 to 50 inches in the southern. At Wappingers Falls, the average yearly precipitation is 45.12 inches; at Red Hook, 38.41 inches; at Honeymead Brook, 42.92 inches; and at Poughkeepsie, 39.23 inches. Annual precipitation throughout the western part of the county is somewhat higher than it is in the northern part of the Hudson Valley.

Boyd Corners, in Putnam County, has 49.55 inches of precipitation annually, which is about the same as the amount received along the Harlem River in Dutchess County.

It is generally believed that the tempering influence of the Hudson River has made possible the successful growing of apples, peaches, pears, and other fruits in a belt several miles wide along the river. These fruits are grown also at higher altitudes farther from the river, but success is much less certain because there is greater danger of extreme cold in winter and of late killing frosts in spring.

Winter loss of or injury to crops, especially hay crops, is most noticeable on the imperfectly and poorly drained soils of the county. On these freezing and consequent heaving break off the lower plant roots and force the rest of the plant above ground. This damage is noted most often with the leguminous crops (alfalfa and clovers) and to some extent with the minor grain crops (wheat and rye). The practice of rolling the land after the last frost in spring frequently reduces losses resulting from frost heaving.

The general direction of the wind is from the west or northwest. Wind seldom reaches a velocity high enough to cause serious losses of fruits. The average annual sunshine is 56 to 58 percent of the total possible. The percentage of sunshine is highest during the growing season. The relative humidity is highest during summer. The average annual relative humidity ranges from 74 to 78 percent in the county. Tornadoes or hurricanes occur infrequently. Perhaps the most severe hurricane occurred in 1938; it did considerable damage to property, crops, and forests.

Table 1 gives the normal monthly, seasonal, and annual temperature and precipitation for the county.

#### WATER SUPPLY

Water for the smaller villages is piped from local reservoirs. Poughkeepsie pumps its water from the Hudson River and filters it; Beacon Reservoir is in the mountains near Fishkill Creek. Most farm houses obtain water from wells, cisterns, or springs on the farm. In 1945, 85 percent of the farms had water piped into the house, and many had drilled wells.

The lakes in the more mountainous parts are used for recreational purposes in summer. Many people from New York City and the adjacent metropolitan area have summer homes near the lakes. The most important lakes and ponds are Whaley Lake, Sylvan Lake, Green Mountain Lake, Rudd Pond, Sharparoon Pond, Ellis Pond, and Spring Lakes. Some summer cottages have been built along Wappinger and Fishkill Creeks. Several private summer camps are located in the county.

#### VEGETATION

The predominant forest associations, or types, present in the county are (1) beech-maple-hemlock and (2) the oak (7). The trees present in the oak association are mockernut, pignut, and shagbark hickories, flowering dogwood, tuliptree, white mulberry, hophornbeam, wild and black cherry, American mountain-ash, white, scarlet, yellow, chestnut, red, post, and black oaks, sassafras, and basswood.

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

[Elevation, 103 feet]

Month	Temperature <sup>1</sup>			Precipitation <sup>2</sup>			
	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.....	30.0	66	-14	2.79	2.64	3.81	6.9
January.....	26.4	67	-20	3.00	2.17	4.06	10.9
February.....	26.6	57	-21	2.66	2.22	3.50	15.7
Winter.....	27.7	67	-21	8.45	7.03	11.37	33.5
March.....	36.3	76	-7	3.10	.95	1.89	6.7
April.....	48.8	91	10	2.83	.78	4.77	1.6
May.....	59.7	95	26	3.57	1.64	7.49	( <sup>3</sup> )
Spring.....	48.3	95	-7	9.50	3.37	14.15	8.3
June.....	68.5	99	36	3.44	4.80	5.82	0
July.....	73.4	103	40	4.26	5.01	10.77	0
August.....	71.6	101	37	3.98	2.39	5.73	0
Summer.....	71.2	103	36	11.68	12.20	22.32	0
September.....	63.9	101	30	3.24	.87	5.60	0
October.....	52.3	90	18	3.08	1.78	2.40	0
November.....	41.2	75	5	3.28	1.92	4.41	1.7
Fall.....	52.5	101	5	9.60	4.57	12.41	1.7
Year.....	49.9	103	-21	39.23	<sup>4</sup> 27.17	<sup>5</sup> 60.25	43.5

<sup>1</sup> Average temperature based on a 51-year record, 1901 to 1951; highest and lowest temperatures from 13-year record, 1918 to 1930.

<sup>2</sup> Average precipitation based on a 50-year record, 1902 to 1951; wettest and driest years based on a 29-year record, 1902 to 1930; snowfall on 11-year record, 1920 to 1930.

<sup>3</sup> Trace.

<sup>4</sup> In 1941.

<sup>5</sup> In 1945.

Some of the more common shrubs in this association are shadbush, bitersweet, witch-hazel, mountain-laurel, summer grape, northern fox grape, and huckleberry.

The trees in the beech-maple-hemlock association are sugar and red maples, white, yellow, and black birches, chestnut, flowering dogwood, beech, white ash, and basswood. Some of the more common shrubs are Juneberry, shadbush, witch-hazel, and mountain-laurel.

A third rather distinct association, the juniper association, is closely associated with the limestone regions and to a lesser extent with the calcareous sandstone region. The dominant trees of this association are redcedar and arborvitae, with some gray and white birches present. The most common shrubs are bitersweet, common barberry, sweetfern, Virginia creeper, common juniper, and sumac.

There are other forest associations of lesser importance which include elm, butternut, walnut, sweetgum, sycamore, willow, aspen, gray and paper birches, larch, and red, white, and pitch pines.

The original forest was dense and unbroken and had a tangled undergrowth. The only open areas were those made by the Indians for their villages, crops, and orchards. The first white men purchased the land from the Indians principally for lumbering and hunting. The present forest, consisting of second- and third-growth trees and forest plantations, occurs in the more mountainous areas and in farm wood lots.

The predominant grasses are Canada bluegrass, Kentucky bluegrass, fescue, and redtop. Wild white clover is common in the regions occupied by limestone and calcareous sandstone soils and on the heavy clay soils in the western part of the county. In the regions of slate and shale, schist, and crystalline rocks, poverty oatgrass, redtop, and sweet vernal are the most permanent uncultivated grasses.

### ORGANIZATION AND POPULATION

Dutchess County was first settled by the Algonquin Indians, called the Lenapes or Delawares. The Lenapes divided into several tribes, one of which was the Mohicans or River Indians, who held possession of the east side of the river under subtribal organization. These Indians were sedentary rather than nomadic. Their villages were small, seldom with more than a few inhabitants, and were usually permanent. The Indians occupied well-defined areas, as did the whites later. Areas between settlements were not inhabited, and only small areas were cleared for crops.

Since its first settlement, the county has passed through five distinct periods of development (*1*). The first was the landowner period, when Dutchess County included all of Putnam and part of Columbia Counties and was divided into 13 large tracts, or patents, owned by influential New Yorkers. The first land purchase was in 1683, but by 1714 there were only 60 householders and 445 people in the county.

The second period (the pioneer-settlement period) began with the clearing of the land by pioneers in the early 1700's and reached its peak after 1750, when settlers were permitted to buy and sell land. The settlement was by individual families. Few villages were established, and the houses were widely separated. Each farm was nearly self-sufficient, and cash crops were unknown. By the time of the American Revolution the population had reached 20,000 and was extending to all parts of the county.

The third was the grain period, during which most of the farmers raised grain for the New York markets. After the American Revolution and until 1825, times were prosperous. With the opening of the Erie Canal in 1825, the wheat farmers of the county were confronted with competition from wheat growers in western New York. This marked the beginning of the fourth period, that of dairying and industrial growth. The beef cattle industry gradually changed to dairying as a result of competition from western cattle. As soon as the railroads began to ship dairy products to New York, about 1860, the dairy industry became prominent. After 1870 industries developed rapidly in the western part of the county.

The fifth period of development was one of rapid growth of population; it coincided with the growth of dairying and manufacturing and extended from 1870 until 1930. As a result of the accelerated industrial development, the years 1920 to 1930 saw the largest increase of population of any decade. The Bureau of the Census lists the 1950 population of Dutchess County at 136,781, an increase of 16,239 since 1940.

Since 1940 there has been an increase in the total rural population. The total acreage in farm land decreased between 1940 and 1950, but the average size of farms increased. This is a continuation of the trend observed between 1930 and 1940. The automobile and improved highways have opened the county to summer and weekend residents from New York City. A considerable acreage has been purchased for summer residence or for year-round suburban residence.

Settlement of the county began and was continued in two separate sections by people of different nationalities. The Dutch from New York City and Albany made the earliest settlement in the section along the Hudson River. Pioneers of English descent, from New England, settled the valley in the eastern part contiguous to Connecticut. In general, the eastern part was settled later than the section along the Hudson, though there were isolated settlements in the eastern part at a fairly early date. A number of English Quakers from Rhode Island and Long Island settled in the eastern part about 1741, and by 1755 they had become numerous. The pioneers of English descent from Connecticut and other New England colonies settled in the county later than the Quakers.

In 1950, about 40 percent of the county population was in Poughkeepsie and Beacon, the two cities of the county. A large part is in smaller towns and villages. Poughkeepsie, in the western part of the county by the Hudson River, is the county seat and largest city (40,975 in 1950). It is an important industrial center and the site of Vassar College. Beacon, in the southwest on the Hudson, is the second largest city in the county (14,110 in 1950). Beacon is also an industrial center and, at one time, was one of the more important brick-producing cities. Other industrial towns in the county are Wappingers Falls, Pleasant Valley, and Pawling. Smaller rural towns are Red Hook, Rhinebeck, Staatsburg, and Hyde Park in the western part, Millbrook and Pine Plains in the central part, and Millerton, Amenia, and Dover Plains in Harlem Valley.

## INDUSTRIES

Lumbering was the principal early industry in the county. Farm products not sold locally were shipped by water to New York. Flour was milled in the county for local use. Mining of iron ore was important before and after the American Revolution, and small iron works were developed near Amenia, Dover, Beekman, and Fishkill. Early in the nineteenth century, woolen mills were opened in several towns, and cotton and silk mills followed. Between 1840 and 1860 several machinery works were developed. The Poughkeepsie Iron Works was established in 1848; the operators installed the first local blast furnaces and brought iron to Poughkeepsie from Sylvan Lake. The brick industry developed early in towns along the Hudson River south of Poughkeepsie and continued to be important until recently. Nearly all

of the small villages and hamlets at one time had some local industry employing 20 to 200 men. Many of these small industries, especially cotton and machine manufacturing, reached their peak between 1870 and 1880.

The principal nonfarm industries are now concentrated in the western part of the county, in Poughkeepsie, Beacon, Wappingers Falls, and Pleasant Valley. Pawling is the only industrial town in the eastern part. Manufacturing now is the principal industry. The goods manufactured include agricultural implements, machinery and tools, woolen and leather goods, wool-felt hats, clothing, millinery, cough drops, and wood products.

The great number of industrial workers furnish a local market for some of the farm products. Industry has caused shortage of farm labor at times and a demand for higher farm wages. The cash expense per farm for farm labor is much higher in this county than the average for the State.

#### TRANSPORTATION FACILITIES

Two divisions of the New York Central Railroad traverse the county from north to south; the Hudson River division in the western part follows the bank of the Hudson River, and the Harlem division passes through the Harlem Valley in the eastern part. The Hopewell branch of the New York, New Haven, and Hartford Railroad affords connections from interior points to the main lines of the New York Central Railroad. Improvement of highways and trucking facilities has resulted in abandonment of many branch railroads.

River transportation is not so important as in earlier days. Ocean transports, Hudson River passenger liners, and river barges load and unload at Poughkeepsie, the most important river port. Barges stop at Beacon and other smaller ports along the river; ferries cross from Beacon to Newburgh, from Poughkeepsie to Highland, and from Rhinecliff to Kingston.

A system of hard-surface roads connects all the towns and villages with the more important trunk highways. Truck transports operate from most parts of the county to New York City and the surrounding cities. United States Highway No. 9, crossing the western part of the county from north to south, is the main truck line between Albany and New York City. United States Highway No. 44, the main cross-county highway, extends from Poughkeepsie northeastward to the New England States.

Many farms are still located on gravel or dirt roads, but few are more than 3 or 4 miles from hard-surfaced roads. Roads are poorest in the rougher central part of the county and in the southern and eastern mountainous areas. Highways are kept open during winter months by town and county snowplows and are generally passable throughout the year. According to census releases for 1950, the average farm was 5 miles from the trading center most frequently visited, and 0.6 mile of this distance was on unimproved or dirt road. Of the 1,729 farms in 1950, 953 were on hard-surface roads, 197 on gravel, shale, or shell roads, and 433 on dirt roads.

## SOCIAL FACILITIES AND FARM IMPROVEMENTS

The public schools are divided among four supervisory districts and two city departments. Each superintendent of each supervisory district is responsible for several district schools, union free schools in villages, consolidated schools, and central rural schools. Superintendents in Beacon and Poughkeepsie are appointed by the respective boards of education.

Many one-room district schools remain in the county, but a great number have been abandoned recently in favor of central, or consolidated, schools. Bus transportation is provided for rural children. Many needed additions and improvements have been made in the county schools already existing. Several new ones have been built through Federal aid.

Some rural churches have closed in recent years, but nearly every small village has at least one active church. Several Grange organizations are located throughout the county; many of them have their own halls.

According to census reports for 1950, slightly more than 84 percent of the farms have telephones, and 96 percent have electricity. The condition of farm buildings ranges from very poor to up-to-date with modern equipment. On most farms the buildings are good. All dairy barns have to pass State sanitary requirements before the operators can ship milk to the markets. Many farms that do not have electricity or electrical equipment use other power units for milking and pumping water.

## AGRICULTURE

### AGRICULTURAL HISTORY

Indians practiced the first agriculture in Dutchess County. They cleared only a small percentage of the total area for maize, squash, beans, tobacco, some small fruits, and apples.

White men first purchased land in the county in 1683 for the purpose of hunting and trapping fur-bearing animals. Later the timber was cut, and lumber and grist mills sprang up. The early white settlers cleared land for cultivation and, after clearing, removed the larger stones from the fields to make tillage less difficult. They were farmers who produced corn, wheat, oats, flax, sheep, and cattle mainly for home use.

Wheat became the first cash crop in the western part of the county. It was sent down the Hudson River to the New York market for local use or export. In the eastern settlements, beef cattle and sheep were raised for cash income and driven to the New York City markets. The opening of the Erie Canal in 1825 began a gradual revolution in the agriculture of the county. Confronted with competition from western wheat growers, the wheat farmers gradually turned to dairying. The beef cattle growers also changed to dairying. About 1860, as soon as the new railroad systems began to carry dairy products to New York City, the dairy industry began to flourish. Before the opening of the railroads, farmers were to a large degree self sufficient; since then farming has become more specialized, with improvement in dairy herds and a decline in production of sheep and swine. The

use of refrigerator trucks in more recent years has revolutionized dairying by the introduction of up-State milk competition. Dairying is now the leading type of farming, followed by poultry raising and fruit growing.

The average size of farms has increased from 140.2 acres in 1920 to 175.7 acres in 1950. According to census reports for 1950, there are 1,729 farms in the county, which together cover 303,763 acres, or 58 percent of the county. The acreage in farms dropped from 365,637 in 1945 to 303,763 in 1950.

### CROPS

Table 2 gives the acreage of the more important farm crops for stated census years. General trends in crop production can be determined by study of this table.

TABLE 2.—*Acreage of the principal crops and number of fruit trees and grapevines of bearing age in Dutchess County, N. Y., in stated years*

Crop	1919	1929	1939	1949
Corn:	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>	<i>Acres</i>
For all purposes .....	14, 792	16, 343	16, 396	16, 973
For silage .....	9, 105	10, 663	11, 597	11, 314
For grain .....	( <sup>1</sup> )	4, 177	4, 044	5, 308
Small grains threshed or combined:				
Oats .....	10, 731	7, 049	7, 568	8, 390
Wheat .....	4, 763	867	699	1, 660
Rye .....	4, 952	432	288	157
Barley .....	207	87	122	262
Buckwheat .....	2, 274	529	119	82
Mixed grains not separated .....	193	817	857	1, 637
All hay .....	92, 458	64, 820	57, 477	58, 566
Timothy and clover, alone or mixed .....	59, 733	45, 458	33, 299	38, 685
Alfalfa .....	957	2, 845	7, 061	9, 831
Other tame hay .....	30, 235	15, 738	16, 212	8, 651
Grains cut green .....	1, 350	530	1, 719	1, 377
Annual legumes for hay .....	183	249	186	22
Potatoes for sale and home use .....	3, 514	972	714	267
Other vegetables for sale .....	923	1, 489	1, 597	1, 705
Strawberries .....	154	108	116	98
Raspberries .....	47	21	42	5
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Apple .....	284, 846	301, 311	269, 357	253, 923
Peach .....	55, 392	42, 425	34, 675	18, 065
Pear .....	41, 041	30, 743	11, 738	6, 285
Cherry .....	10, 218	4, 701	10, 263	2, 108
Plum and prune .....	9, 579	4, 771	1, 536	2, 475
Grapevines .....	116, 979	344, 030	184, 109	89, 549

<sup>1</sup> Not reported.

Shifts in crop production have been accompanied by important changes in the character of the population, a movement of farm people to industrial centers after 1920, and changes in the types of farming.

Many general farms have been replaced by dairy and poultry farms, commercial fruit farms, or truck-crop farms. Much of the least productive land has been abandoned or has been taken over by persons who do not depend on agriculture for a living.

The principal crops are those grown in support of dairying—corn, oats, and hay. The acreage of alfalfa has increased since 1919, but that of clover and timothy has decreased. Most of the hay is used locally; little has been used as grass silage. According to the county agricultural agent, alfalfa yields 2 tons an acre on the average; timothy and clover, 1½ to 2 tons; timothy alone, 1½ tons; and mixed meadow grasses, 1 to 1½ tons.

Corn, most of which is used in the county, is grown principally for silage or fodder. The acre yield for silage is 10 to 12 tons; and for grain, 40 to 45 bushels.

The acreage of small grains is controlled primarily by the need for companion crops for new hay seedings. Oats are all used locally; they are fed green or threshed and used for feed. Yields range from 30 to 35 bushels an acre. The acreage of other small grains is small. Buckwheat and rye are grown to some extent for green manure; and rye, as a winter cover crop, may help control erosion.

Next to the growing of crops needed for dairying, the production of fruit is most important. Orchards average 20 years in age; they range from 20 to 250 acres but average 70 acres in size.

The leading varieties of apples, in order of importance, and their estimated average acre yields are: MacIntosh, 200 to 250 bushels; Baldwin, 150 bushels; Cortland, 200 bushels; Delicious, 175 bushels; Northern Spy, 175 bushels; Rhode Island Greening, 200 bushels; and Rome Beauty, 175 bushels. Other varieties are Wealthy, Dutchess, Yellow Newtown, Stayman Winesap, Northwestern Greening, and Ben Davis.

The principal insects injurious to apple orchards are the apple maggot, codling moth, and the roseleaf beetle. Lime-sulfur and bordeaux sprays are most commonly used for control, though some orchardists dust.

About 95 percent of the apples produced are marketed outside of the county by truck peddlers and by commercial dealers in New York City, Boston, and Philadelphia. Approximately 50 percent are marketed between August and December, or during the harvest period; the rest are stored and marketed between December and May. Of those in storage, approximately 15 percent are stored in New York City; the rest are stored locally in private or commercial storage plants.

Other commercial orchards produce peaches, pears, and cherries. The peach varieties, in order of importance, are Elberta, Halehaven, South Haven, Golden Jubilee, and Early Crawford; the pear varieties include Kieffer, Bartlett, Clapp Favorite, Seckel, and Beurr Bosc; and the cherry varieties are Early Richmond and Montmorancy (sour) and Black Tartarian, Schmidt, and Windsor (sweet). Of these fruits, about 15 percent are marketed within the county; the rest are shipped by truck to New York City. The county has no commercial canning factories.

Small fruits include grapes, raspberries, and strawberries. Concord, Worden, Delaware, and Niagara are the principal grape

varieties; Latham and Newburgh, the raspberry; and Catskill, Dorsett, and Howard 17 (Premier), the strawberry.

Most of the vegetables are grown in the western part of the county, and their acreage is increasing. Potatoes (Irish Cobbler, Green Mountain, and Russet), sweet corn, string beans, cabbage, tomatoes, and squash are the leading vegetables grown. Potatoes average 90 bushels an acre and most of them are marketed locally. Tomatoes, sweet corn, string beans, cabbage, and squash are trucked to New York City markets.

#### AGRICULTURAL PRACTICES

About half of the land prepared for corn, oats, and vegetables is plowed in fall, and the rest in spring. Most of the land for corn and vegetables is left fallow during late fall and in winter. The few farmers who plant cover crops use rye, which is turned under in spring as green manure. Rotations vary from 4 to 7 years, but the general length is 5 years. Corn is commonly planted 1 year, followed by 1 year of oats, and then by 3 years of hay. Corn may be planted 2 years in the rotation, and meadows, after 2 or 3 years of mowing, may be top-dressed with phosphated manure and pastured for 1 or 2 years.

In 1940, 48 percent of the farms in the county reported using commercial fertilizer, a slight increase over previous years partly caused by agricultural adjustment payments for conservation practices. The fertilizers commonly used are 5-10-5,<sup>3</sup> 5-10-10, and nitrate of soda. The most commonly purchased fertilizer is 5-10-5, which is applied to corn and grain in the rotation generally used. This mixture is used on the lighter sandy soils for corn, grain, and vegetables; nitrate of soda is used on orchards. Ammonium phosphate is used to some extent, and 20-percent phosphate is applied to new seedings and pastures. Most of the fertilizer is factory-mixed and is purchased through local fertilizer dealers.

In 1939, 38.5 percent of the farms reported the use of 13,397 tons of lime. Both ground and burnt limestone are used, but most farmers prefer ground limestone. There is a definite trend toward applying the lime farther ahead of the legume seeding used in the rotation, either on the corn stubble or on sod before it is turned under for corn. This is a change from the more common practice of applying lime before the oats seeding. From 1 to 4 tons of lime an acre are used, the application varying according to the need.

Most dairy farms produce enough manure to make the use of complete fertilizers unnecessary. The manure is supplemented with phosphates for corn and grain crops, and with lime for leguminous crops grown in areas where the soils are acid. From 8 to 10 tons of manure an acre, supplemented with 20-percent phosphate, is applied for corn; and 300 pounds of phosphate is applied for oats or other small grains grown in the 5-year rotation. Meadows are frequently top-dressed with 4 to 6 tons of manure, and a few farmers apply 150 to 200 pounds of nitrate of soda an acre to them. The quantity of commercial fertilizer used on corn and grain depends upon the crop grown and the supply of manure available for use with the fertilizer. On vegetable crops as much as 800 pounds of commercial fertilizer

<sup>3</sup> Percentages, respectively, of nitrogen, phosphoric acid, and potash.

an acre is used. Ammonium phosphate, used to some extent for corn and as a top dressing on sod, is applied at the rate of 300 pounds an acre.

Orchards receive manure if it is available. Nitrogen-carrying fertilizers such as nitrate of soda, cyanamids, and sulfate of ammonia are used where the quantity of manure is not sufficient. Nitrate of soda, applied at the rate of approximately one-fourth pound per year of age per tree, is the most commonly used. The nitrate is applied in spring before the buds open.

Approximately 2 percent of the orchard acreage is clean-cultivated; the rest is maintained under sod. The use of a nitrogen-consuming crop is recommended on clean-cultivated orchards after the buds are set, and cover crops such as rye are recommended for winter protection of the soil and tree roots. Both rye and buckwheat are used as green-manure crops in a few cultivated orchards.

### PASTURE

The 1950 census shows that more than 32 percent of the farm acreage is pastured and that 40 percent of the land pastured is cropland used only for pasture. The pastures are distributed throughout the county. Predominant are permanent pastures that contain mostly native grasses. Little effort is made to improve permanent pastures, though brush is occasionally removed when it becomes too thick. In areas occupied by limestone and lacustrine (lake-deposited) soils, the native pasture contains many desirable grasses, especially bluegrasses and wild white clover. Pastures on the naturally acid soils that occupy the greater part of the county are generally poor; they contain little or no bluegrass or wild white clover, but some redtop, much poverty oatgrass, and many weeds. These poor pastures could be greatly improved by adding lime and phosphate.

Interest in improving permanent pastures has increased recently, especially on the beef-cattle farms and the more progressive dairy farms. Where the pasture is too poor, it is plowed and reseeded. To get good pasture on the naturally acid soils, one must apply 1 to 2 tons of lime and 400 to 600 pounds of 20-percent superphosphate, or its equivalent, every 5 to 7 years. There is a tendency toward use of more of the better land for pasture, either as long time stands or for aftermath grazing. A few farmers control grazing, which is a desirable practice.

Many fair to good rotation pastures occur throughout the county. They generally contain some red and wild white clovers, timothy, bentgrass, redtop, and a small percentage of undesirable weeds. Pastures following meadows that have not been top-dressed usually contain more weeds. After the second or third season of cutting, meadows are pastured 1 or 2 years before being plowed for corn. After the second season of cutting, meadows are usually top-dressed with 4 to 6 tons of manure that is supplemented with superphosphate.

### LIVESTOCK AND LIVESTOCK PRODUCTS

The principal farm animals, other than work stock, are dairy and beef cattle, chickens, turkeys, hogs, and sheep. Table 3 gives the number of livestock on farms for stated years.

TABLE 3.—*Number of livestock on farms of Dutchess County, N. Y., in stated years*

Livestock	1920	1930	1940	1950
	<i>Number</i>	<i>Number</i>	<i>Number</i>	<i>Number</i>
Horses.....	9, 053	4, 858	<sup>1</sup> 3, 998	1, 745
Mules.....	242	98	<sup>1</sup> 40	29
Cattle.....	43, 076	37, 913	<sup>1</sup> 35, 311	41, 780
Sheep.....	6, 745	6, 788	<sup>2</sup> 2, 655	2, 664
Goats.....	62	144	<sup>(3)</sup>	<sup>(3)</sup>
Swine.....	14, 677	5, 794	<sup>4</sup> 2, 870	3, 894
Chickens.....	239, 263	<sup>1</sup> 212, 740	<sup>4</sup> 210, 812	<sup>4</sup> 224, 327
Other poultry.....	10, 928	9, 843	13, 064	<sup>5</sup> 2, 379
Beehives.....	2, 692	2, 180	1, 369	<sup>(3)</sup>

<sup>1</sup> Over 3 months old.<sup>2</sup> Over 6 months old.<sup>3</sup> Not reported.<sup>4</sup> Over 4 months old.<sup>5</sup> Turkeys only.

The Holstein is the prevailing breed of dairy cattle, followed by Guernsey and Jersey. There are few Ayrshires, and only one herd of Brown Swiss. Approximately 90 percent of all the dairy herds are accredited. Two dairy-herd improvement associations included 94 herds, or 2,489 cows with an average production of 9,000 pounds of milk in 1938.

Census reports for 1950 show that 168,041,048 pounds of whole milk and 45,996 pounds of butterfat were sold in 1949. The total number of milk cows on farms in 1950 was 23,422.

Most of the beef herds, mainly Aberdeen Angus, are kept by wealthy farmers. The industry was started about 25 years ago at Briarcliff Farms, and many Aberdeen Angus were then imported from Scotland. A small percentage of the beef cattle were brought in from Virginia and Maryland, but about 95 percent of the Angus cattle now kept are from the Briarcliff stock. Formerly the market was for breeding stock, but most of the beef cattle are now sold to local or New York City markets as baby beef (14 to 18 months old). Breeding stock is sold when 1 to 3 years old.

Poultry raising is one of the leading industries in the county. Most of the poultry is raised in the western part of the county and in La Grange and Pleasant Valley towns (townships). The common breeds, in order of importance, are White Leghorn, Rhode Island Red, Barred Rock, and White Rock. White Leghorns are the principal egg-producing stock; some of the good commercial flocks average 240 eggs per hen. One organized poultry-improvement association is functioning.

Census reports for 1950 show that 2,264,610 dozens of eggs and 365,436 chickens were sold in 1949. Eggs are sold in Yonkers, Tarrytown, and White Plains; chickens, to meat markets and dealers in live poultry.

There are few commercial hog farms in the county. Chester White, Berkshire, and Hampshire are the important pure breeds. The meat is marketed locally.

Most of the sheep—Southdown, Cheviot, and Shropshire breeds—are raised in the central part of the county, in East Fishkill, La Grange, Milan, Union Vale, and Rhinebeck. All mutton is sold locally. Census reports for 1950 show that 8,956 pounds of wool were shorn in 1949. Wool is shipped to Boston or sold in the county.

In 1950 there were 1,745 horses and colts on farms, or a little more than half the number reported in 1945. Most of the purebred horses are kept by owners of estates and used for breeding. Many are Percherons imported from France, Belgians from the West, and Suffolks and Clydesdales from the South. The county has a number of good stallions. Most horses on the farms are cross-breeds from the West, and few replacements are raised locally.

#### TYPES OF FARMS

According to reports for the 1950 census, there are 1,729 farms in the county, classified as follows:

	<i>Number</i>
Cash-grain.....	13
Vegetable.....	48
Fruit-and-nut.....	97
Dairy.....	770
Poultry.....	151
Livestock.....	80
General farms:	
Primarily crop.....	26
Primarily livestock.....	5
Crop and livestock.....	18
Miscellaneous and unclassified.....	521

There are many double-enterprise farms in the county—dairy-fruit, dairy-vegetable, dairy-poultry, or fruit-poultry. Dairy farms, the leading type, are distributed throughout the county but are concentrated chiefly in the limestone area along the Harlem Valley in the towns (townships) of Amenia, Northeast, Dover, and Pawling. The farms are on the Pittsfield, Wassaic, Dover, Amenia, Kendaia, and Lyons soils of the uplands; the Palmyra, Copake, and Braceville soils of the outwash knolls and terraces above the streams; and the Chagrin, Eel, and Wayland soils of the stream flood plains.

The principal poultry centers are in the towns of Red Hook, Rhinebeck, Hyde Park, Poughkeepsie, La Grange, and Pleasant Valley. The most important beef cattle farms are in the towns of Pine Plains, Stanford, Washington, and Beekman. The fruit farms are located in the towns adjacent to the Hudson River and in the valleys and western parts of the towns immediately east of the towns along the Hudson River. The principal soils on which fruit is raised are the Hudson, Rhinebeck, Hoosic, and Copak on the high lacustrine and outwash terraces above the Hudson River and the Cossayuna, Troy, and Albia soils of the uplands. Some fruit is grown on Dutchess and Pittstown soils, upland soils developed chiefly from acid slate and shale.

#### LAND USE AND FARM TENURE

The total land area in farms has decreased from 436,730 acres in 1920 to 303,763 in 1950. The decrease results from the rise in industries and the movement of farm population to the cities. In-

creased industrial activity has created a scarcity of farm labor and necessitated increases in farm wages.

Some of the poorer farms, particularly those in the central part of the county on the shallow Nassau and associated soils, have been abandoned and are now idle or in woodland. The rural population, however, has increased through suburbanization and an influx of summer residents. Much of the abandoned land has been bought by nonresidents from the city for use as summer homes and camps. In some sections there is a trend toward farming the land in large estates. The park system has increased with establishment of five parks in recent years.

The size of farms has increased gradually from an average of 140.2 acres in 1920 to 175.7 acres in 1950. During this period the number of farms has declined from 3,114 to 1,729.

Census reports for 1950 show distribution of the land in farms as follows:

	<i>Acres</i>
Cropland harvested.....	103,430
Cropland used only for pasture (including rotation pasture).....	39,976
Cropland not harvested and not pastured.....	19,504
Woodland pastured.....	11,919
Woodland not pastured.....	57,653
Other pasture (not cropland and not woodland).....	46,221
Other land (house lots, roads, wasteland, and so on).....	25,060
<b>Total land in farms.....</b>	<b>303,763</b>

Of the 1,729 farms in the county in 1950, 70 percent were operated by full owners, 18.7 percent by part owners, 3.9 percent by managers, and 7.4 percent by tenants. Of the 128 farms operated by tenants in 1950, 88 were held by cash tenants, 1 by share-cash tenant, 4 by share tenants and croppers, and 35 by unclassified tenants.

The prevailing systems of renting farms, other than for cash, vary considerably. On many farms the owner furnishes the land, livestock, and equipment and shares the income equally with the operator, who furnishes labor, fertilizers, and feed. Numerous other arrangements are made for furnishing equipment, stock, fertilizers, and feeds and sharing the income between owner and operator.

### FARM EQUIPMENT

Tractors and trucks have replaced horses on many farms. In 1950, 2,527 tractors were reported on 1,247 farms, and 1,886 motor trucks on 1,108 farms. On 1,382 farms, there were 2,670 automobiles. Most farms that have tractors have plow, harrow, and cultivator attachments. A few farms, especially the estates, have other power attachments. The average farm is equipped with a plow, cultivator, harrow, wagon, hay rake, and a team or tractor. Most farms have hay loaders and manure spreaders. None have combines.

In the poorer sections, especially in regions of shallow soils and in the mountains, there has been little improvement of farms, buildings, equipment, or fences. In the fruit and main dairy regions, fences, buildings, and equipment are well kept. The use of one-strand electric fences has reduced the labor costs and time spent in maintenance of fences.

## 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 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 the things about it 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 it feels when rubbed between the fingers and may be checked by mechanical analyses in the laboratory. Texture has much to do with the quantity of moisture the soil will hold available to plants, whether plant nutrients or fertilizers will be retained in forms available to plants or will be leached out, and how hard or easy the soil will 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 penetrate the soil and how readily water enters it. Consistence, or the tendency of the soil to crumble or to stick together, indicates whether it is difficult to keep the soil open and porous under cultivation.

The kind of rock material from which the soil has developed (its parent material) affects the quantities and kinds 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 much alike in 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 3 up to 12 percent, the type may be mapped in two phases, an undulating phase (3- to 8-percent slopes) and a gently rolling phase (8- to 12-percent slopes); or a soil that has been eroded in places may be mapped in two or more phases, an uneroded or normal phase (denoted by the name of the soil type only), an eroded phase, and perhaps a severely eroded phase. A soil type will be broken 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 frequency of outcropping bedrock, the extent of erosion, or artificial drainage are examples of characteristics 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 the texture, especially of the surface layer, will differ. As long as the other characteristics of the 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 have about the same kind, thickness, and arrangement of layers,

except for texture, particularly of the surface layer, whether the number of such soil types be only one or several.

The name of a place near where a soil series was first found is chosen as the name of the series. Thus, Hoosic is the name of a deep, porous, well-drained acid soil series found on deposits of water-laid sand and gravel first mapped near a place named Hoosic. Four types of the Hoosic series are found—Hoosic gravelly loam, Hoosic fine sandy loam, Hoosic gravelly sandy loam, and Hoosic loam. They differ in texture of surface soil, as their names show. Hoosic gravelly loam is divided into phases because some of it is nearly level and undulating, some is rolling, some is hilly, and some is steep.

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. Nassau-Cossayuna gravelly loams is a complex of Nassau gravelly loam and Cossayuna gravelly loam in Dutchess County.

Areas such as bare rocky mountainsides, tidal marsh, or dune sand that have little true soil are not designated by series and type names but are given such descriptive names as Rough stony land (Gloucester, Hollis, and Chatfield soil materials) and Tidal marsh, fresh-water phase.

The soil type, or where it 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 the type (or phase) than for broader groups of soil that contain more variation. One can say, for example, that soils of the Dutchess series need lime for alfalfa. More specifically, it can be said that Dutchess gravelly silt loam, undulating and rolling phases, have mild slopes, need lime, and are suited to row crops grown in rotation with small grains and hay; whereas Dutchess gravelly silt loam, hilly phase, has slopes that fall more than 15 feet in 100, is hard to work with heavy machinery, erodes easily, and should be used principally for long-term hay or pasture. All these phases are included in the Dutchess series.

## THE SOILS OF DUTCHESS COUNTY

The soils of Dutchess County differ greatly in characteristics and suitability for use. Silt loam textures predominate, although texture varies from gravelly sandy loam to silty clay loam. Generally several associated soils occur in complex patterns. With the exception of some of the most nearly level ones, most of the soils that have been cultivated are slightly to moderately eroded.

The differences of outstanding significance to agriculture are depth to bedrock, drainage, and slope. More than 70 percent of the soils are well-drained. Nevertheless, small areas of poorly or very poorly drained soil may occur in such complex association that use of the well-drained soils is controlled by the wet areas.

Approximately 35 percent of the soils are shallow over bedrock and have limited use. About 35 percent are hilly or steep (slopes greater 15 percent) and have limited capability for use. More than

50 percent are undulating to rolling (5- to 15-percent slopes), and less than 15 percent are nearly level (0- to 5-percent slopes).

#### SOIL SERIES AND THEIR RELATIONS

The soils of Dutchess County are comparatively young, and their characteristics are strongly influenced by the kind of material from which they were derived. This material was accumulated largely by glacial action.

Most of the upland is covered by ground-up rock, which was pulverized by the crushing action of millions of tons of ice as the glacier advanced. This material was left as a mantle of varying thickness when the glacier melted and is called glacial till. It is a mixture of fine and large pieces of rock, with no evidence of sorting. The value of this till as a source of plant nutrients is strongly influenced by the kind of rock from which it came. In Dutchess County the upland glacial till is derived mostly from the local rock. A close relationship exists between the kinds of bedrock and the kinds of soil.

Water from the melting glacier flowed out in torrents southward along natural valleys, carrying with it huge quantities of ground-up and broken rock. As the speed of the waters slackened, these materials were deposited in layers. The heavier pieces were deposited first and gave rise to deposits of layered sand and gravel, called glacial outwash. This is the parent material of a second broad group of soils, the highly productive nearly level soils that occupy much of the valleys.

In places near the Hudson River were lakes into which fine material was washed. This material settled as layers of silt, clay, and fine sand, or lake-laid (lacustrine) sediments, which gave rise to a third group.

The present streams carry sediments, and through the centuries they have laid these down on the first bottoms during floods. This recent alluvium is the parent material of a fourth broad group of soils.

Plants and water-loving animals have died and settled to the bottom of ponds at spots throughout the county to develop into organic soils—the mucks—which constitute the fifth group of soils.

Within an area in which one kind of parent material exists, differences in drainage have influenced the speed and kind of soil formation. Differences in the removal of plant nutrients, in the kind of plants that grow, in rate of decomposition, in rate and kind of accumulation of organic matter, and in other factors have gradually caused the formation of several different kinds of soil from any one kind of parent material.

Table 4 gives a general idea of the nature and relations of soil series of the county. Soils grouped together in this table may differ in physical characteristics and in requirements for use and management. Each major group shown in table 4, as well as subgroups within the major groups, is discussed in the text. The order of discussion follows the order in table 4; that is, the soils in each subgroup are discussed in order of drainage, the well-drained soils first and the very poorly drained last.

#### SOILS DEVELOPED FROM GLACIAL TILL AND WEATHERED ROCK

The soils developed from glacial till and weathered rock are by far the most extensive in the county. The group includes all soils whose parent materials are mainly deposits of fine earth, sand, gravel, and

TABLE 4.—Relations among the soil series of Dutchess County, N. Y.

Parent material	Depth to bed-rock	Drainage				
		Good	Moderate to imperfect	Poor	Very poor	Permanently wet
Glacial till and weathered rock:						
Chiefly schist	Deep	Paxton	Woodbridge		Whitman	
	Medium	Charlton	do		do	
	Shallow	Hollis				
Chiefly granite and gneiss	Medium	Gloucester	Woodbridge		Whitman	
	Shallow	Chatfield				
Chiefly acid shale and slate	Deep	Bernardston	Pittstown	Stissing	Mansfield	
	Medium	Dutchess	do	do	do	
	Shallow	Nassau				
Chiefly calcareous sandstone and slate	Deep	Troy	Albia	Boynton	Mansfield	
	Medium	Cossayuna	do	do	do	
	Shallow	Staatsburg				
Chiefly limestone and slate	Deep	Stockbridge				
Chiefly limestone	do	Pittsfield	Amenia	Kendaia	Lyons	
Crystalline	Medium and shallow.	Dover	do	do	do	
Noncrystalline	do	Wassaic	do	do	do	
Glacial outwash:						
Chiefly granite and gneiss	Deep	Merrimac				
Chiefly acid shale and slate	do	Hoosic	Braceville	Red Hook	Atherton	
Chiefly calcareous sandstone, limestone, and slate.	do	Copake	Hero			
Chiefly limestone	do	Palmyra	Phelps			
Lake-laid sediments:						
Calcareous silt and clay	do	Hudson	Rhinebeck	Madalin	Livingston	
Sand and gravel over clay:						
Sand and gravel mixed	do		Claverack			
Acid and calcareous sands mixed (deep)	do	Colonie				

Acid sands	do		Elmwood			
Recent alluvium:						
Acid	do	{Poultney Ondawa}	Pawlet	Housatonic	Saco	
Neutral or alkaline:						
Throughout	do	Genesee	Eel		Wayland	
In subsoil only	do	Chagrin	Lobdell		do	
Organic:						
Neutral	do					Carlisle muck.
Acid	{Deep					Muck, acid deep phase.
	{Shallow					Muck, acid shallow phase.

stone in unassorted mixtures. This group has been divided into six subgroups on the basis of kinds of rocks contributing.

#### SOILS FROM SCHIST

The soils developed from schist occur in the eastern part of the county, mainly on the tops and slopes of Quaker Hill and Chestnut Ridge. They occupy about 6½ percent of the county. The low plant-nutrient content of the schist rock is reflected in the soils, which generally need applications of lime and complete fertilizer.

The Paxton soils are deep and, as indicated by their uniform bright yellowish-brown subsoil, are well-drained. Water penetrates rapidly enough to provide fair aeration, even though the subsoil is compact.

The well-drained Charlton soils are associated with the Paxton but are shallower (3 to 6 feet deep over bedrock). Charlton soils have an open friable subsoil.

The well-drained Hollis soils, occurring in association with both Charlton and Paxton soils, resemble very shallow Charlton soils. Their depth to bedrock is less than 2 feet, and rock crops out frequently.

On the gentler slopes, in association with the well-drained Paxton, Charlton, and Hollis soils, is the moderately well-drained to imperfectly drained Woodbridge soil. The Woodbridge soil has a very compact subsoil below 20 to 24 inches. It is comparable to Paxton and Charlton soils in depth, but its surface soil is grayer, and the subsoil below depths of 15 to 18 inches is streaked and mottled with yellow and rusty brown, which indicates periodic saturation with water below those depths.

The black-surfaced very poorly drained Whitman soil occurs in level areas or depressions. Its gray highly mottled subsoil indicates waterlogging most of the year.

#### SOILS FROM GRANITE AND GNEISS

The soils developed from granite and gneiss occur on the Housatonic highlands in the eastern part of the county, on the Hudson highlands in the southern part, and on Stissing Mountain in the north-central part. The parent material contains a high proportion of quartz and relatively less of minerals bearing plant nutrients. The resultant soils are correspondingly acid and low in fertility.

The Gloucester soils are the deepest among those developed from granite and gneiss, or comparable in depth to the Charlton soils of the group developed from schist. Gloucester soils are open and porous throughout and are well drained.

The well-drained shallow Chatfield soils are associated with the Gloucester. Chatfield soils are less than 2 feet thick over bedrock and may have outcrops of bedrock.

The moderately well-drained to imperfectly drained Woodbridge soil occurs in this group and, as previously mentioned, with the group of soils developed from schist. The Woodbridge soil is on gentle slopes and is mottled below depths of 15 to 18 inches. The black-surfaced very poorly drained Whitman soil, developed from schist materials, as well as from granite and gneiss, occurs in flats and depressions.

## SOILS FROM ACID SHALE AND SLATE

The soils that developed from acid shale and slate occupy a broad band extending through the central part of the county from the Columbia County line to the valley of Fishkill Creek. They occupy about 29 percent of the county. These soils are moderately to strongly acid and low in plant nutrients. Textures are commonly silt loam, or slightly heavier than those of the soils derived from granite and gneiss, and the capacity to hold water and plant nutrients is correspondingly greater.

The Bernardston are very deep slightly compact well-drained soils on the long slopes of high oblong hills. The well-drained Dutchess soils associated with them are only moderately deep (3 to 6 feet over bedrock) and have short choppy slopes. The well-drained Nassau soils are generally less than 2 feet thick over bedrock and have numerous outcrops.

The moderately well-drained to imperfectly drained Pittstown soils, which are moderately deep to deep, occur on long gentle slopes in association with Bernardston soils, and in more gently sloping areas with Dutchess soils. The brown surface soil and bright brownish-yellow subsoil to depths of 15 or 18 inches indicate that Pittstown soils have good aeration. Below that depth, however, are mottles and splotches of rusty brown and gray that indicate a high water table part of the time. Drainage is good enough to permit using the Pittstown soils for crops.

Associated with the Pittstown soils is the Stissing soil. Its poor drainage is indicated by the gray or dark brownish-gray surface soil and the high degree of mottling with gray and rusty brown below depths of 8 to 10 inches. Unless artificially drained, Stissing soil is used mainly for hay and pasture. For the associated Mansfield soil of the depressions, a black surface soil and a gray highly mottled subsoil indicate very poor drainage.

## SOILS FROM CALCAREOUS SANDSTONE AND SLATE

Soils from calcareous sandstone occupy a broad belt in the western part of the county. They lie east of the area occupied by slate and shale and cover about 20 percent of the county. In physical characteristics they are similar to comparable soils derived from acid shale and slate, but they contain much more lime and presumably more of other plant nutrients, so they are considered more fertile. The deep subsoils are slightly acid or neutral, and the surface soils are moderately acid.

The deep well-drained Troy soils have a moderately compact subsoil; they occupy areas on the uniform slopes of long high hills like those occupied by Bernardston soils of the acid shale and slate group. Cossayuna soils are also well-drained, but they have less compact subsoil than the Troy and are shallower (3 to 6 feet) to bedrock.

The shallow well-drained Staatsburg soils, less than 2 feet thick, are associated with the Troy and Cossayuna soils. Like the Nassau soils, the Staatsburg are characterized by many bedrock outcrops.

Associated with the well-drained soils mentioned in the preceding paragraphs are the moderately well-drained to imperfectly drained Albia soils. Albia soils have a mottled subsoil and brown surface

soil. They are sufficiently well-drained for use as cropland and are comparable in drainage to the Pittstown soils, which were derived from acid shale and slate.

The Boynton soils are poorly drained, have gray or dark grayish-brown surface soil, and are mottled within 8 or 10 inches of the surface. They are comparable in drainage to the Stissing soils of the acid shale and slate group.

The very poorly drained black-surfaced Mansfield soil has a gray-mottled subsoil. As indicated in table 4, the Mansfield soil developed both from calcareous sandstone and slate and from acid shale and slate.

#### SOILS FROM LIMESTONE AND SLATE

The very deep well-drained Stockbridge soils occur in scattered areas throughout the eastern half of the county in association with soils of the acid shale and slate group and of the limestone group. They are comparable to Bernardston soils, acid shale and slate group, and like them, occupy broad hills with uniform slopes. The limestone is sufficient to make them neutral or calcareous in the lower subsoil, as are soils of the Troy series. Unlike the Troy soils, their source of lime is mainly limestone, not calcareous sandstone.

#### SOILS FROM LIMESTONE

The soils from limestone have developed from glacial till in which the principal rock material is limestone. These soils generally have a calcareous subsoil, though the plowed layer may be slightly to moderately acid. They are darker in color and generally "stronger" than the soils derived from till that contains less lime.

The very deep well-drained Pittsfield soils are not extensive but among the most productive in the county. In association with them, where the limestone in the till is mainly crystalline (approaching a marble), the sandy well-drained Dover soils have developed. Dover soils vary from a few inches to 6 feet deep over bedrock. Areas less than 2 feet thick over bedrock are characterized by many outcrops and are separated from the deeper Dover soils as a ledgy type. The well-drained Wassaic soils—heavier textured than the Dover—have developed where the limestone in the till is not crystalline. Like the Dover, the Wassaic soils vary from a few inches to 5 or 6 feet in thickness, and a ledgy Wassaic type is separated from the deeper Wassaic soils.

The Amenia soil occupies flat or gently sloping moderately well-drained to imperfectly drained areas. It has a brown surface soil and mottling below 15 or 18 inches. The poorly drained Kendaia soil has a dark-gray surface soil and mottling below 8 or 10 inches. The very poorly drained Lyons soil has a black surface soil and a gray-mottled subsoil.

#### SOILS DEVELOPED FROM GLACIAL OUTWASH

The soils developed from glacial outwash occur mainly as broad nearly level plains or hilly and hummocky kames in the valleys. They were derived from layered sands and gravel deposited by running water during the melting of the glacier. They are not so extensive as the soils derived from glacial till, but their favorable relief

and general productivity place them among the best soils in the county.

#### SOILS FROM GRANITE AND GNEISS

The glacial outwash soils derived chiefly from granite and gneiss are the Merrimac. These sandy soils are deep, strongly acid, and well-drained or excessively drained. They have developed from glacial outwash from granite and gneiss materials. They are loose and open throughout and are underlain by deep beds of layered sands and gravel. They are low in content of plant nutrients and are inclined to be droughty. The hilly and steep phases were formerly recognized as a separate series, the Hinckley.

#### SOILS FROM ACID SHALE AND SLATE

Glacial outwash soils derived chiefly from acid shale and slate occur mainly in the western half of the county in the valleys of Fishkill and Wappinger Creek and on the high terraces along the Hudson River. They are deep and moderately to strongly acid throughout. They are underlain at depths between 2 and 4 feet by layered beds consisting of rounded pieces of slate, shale gravel, and sand.

The well-drained Hoosic soils range from gravelly sandy loam to loam in texture. They are not naturally high in plant nutrients but respond well to fertilization and are highly productive when properly managed. Their good internal drainage is indicated by the uniform brown to yellow colors of the profile. The hilly and steep phases were formerly recognized as a separate series, the Otisville.

In small depressions and flats associated with the Hoosic soils are areas with very compact substrata below 24 or 30 inches. These areas were mapped as Braceville, Hero, and Phelps silt loams, undifferentiated. The moderately well to imperfectly drained bodies of Braceville soil occur where internal drainage is retarded only enough to cause mottling with rusty brown and gray in the subsoil below depths of 15 to 18 inches. The Hero and Phelps soils, though mapped in the undifferentiated unit, did not develop from acid shale and slate, so are mentioned with their appropriate groups.

The Red Hook soil occurs where a high water table is maintained for long periods; its surface soil is dark gray or dark grayish brown, and its subsoil is mottled to within 8 or 10 inches of the surface. The Atherton soil is in the more poorly drained depressions; its surface soil is black, and its subsoil is gray or mottled gray and brown throughout.

#### SOILS FROM CALCAREOUS SANDSTONE, LIMESTONE, AND SLATE

The glacial outwash soils derived chiefly from sandstone, limestone, and slate are the Copake and Hero. The Copake soils are comparable to the Hoosic soils in being deep, well-drained, and underlain by stratified gravel and sand. They differ, however, in having free lime at depths of 3 to 8 feet and in having a slightly less acid surface soil. The hilly and steep phases of Copake soil were formerly recognized as belonging to the Schodack series. The Hero soils, mapped in an undifferentiated group with Braceville and Phelps soils, have developed from materials similar to those of the Copake soils, but they occupy depressions or flats and are moderately well to imperfectly drained.

## SOILS FROM LIMESTONE

Glacial outwash soils derived chiefly from limestone occur mainly along the Harlem River, where they are associated with the high-lime soils derived from glacial till. Like other soils developed from outwash materials, these are underlain by layered deposits of sands and gravel. Limestone, however, is the principal rock constituent, and the soils are correspondingly less acid. Their surface soils range from slightly acid to alkaline, and free lime is generally encountered at depths between 18 and 36 inches.

In this group, only the well-drained Palmyra soils are mapped separately. The Phelps is mapped in an undifferentiated soil group with the Braceville and Hero. In depth and drainage, Palmyra soils are comparable to the Hoosic and Copake, but they have a higher content of lime, lower acidity, and generally a better supply of other plant nutrients than either of these. The hilly and steep phases of Palmyra soil were formerly recognized as members of the Groton series.

## SOILS DEVELOPED FROM LAKE-LAID SEDIMENTS

The soils developed from lake-laid sediments cover less than 3 percent of the county. They occur mainly near the Hudson River where a lake existed during the melting of the glacier.

## SOILS FROM CALCAREOUS SILT AND CLAY

The deep heavy-textured soils developed from lake-laid calcareous silt and clay have a moderately acid silt loam or silty clay loam surface soil underlain by a slightly acid silty clay subsoil that becomes alkaline or calcareous with depth. Interbedded layers of silt and clay are generally found at depths greater than 40 or 50 inches. Heavy textures contribute to slow movement of water and result in imperfectly or poorly drained soils.

Good structure permits fair to good internal drainage in the Hudson soils, which are characterized by a uniform gradation of color from the grayish-brown surface soil through a brown subsoil to a slightly reddish-brown substratum.

The imperfectly drained Rhinebeck soils have a light-brown subsoil that is highly mottled below 10 inches, an indication of saturation with water for short periods.

The Madalin soils have still slower internal drainage than the Rhinebeck, so are classified as poorly drained. The Madalin surface soil is dark grayish brown, and the subsoil is mottled with rusty brown and gray within 6 or 8 inches of the surface. External drainage also is slow for Rhinebeck soils.

The Livingston soil occurs in slightly depressed areas that have very poor drainage; it has a black surface soil and strong mottling throughout the dominantly gray subsoil.

## SOILS FROM SAND AND GRAVEL OVER CLAY

The soils developed from lake-laid sand and gravel over clay are the Claverack, Colonie, and Elmwood. They formed where streams flowed into glacial lakes and deposited sand and gravel over the clay that had previously settled.

The moderately well to imperfectly drained Claverack soil developed where thin deposits of mixed acid and calcareous sand and gravel were deposited. The substratum of silt and clay generally lies within  $3\frac{1}{2}$  feet of the surface and retards internal drainage enough to cause mottling in the yellowish-brown subsoil below depths of 15 to 18 inches. Enough calcareous material was present to result in an alkaline reaction at 36 inches, though the surface soil is moderately acid.

Colonie soils have developed where mixed acid and calcareous sands were 4 to 7 feet deep over clay. Colonie soils have good internal drainage. Their sandy dark grayish-brown surface soil is acid, but the light-brown subsoil is neutral at depths of  $3\frac{1}{2}$  to 4 feet.

The acid moderately well to imperfectly drained Elmwood soil developed where thin deposits of acid sand settled over clay. Its strongly acid dark-brown surface soil gives way to a light yellowish-brown acid sandy subsoil, strongly mottled below 18 inches. Interbedded silt and clay occur below 30 to 50 inches, and the upper part of the heavy substratum is moderately acid.

#### SOILS DERIVED FROM RECENT ALLUVIUM

New sediments are frequently deposited on the first bottoms along streams, and these give rise to alluvial soils. Alluvial soils are young, and since they consist of sediments relatively unaltered except for some accumulation of organic matter in the topmost layer, they are high in most plant nutrients.

#### SOILS FROM ACID MATERIAL

The soils developed from acid recent alluvium are the Poultney, Ondawa, Pawlet, Housatonic, and Saco. They occur in parts of the county where the soils of the upland are mainly acid. The sediments from which they have developed were washed from the upland soils by streams during floods. All these alluvial soils are acid because they have formed from sediments washed from acid upland soils.

The Poultney and Ondawa soils, the higher lying of these alluvial soils, are well drained, acid throughout, open, and porous. Colors grade from dark brown to light brown with depth.

The moderately well-drained to imperfectly drained Pawlet soil is associated with the Poultney and Ondawa, commonly a little farther back from the streams. Pawlet soil has a mottled subsoil below 15 to 18 inches.

The poorly drained Housatonic soil occurs where drainage is poor enough to cause a grayish-brown surface soil and mottling of the subsoil within 8 to 10 inches of the surface.

The Saco soil, still less well-drained than the Housatonic, has a black surface soil and strong mottling extending from the surface downward. Gray predominates below 20 inches.

#### SOILS FROM NEUTRAL OR ALKALINE MATERIAL

The alluvial soils developed from neutral or alkaline material are the Genesee, Wayland, Chagrin, Eel and Lobdell. They occur in first bottoms where streams draining areas of high-lime soils deposit their sediments. In reaction these alluvial soils range from alkaline to neutral.

The Genesee is a well-drained soil derived almost entirely from material washed from high-lime soils. It grades from neutral in the dark-brown surface soil to alkaline in the light-brown subsoil.

The well-drained Chagrin soils developed from sediments consisting of mixed acid and alkaline materials. They commonly have a moderately acid surface soil but a neutral or alkaline subsoil. They are intermediate in acidity between the strongly acid Poultney soil and the neutral Genesee.

The Eel and Lobdell are moderately well-drained to imperfectly drained soils associated with the Genesee and Chagrin soils respectively. They have a slightly lighter, or more grayish-brown, surface soil than their well-drained associates. They have a light-brown subsoil, which is highly mottled with gray and brown below depths of 12 to 18 inches.

The Wayland soil occurs in poorly and very poorly drained areas on bottom lands. It has a dark grayish-brown to black surface soil and is highly mottled from the surface downward. Gray predominates in the lower subsoil.

#### SOILS DEVELOPED FROM ORGANIC MATERIAL

Soils developed from organic material occur in old ponded areas. Accumulations of plant and animal remains have, in many places, filled the lake or pond and decomposed into black stable deposits of muck. The deep areas of muck that have a neutral or only slightly acid reaction are classified as Carlisle muck. Deposits of strongly acid organic material that are more than 30 inches thick over mineral soil or bedrock are classified as Muck, acid deep phase; those less than 30 inches thick, as Muck, acid shallow phase.

#### DESCRIPTIONS OF SOIL UNITS

In this section each kind of soil or land type shown on the soil map of the county is described, and its agricultural relations are discussed. General conditions of slope, drainage, or other important features affecting use and management are given for each, as well as the location in the county and the association with other soils. Present soil management is discussed, and requirements for good soil management are given. In table 5 the approximate acreage, proportionate extent, and use are given for the soil units mapped.

**Albia gravelly silt loam, gently sloping phase (0-8% slopes) (AA).**—This deep moderately well drained soil has developed from alkaline or slightly calcareous glacial till. It occurs on slightly concave slopes in association with the Troy soils of soil association C'T (see fig. 3, p. 164) and on nearly level or slightly concave gentle slopes in the Cossayuna association. Small areas occur throughout the regions occupied by calcareous sandstone soils, but most areas extend southwest of Pleasant Valley to Fishkill and southwest of Verbank to Hopewell Junction, where they occur on drumlins or hills similar to those occupied by the Troy soils.

The surface soil in sodded areas is dark brown, friable, and about 10 inches thick. The subsoil extending from 10 to 20 inches is light-brown gravelly firm but friable silt loam easily penetrated by roots. Below 20 inches to a depth of 48 inches the subsoil is compact brown

TABLE 5.—*Approximate acreage, proportionate extent, and use of soils of Dutchess County, N. Y.*

[All estimates made at the time the county was surveyed.]

Soil	Total area	Percent- age of county area	Distribution according to use				
			Crops	Idle	Pas- ture	Wood- land	Urban
Albia gravelly silt loam:							
Gently sloping phase.....	5,506	1.05	52	16	19	10	3
Sloping phase.....	3,024	.58	56	17	19	7	1
Alluvial soils, undifferentiated....	2,169	.42	12	16	42	29	1
Amenia silt loam.....	839	.16	38	19	40	2	1
Atherton silt loam.....	1,128	.22	18	22	21	38	1
Bernardston gravelly silt loam:							
Sloping phase.....	12,911	2.47	58	13	23	5	1
Moderately steep phase.....	2,570	.49	46	9	27	17	1
Eroded moderately steep phase.....	700	.13	43	36	15	5	1
Boynton gravelly silt loam.....	4,136	.79	45	16	24	13	2
Braceville, Hero, and Phelps silt loams, undifferentiated.....	2,600	.50	44	14	24	15	3
Carlisle muck.....	2,591	.50	3	10	16	71	0
Chagrín silt loam.....	274	.05	56	6	30	—	8
Chagrín gravelly loam, alluvial fan phase.....	254	.05	36	2	48	11	3
Charlton gravelly loam:							
Undulating and sloping phases.....	6,670	1.29	38	24	23	9	6
Moderately steep phase.....	2,258	.43	23	28	30	14	5
Steep phase.....	2,359	.45	16	15	27	40	2
Charlton stony loam, moder- ately steep phase.....	620	.12	9	4	24	62	1
Chatfield stony loam:							
Ledgy rolling phase.....	867	.17	14	28	18	37	3
Ledgy hilly phase.....	2,289	.44	3	10	10	77	0
Claverack gravelly loam.....	462	.09	43	27	10	14	6
Colonie fine sandy loam:							
Nearly level phase.....	1,717	.33	55	15	5	9	16
Rolling phase.....	1,399	.27	34	20	6	17	23
Hilly and steep phases.....	805	.15	16	14	4	39	27
Copake fine sandy loam, nearly level and undulating phases.....	437	.08	53	15	10	7	15
Copake gravelly loam:							
Nearly level and undulating phases.....	7,465	1.42	60	9	23	6	2
Rolling phase.....	213	.04	63	28	2	5	2
Hilly phase.....	3,047	.58	38	17	29	11	5
Steep phase.....	1,619	.31	25	21	27	24	3
Cossayuna fine sandy loam, un- dulating and rolling phases.....	693	.13	45	16	5	18	16
Cossayuna gravelly loam:							
Undulating and rolling phases.....	30,828	5.91	47	17	15	15	6
Eroded undulating and rolling phases.....	977	.19	34	44	12	8	2
Hilly phase.....	4,382	.84	38	16	18	26	2
Eroded hilly phase.....	1,454	.28	32	31	28	9	0
Cossayuna stony silt loam:							
Rolling phase.....	3,559	.68	3	7	5	83	2
Hilly phase.....	1,417	.27	4	2	6	87	1

TABLE 5.—*Approximate acreage, proportionate extent, and use of soils of Dutchess County, N. Y.—Continued*

Soil	Total area	Percentage of county area	Distribution according to use				
			Crops	Idle	Pasture	Woodland	Urban
Dover fine sandy loam:							
Rolling phase.....	<i>Acres</i> 1, 112	0. 21	<i>Percent</i> 47	9	26	8	10
Hilly phase.....	282	. 05	19	12	51	15	3
Ledgy rolling phase.....	1, 978	. 38	17	6	51	15	11
Ledgy hilly phase.....	3, 510	. 67	7	6	54	26	7
Ledgy steep phase.....	839	. 16	3	4	33	59	1
Dutchess gravelly silt loam:							
Undulating and rolling phases.....	16, 915	3. 24	50	26	5	15	4
Eroded undulating and rolling phases.....	3, 560	. 68	5	4	90	1	0
Hilly phase.....	3, 261	. 62	33	19	20	28	0
Eroded hilly phase.....	1, 674	. 32	30	38	25	6	1
Eel and Lobdell silt loams, undifferentiated.....	2, 023	. 39	42	6	43	7	2
Elmwood fine sandy loam.....	359	. 07	55	13	12	11	9
Genesee fine sandy loam.....	456	. 09	92	0	7	1	0
Gloucester gravelly loam:							
Rolling phase.....	1, 320	. 25	34	31	12	13	10
Hilly phase.....	1, 349	. 26	19	22	24	26	9
Steep phase.....	887	. 17	12	18	33	31	6
Gloucester stony loam:							
Rolling phase.....	1, 050	. 20	9	49	9	29	4
Hilly phase.....	886	. 17	6	38	11	41	4
Steep phase.....	890	. 17	22	12	12	49	5
Hollis channery loam:							
Rolling phase.....	2, 503	. 48	10	33	22	33	2
Eroded rolling phase.....	708	. 14	16	42	19	23	0
Eroded hilly phase.....	6, 802	1. 30	5	24	16	54	1
Ledgy hilly phase.....	10, 704	2. 05	2	8	8	82	0
Hoosic fine sandy loam, nearly level and undulating phases.....	968	. 19	54	17	8	7	14
Hoosic gravelly loam:							
Nearly level and undulating phases.....	19, 870	3. 83	57	17	13	4	9
Rolling phase.....	1, 678	. 32	37	36	14	6	7
Hilly phase.....	3, 003	. 57	30	28	22	15	5
Steep phase.....	2, 162	. 41	16	26	23	33	2
Hoosic gravelly sandy loam, nearly level and undulating phases.....	2, 063	. 40	40	21	4	4	31
Hoosic loam, nearly level and undulating phases.....	6, 240	1. 19	58	12	9	4	17
Housatonic silt loam.....	2, 789	. 53	24	14	39	22	1
Hudson fine sandy loam, gently sloping phase.....	333	. 06	36	38	9	15	2
Hudson silt loam:							
Gently sloping phase.....	1, 781	. 34	52	13	11	11	13
Rolling phase.....	631	. 12	42	18	7	18	15
Hilly phase.....	845	. 16	10	20	7	61	2
Hudson silty clay loam:							
Gently sloping phase.....	321	. 06	43	4	15	8	30
Eroded rolling phase.....	216	. 04	8	59	8	6	19
Hilly phase.....	1, 219	. 24	14	2	11	68	5
Steep phase.....	89	. 02	0	0	6	94	0
Kendaia silt loam.....	1, 100	. 21	25	9	56	9	1
Livingston silty clay loam.....	1, 483	. 28	20	19	16	43	2
Lyons silt loam.....	2, 489	. 48	12	13	58	15	2

TABLE 5.—*Approximate acreage, proportionate extent, and use of soils of Dutchess County, N. Y.—Continued*

Soil	Total area	Percent- age of county area	Distribution according to use				
			Crops	Idle	Pas- ture	Wood- land	Urban
			Percent	Percent	Percent	Percent	Percent
	<i>Acres</i>						
Madalin silt loam.....	2, 012	0. 39	40	20	20	20	0
Madalin silty clay loam.....	1, 242	. 24	53	18	18	9	2
Made land.....	1, 901	. 36	13	35	2	9	41
Mansfield silt loam.....	14, 397	2. 76	13	16	30	40	1
Merrimac gravelly fine sandy loam, nearly level and undulating phases.....	506	. 10	43	26	16	10	5
Merrimac gravelly sandy loam, hilly phase.....	242	. 05	7	36	14	33	10
Muck:							
Acid deep phase.....	4, 766	. 91	2	12	9	77	0
Acid shallow phase.....	3, 453	. 66	7	14	14	65	0
Nassau-Cossayuna gravelly loams:							
Undulating and rolling phases.....	7, 370	1. 41	27	20	20	23	10
Eroded undulating and rolling phases.....	1, 556	. 30	22	37	30	8	3
Eroded hilly phases.....	4, 940	. 94	20	27	22	28	3
Nassau slaty silt loam:							
Undulating and rolling phases.....	16, 193	3. 10	19	23	26	30	2
Eroded undulating and rolling phases.....	3, 229	. 62	14	45	32	8	1
Ledgy undulating and rolling phases.....	4, 020	. 77	9	17	17	54	3
Ledgy hilly phase.....	34, 850	6. 67	9	21	17	52	1
Ondawa gravelly loam, alluvial fan phase.....	443	. 08	54	5	32	5	4
Palmyra gravelly loam:							
Nearly level and undulating phases.....	2, 663	. 51	63	3	23	1	10
Hilly phase.....	973	. 19	47	3	38	2	10
Steep phase.....	621	. 12	36	1	47	10	6
Pawlet silt loam.....	3, 514	. 67	39	13	24	22	2
Paxton gravelly loam:							
Gently sloping and sloping phases.....	5, 549	1. 06	42	28	21	8	1
Moderately steep phase.....	1, 836	. 35	25	27	27	20	1
Pittsfield gravelly loam:							
Sloping phase.....	2, 226	. 43	61	3	32	1	3
Moderately steep phase.....	653	. 12	37	3	51	7	2
Pittsfield-Wassaic gravelly loams:							
Undulating and rolling phases.....	5, 316	1. 02	52	15	25	5	3
Hilly phases.....	653	. 12	30	20	33	13	4
Stony and ledgy rolling phases.....	505	. 10	30	9	55	6	0
Stony and ledgy hilly phases.....	245	. 05	5	28	42	25	0
Pittstown gravelly silt loam, nearly level and gently sloping phases.....	8, 060	1. 54	42	27	20	9	2
Poultney loam.....	1, 100	. 21	54	7	22	11	6
Poultney silt loam.....	969	. 18	60	14	18	6	2
Red Hook silt loam.....	1, 371	. 26	36	2	42	19	1
Rhinebeck silt loam.....	1, 133	. 22	58	14	11	5	12
Rhinebeck silty clay loam.....	364	. 07	52	13	9	26	0
Rough stony land (Gloucester, Hollis, and Chatfield soil materials).....	48, 012	9. 19	1	2	2	95	0

TABLE 5.—*Approximate acreage, proportionate extent, and use of soils of Dutchess County, N. Y.—Continued*

Soil	Total area	Percent- age of county area	Distribution according to use				
			Crops	Idle	Pas- ture	Wood- land	Urban
			Percent	Percent	Percent	Percent	Percent
Saco silty clay loam.....	6,980	1.34	8	21	29	41	1
Staatsburg gravelly loam:							
Ledgy undulating and rolling phases.....	2,170	.42	32	23	12	30	3
Very ledgy rolling phase.....	3,588	.69	8	9	10	71	2
Very ledgy hilly phase.....	2,563	.49	8	11	10	69	2
Steep ledgy land:							
Nassau soil material.....	18,358	3.53	4	9	9	77	1
Wassaic and Staatsburg soil material.....	2,769	.53	7	4	13	75	1
Stissing gravelly silt loam.....	3,856	.74	31	21	32	15	1
Stockbridge gravelly loam:							
Gently sloping and sloping phases.....	14,591	2.79	59	10	23	3	5
Moderately steep phase.....	3,828	.73	35	10	39	12	4
Eroded moderately steep phase.....	589	.11	47	14	32	6	1
Stockbridge stony loam, sloping phase.....	627	.12	25	6	58	10	1
Tidal marsh, fresh-water phase.....	460	.09	0	4	1	95	0
Troy gravelly loam:							
Gently sloping phase.....	3,873	.74	62	14	10	9	5
Sloping phase.....	5,405	1.03	52	25	12	5	6
Moderately steep phase.....	3,584	.69	38	21	16	21	4
Eroded moderately steep phase.....	1,821	.35	46	22	23	7	2
Steep phase.....	803	.15	21	17	17	43	2
Urban land, undifferentiated.....	1,968	.38	0	0	0	0	100
Wassaic gravelly loam:							
Rolling phase.....	6,523	1.25	26	20	30	20	4
Hilly phase.....	3,361	.64	19	15	29	35	2
Ledgy rolling phase.....	1,761	.34	14	4	49	23	10
Ledgy hilly phase.....	2,119	.40	9	5	44	41	1
Wayland silt loam.....	10,310	1.97	20	14	43	21	2
Whitman stony silt loam.....	3,777	.72	8	18	33	40	1
Woodbridge silt loam.....	2,327	.45	32	23	28	16	1
Miscellaneous areas:							
Intermittent lakes.....	208	.04					
Gravel pits.....	326	.06					
Marsh.....	4						
Cemeteries.....	179	.04					
Total area.....	522,198	100.0					

gravelly silt loam strongly mottled with yellow, gray, and rusty brown. The mottling indicates slow movement of water and poor aeration. Few roots penetrate this compact layer, but those above it are filled with them. The soil is moderately to strongly acid above 20 inches but becomes less acid with depth. Below 48 inches the deep subsoil or substratum is very compact olive-brown heavy gravelly loam containing no roots. The upper part of this deep layer is slightly alkaline, but it becomes strongly alkaline or calcareous with depth.

All horizons have small boulders, stones, gravel, and angular fragments of calcareous sandstone, acid slate and shale, igneous erratics, and limestone. Calcareous sandstone materials predominate. Surface drainage is good; internal drainage is slow.

This soil varies principally in depth of surface soil, depth to the mottled horizon, and reaction of the deep subsoil. About 85 percent of it has been moderately eroded and has lost 25 to 75 percent of its original surface soil. A small acreage has lost all of its original surface soil; a few cultivated and forested areas have lost little or none. The mottled imperfectly drained layer lies at depths varying from 18 to 30 inches, and the intensity of its mottling varies from slight to strong within a short distance in the same field. Normally the soil is neutral or slightly alkaline at depths of 36 to 40 inches, but the depth to alkaline reaction varies from 24 to 48 inches.

*Use and management.*—This is a good soil when properly managed. About one-fifth of the cultivated area is in orchards, which are generally kept in sod. The rest of the cultivated area is used principally for the general crops needed on dairy farms. A 5- or 6-year rotation is usually followed: 1 or 2 years of corn is commonly followed by 1 year of a small grain and 3 years of hay or hay and pasture. From 8 to 10 tons of manure and 200 to 300 pounds of 20-percent superphosphate are usually applied for corn. Hay is usually seeded in oats after a crop of corn. Approximately 1 ton of lime and about 200 pounds of 20-percent superphosphate are commonly applied on fields prepared for small grains. Timothy and clover are usually sown in mixture. Alfalfa often winterkills (pl. 1, A) but can be used advantageously in mixtures with clover.

Cultivating row crops across the slope with the contour retards runoff and prevents erosion from becoming serious. Where slopes are long, strip cropping may be desirable. While it is under the sod crops in the rotation, there is little danger that the soil will erode. Necessary cultivation should be done across the slope, and sod strips should be left between the trees in orchards. A compact subsoil and slow internal drainage make this soil naturally erodible.

Pasture is grown mostly in rotation with cultivated crops and furnishes good grazing. Areas left in sod several years with little or no care are only moderately productive of poor quality pasture.

Nearly all the idle areas are closely associated with idle areas of Troy and Cossayuna soils and are suitable for cultivation. Abandonment in most instances results from kind of ownership rather than from agricultural value of the soil, or from its association with other soils of low value. Idle areas and unimproved permanent pasture often support Canada and Kentucky bluegrasses.

The small acreage of severely eroded soil included is moderately less productive than the uneroded areas. These severely eroded areas should be used for longer rotations, and manure, in addition to recommended fertilizer, should be applied frequently until soil organic matter is built up and productivity restored.

**Albia gravelly silt loam, sloping phase (8-15% slopes) (AB).**—This soil occurs mainly on the lower parts of long uniform slopes of drumlins, the upper slopes of which are occupied by Troy soils. Areas occur mainly in the Troy soil association, although a small acreage is associated with Cossayuna soils.

The soil profile is essentially the same as that of the gently sloping phase, but slopes are stronger, runoff is more rapid, and need for control of runoff is greater. Although use and management for the two are essentially the same, yields of most crops are slightly lower on this soil. Also, this soil needs contour strip cropping, and occasional diversion ditches on long slopes, to retard runoff, minimize erosion, and retain as much water as possible for crops. Row crops should not be grown 2 years in succession, and the rotation should include a sod-forming crop at least 2 out of 4 years.

An inclusion (about 250 acres) of severely eroded soil should be kept in hay or pasture for long periods and manured frequently until fertility and organic matter are built up.

**Alluvial soils, undifferentiated** (0-3% slopes) (Ac).—This unit occurs along smaller streams. It consists of a mixture of soils of the first bottoms. In any one locality, the members of this unit are generally the imperfectly and poorly drained soils derived from the kind of materials common to the area. In the regions of acid soils, Housatonic and Saco soils predominate in the unit; in the regions of calcareous soils, the Eel and Wayland. The soils occur in such intimate associations that individual types could not be mapped separately at the scale used. The poorly drained soils determine the use of the land. In many places overwash of sand, gravel, or stone is included and small areas of muck are common.

*Use and management.*—Owing to its mixed character, the value of this mapping unit for crops is extremely variable. Most of it has little value except for grass and, in some favored spots, corn and oats.

**Amenia silt loam** (0-5% slopes) (Ad).—Moderately deep or deep deposits of high-lime till mixed with small quantities of slate, schist, sandstone, quartzite, or gneiss are the parent materials for this soil. It occurs on the gentle lower slopes of limestone hills and knolls. Relief is gently sloping and uniform. Slopes are dominantly in the 0 to 5 percent range, though some slopes ranging up to 15 percent are included. The subsoil is mottled and compact, and internal drainage is slow. Surface drainage is slow to medium.

This inextensive soil is closely associated with the other limestone soils of the county and often occurs in intermediate positions between the more rolling well-drained soils and the level or depressed poorly drained limestone soils of the Pittsfield, Wassaic, and Dover soil associations.

The surface soil beneath pasture sod is dark-brown friable silt loam, somewhat granular, neutral or slightly alkaline, and about 10 inches thick. The upper subsoil, extending from below 10 to a depth of 18 inches, is lighter brown firm but friable gravelly silt loam and is strongly alkaline. Below 18 to a depth of 27 inches the subsoil is firm or slightly compact grayish-brown gravelly loam, mottled with yellow, rust brown, and gray. This layer is friable, strongly alkaline, and penetrated by roots; it contains weathered limestone gravel. From depths of 27 to 32 inches occurs the deep subsoil, a very compact gray gravelly sandy loam strongly mottled with yellow, rust brown, and gray, that is calcareous and contains few roots. Below a depth of 32 inches lies the substratum, a firm or slightly compact strongly calcareous gray gravelly sandy loam, the upper part of which is stained

with yellow and rust brown. The total depth of this soil over underlying limestone bedrock varies from 6 to 10 feet or more.

Surface soil texture varies from heavy silt loam to gritty or light silt loam. Where it is associated with Dover soils, the surface soil is light silt loam. The reaction of the surface soil varies from slightly acid to slightly alkaline.

*Use and management.*—Corn, oats, timothy, redtop, and alsike clover—the principal crops on this soil—are commonly grown in a rotation consisting of corn, oats, and 3 or 4 years of hay. From 8 to 10 tons of manure and 200 to 300 pounds of 20-percent superphosphate are applied for corn, and 150 to 200 pounds of superphosphate are applied for oats with which a mixture of timothy and clover is seeded. No lime is required for clover. Hay crops are maintained from 2 to 4 years and then pastured 1 or 2 years before plowing.

Pastures are good or excellent. The heavy bluegrass sods have a good mixture of wild white clover, timothy, redtop, and, occasionally, orchard grass. Some weeds, including thistles, goldenrod, wild aster, wild carrot, and plantain, grow in the poorer pastures.

**Atherton silt loam** (0–3% slopes) (A<sub>E</sub>).—This very poorly drained soil has developed in the valleys on glacial stream terraces from layered silt, sand, and gravel. The parent materials are composed chiefly of gravel and sand from acid slate, shale, and sandstone rock materials mixed with some calcareous sandstone, limestone, and crystalline rock. The soil occurs in depressions within the terraces of Hoosic soils or adjacent to muck soils at the edges of terraces. It is associated with Braceville, Red Hook, and Hoosic soils. A considerable accumulation of organic materials in the surface layer gives it an almost black color. Although it is permanently wet or has standing water on the surface during wetter months of the year, it is above the flood plains of the present streams. Areas are generally small (2 to 20 acres) and occur mainly on low terraces in the valley of Fishkill Creek.

The dark grayish-brown or black surface soil, friable and granular, has a high content of organic material, is strongly acid, and is 10 to 12 inches thick. The subsoil is heavy silt loam strongly mottled with yellow, rust brown, and gray. It is friable in the upper part but becomes more compact and plastic with depth. Below depths of 28 to 32 inches begins a friable strongly mottled bluish-gray gravelly sand that continues to depths of 36 to 40 inches. The variable substratum consists of stratified silt, sand, and gravel, or, in places, silty clay. The soil is acid throughout, except in a few included areas mapped in association with the Copake and Palmyra series, which are alkaline in the deep subsoil.

*Use and management.*—Atherton silt loam supports poor quality pasture containing mostly reeds, sedges, coarse water-loving grasses, rebel weed, plantain, buttercup, goldenrod, and many other weeds. Alders and small willows are present in the poorest pastures. The forested areas include mostly elm, black ash, basswood, birch, alder, and willow. About 18 percent of the soil is cultivated.

**Bernardston gravelly silt loam, sloping phase** (5–15% slopes) (B<sub>c</sub>).—This deep well-drained acid soil occurs typically on the uniform slopes of drumlins (pl. 1, B). It was derived from deep deposits of glacial till composed mainly of acid slate and shale, with some

sandstone, igneous rock, schist, and quartzite. It is the dominant soil of the Bernardston soil association and occurs in association with the moderately well drained Pittstown, the poorly drained Stissing, and the very poorly drained Mansfield soils, all of which were derived from similar materials. Most of the soil has been cleared and used for crops. The forest consists mainly of oak, hickory, dogwood, and ash but includes some maple, beech, and hemlock.

The surface soil, to a depth of 9 inches, is dark-brown mellow finely granular moderately acid silt loam. Beneath this layer and continuing to a depth of 14 inches is dark yellowish-brown friable acid gravelly silt loam, which is underlain by olive-brown firm acid silt loam subsoil that extends to a depth of 21 inches. From 21 to 36 inches the subsoil is similar to the above layer but slightly more compact. Below 36 inches lies the substratum, a very deep compact olive-brown gravelly silt loam. The substratum is not compact to the extent that it seriously retards movement of soil water. Internal drainage is good throughout the profile. The soil is acid but not so acid as associated soils of the Dutchess and Nassau series. As for most soils from deep till, some stones and small boulders occur in the profile. The surface soil is not excessively stony.

Through previous use the soil generally has been slightly to moderately eroded; it has been severely eroded on a few small areas and one larger area of about 45 acres. This soil varies from heavy loam to silt loam in texture and also varies in the quantity of gravel in the surface soil. South of Smithfield a few areas are included that seem to contain some outwash materials.

*Use and management.*—The principal crops on this soil—corn, oats, and hay—are generally grown in 5- or 6-year rotations. Corn is commonly grown for 1 or 2 years and followed by 1 year of oats and then 3 years of hay. The rotation is varied somewhat so as to last from 4 to 7 years. From 10 or 12 tons of manure supplemented with 200 to 300 pounds of 20-percent superphosphate is applied to land prepared for corn, and a ton of lime and 200 pounds of 20-percent superphosphate are applied to land for oats or other small grains in which hay is seeded. Wheat is occasionally grown as a companion crop for hay. Timothy, timothy and clover, red clover, or alfalfa are the chief hay crops. After 2 or 3 years of cutting, meadows are sometimes pastured for 1 or 2 years.

Erosion is not a serious problem if row crops are cultivated across the slope to retard runoff and the soil is maintained in a good sod for 3 out of every 5 years. The slopes are usually long and well suited to strip cropping, though few areas are now strip-cropped. Active erosion is most evident in cultivated row-crop fields where the rows run up and down or diagonally across the slope and in poorer run-out pasture. Few areas have gullies, and these are shallow.

**Bernardston gravelly silt loam, moderately steep phase (15-30% slopes) (Bb).**—More strongly sloping areas on drumlins are occupied by this soil. Slopes are usually uniform and well suited to contour cultivation and strip cropping. The soil is closely associated with more gently sloping phases of Bernardston gravelly silt loam, and about 90 percent of it has at one time been cleared and cultivated. A lower percentage of it than of Bernardston gravelly silt loam, sloping phase, is cultivated, and a higher percentage is

pastured. The areas vary from 2 to 40 acres in size and occur throughout the region of slates and shales in association with other phases of Bernardston gravelly silt loam.

The soil profile is similar to that of the sloping phase. The surface soil is slightly shallower, and the quantity of the original surface soil lost through erosion has been a little greater in cultivated areas. The soil is moderately eroded, having lost in most areas from 25 to 75 percent of the original surface soil.

*Use and management.*—Rotations used on this soil are similar to those for Bernardston gravelly silt loam, sloping phase, except row crops are generally grown only 1 year in the rotation. Crop yields are slightly lower, though fertilizing and liming practices are the same. Row crops are commonly planted and cultivated across the slope, as nearly as possible on the contour. Though not generally practiced, strip cropping of long slopes is desirable. A few farmers are using a modified form of strip cropping. Diversion terraces are needed. A long rotation—1 year of row crops followed by 4 years or more of hay or pasture—is best.

The pastures vary. Some are well-managed permanent and rotation pastures that support good sods; others are poor and seldom limed or fertilized. The good pastures are partly used for beef cattle; the poor pastures support mostly weeds, herbs, and shrubs, including timothy, sweet vernal, poverty oatgrass, a small quantity of redbtop, spirea (steeplebush), vaccinium, daisy, devils-paintbrush, goldenrod, and sorrel. Most abandoned areas are well-suited to agricultural use but are either isolated by surrounding poor or non-agricultural soils or are in estates that are not farmed. A few included areas of idle Bernardston gravelly silt loam, sloping phase, were temporarily fallow at the time of mapping.

**Bernardston gravelly silt loam, eroded moderately steep phase (15-30% slopes) (BA).**—This is the eroded equivalent of the moderately steep phase of Bernardston gravelly silt loam. It differs from the moderately steep phase in having lost all of the original surface soil. It occurs in the same general areas as other Bernardston soils. Areas are usually small (1 to 10 acres and a few 25 to 30 acres). Since this soil is closely associated with the gently sloping soils, methods of management applicable on the gentler slopes have been used on these stronger slopes with the result that erosion—principally sheet but some gully erosion—has been severe.

The present surface soil has developed almost entirely in the former subsoil. In cultivated areas the plowed layer is about 6 inches of brown friable gravelly silt loam. Below 6 inches to a depth of 13 inches the subsoil is olive-brown to yellowish-brown firm to friable silt loam; then downward to 26 inches it is slightly compact, firm, olive-brown gravelly silt loam. Below 26 inches is the substratum, a compact olive-brown gravelly silt loam. The profile is similar to that of the moderately steep phase except the surface soil is somewhat lighter in color, the apparent organic content is lower, and the depth to each horizon is considerably less.

The soil varies considerably in quantity of gravel on the surface and in the thickness of the present surface soil. The depth to the compact substratum also varies but is generally 10 to 15 inches less than in virgin areas.

*Use and management.*—All of the eroded moderately steep phase of Bernardston gravelly silt loam has been intensively used at one time. Now, about four-tenths of it is cultivated. Approximately three-tenths is suitable for cultivation but lies temporarily fallow or occurs on estates where much of the land is not farmed; the rest is run-down, gullied, and depleted and should be reforested. Pasture varies from good to poor. Most of the rotation pasture and one or two permanent pastures support fair to good sod. The native pastures—chiefly poor, run-out, and eroded—consist of such undesirable plants as poverty oatgrass, paintbrush, sweet vernal, sorrel, spirea, and goldenrod. These poorer pastures should receive lime, phosphate, and manure and be reseeded.

**Boynton gravelly silt loam** (0–8% slopes) (B<sub>D</sub>).—This poorly drained slightly acid soil of the small flats and gentle slopes is in the Cossayuna and Troy soil associations. Like its associates (Troy, Cossayuna, Albia, and Mansfield soils) it has developed from moderately deep to deep deposits of alkaline or slightly calcareous glacial till. The rock materials are principally calcareous sandstone, with some limestone, quartzite, and acid slate and shale. Slow internal drainage contributes to formation of the grayish-brown surface soil but it is not so slow as in the Mansfield soils. This is an excellent soil for grass. Its compact subsoil and poor drainage make it poorly suited to deep-rooted crops. The nearly level or gently sloping areas on which the soil occurs are generally small, though they range from 2 to 30 acres. Commonly this soil lies adjacent to and is used with areas of the better drained Troy, Cossayuna, and Albia soils.

The 8-inch surface soil is grayish brown, friable, granular, and medium to slightly acid. The subsoil, from 8 inches to a depth of 13 inches, is firm or slightly compact light grayish-brown gritty silt loam mottled with yellow, rust brown, and gray; below 13 inches to a depth of 32 inches it is very compact gray or bluish-gray gritty silt loam strongly mottled with yellow and rust brown. The layer extending from a depth of 13 to 32 inches is neutral; those above are slightly acid. Below 32 inches and continuing to a depth of 48 inches is the deep subsoil, an alkaline, very compact brown gritty silt loam strongly mottled with gray, yellow, and rust brown. This layer rests on several feet of olive-brown compact calcareous gritty loam. Gravel from calcareous sandstone and limestone and fragments of acid slate are scattered throughout the profile. Roots are most abundant in the surface soil; only a few penetrate below 15 inches. Surface drainage is slow; internal drainage, very slow.

*Use and management.*—Meadow and the pasture are important on the larger areas of this soil. Many cultivated areas are closely associated with better drained soils of the Albia and Cossayuna series and are used in the same way. Regular rotations are usually not followed on the larger areas. Buckwheat and hay (timothy, redtop, and alsike clover) are the leading crops. In unusually dry years corn produces fair yields; in unusually wet ones it may fail. The soil is fairly well suited to Ladino clover but is not so well suited to red clover. Alfalfa generally fails.

The soil is fairly fertile. The pastures vary considerably in quality. Most of them contain redtop, bluegrass, and wild white clover.

The principal weeds in old meadows and pastures are wild carrot, daisy, cinquefoil, and orange hawkweed. Meadows are generally mowed until they run out and are then pastured an indefinite number of years. Pasture is good where grazing is close and excellent where phosphate is applied and other good management is practiced.

**Braceville, Hero, and Phelps silt loams, undifferentiated** (0-5% slopes) (BE).—These are imperfectly drained soils in slight depressions in the Hoosic and Copake soil associations and in smaller areas occupied by soils from outwash materials. They occur throughout the western and central parts of the county. They were derived from layered deposits of outwash silt, sand, and gravel composed chiefly of acid slate, shale, and sandstone rock materials, with which smaller quantities of calcareous sandstone, limestone, and crystalline rock were mixed. The subsoil below 18 or 20 inches is compact and prevents the free downward movement of water that is characteristic in the Hoosic and Copake soils with which these soils are associated. Internal drainage is not so slow that the soils cannot be used successfully for most commonly grown crops.

The soils were not adequately differentiated during the survey of the county and are therefore shown on the map as an undifferentiated unit. Braceville silt loam is a moderately well-drained to imperfectly drained soil associated with the Hoosic soils, and like them it is moderately to strongly acid throughout. Hero silt loam is also moderately well to imperfectly drained, but it is associated with the Copake soils. It is a moderately acid soil underlain by calcareous gravel. Its profile differs from that of Braceville silt loam mainly in being neutral or calcareous below a depth of 3 feet. The Hero soil occurs on terraces, mainly in the Copake-Chagrin soil associations and adjacent areas, and is of much less extent than Braceville silt loam. Phelps silt loam is also moderately well-drained to imperfectly drained but is less acid than either the Braceville or Hero soils. The entire soil is neutral, and calcareous material generally occurs at a depth of 2 feet. The Phelps soil is limited to small areas in the western part of the county and is associated with the Palmyra soils.

The surface soil of Braceville silt loam is medium to strongly acid, dark brown to grayish brown, friable, and, when in sod, finely granular to a depth of 10 inches. The upper subsoil, to a depth of 18 inches, is light yellowish-brown silt loam, lightly stained in the lower 2 or 3 inches with yellow and gray. Below depths of 18 to 28 inches, the slightly compact subsoil is light grayish brown, strongly mottled with yellow, gray, and orange. From 28 down to 34 inches occurs very compact brownish-gray gravelly sandy loam, strongly mottled with yellow, gray, and orange. Below a depth of 34 inches lies slate-gray stratified loose gravel, sand, gravelly sand, and silt. The loose substratum, several feet thick in most places, rests upon bedrock, lacustrine clay, or till. Few roots penetrate the mottled horizon at a depth of 18 inches. The soil is typically moderately to strongly acid throughout.

The surface soils of this unit vary from silt loam to gravelly silt loam and fine sandy loam in texture, but acreage of the gravelly silt loam and of fine sandy loam was too small to justify separation. The fine sandy loam areas are closely associated with the sandy types of the Hoosic and Copake series.

*Use and management.*—Cultivated areas of these soils are used and managed much like the associated better drained soils such as Hoosic gravelly loam, nearly level and undulating phases. A few areas are used for orchards, however, and alfalfa is not commonly used in the hay seedings. A timothy-redtop-alsike mixture, or timothy alone, is most commonly sown for hay. Yields are not much lower than those on the Hoosic soil. Vegetables are grown successfully on some areas.

Old hay meadows are frequently used for pasture and give fair to good yields of timothy, clover, and redtop, together with some weeds, plattain, devils-paintbrush, and wild strawberry. A few old pastures are run-out and poor and support many weeds and some timothy, redtop, poverty oatgrass, and quackgrass. The few forested areas are mainly in elm, tulip-popular, hard and soft maples, and black birch.

The chief management needs of these soils are use of lime and phosphorus and planting of hay mixtures that include a long-lived legume, such as Ladino clover, that will tolerate imperfect drainage.

**Carlisle muck** (0-2% slopes) (CA).—Most of this deep alkaline muck occurs in the limestone or calcareous sandstone areas or along streams flowing from the limestone regions. Probably the largest areas are those along the Swamp River in the southeastern part of the county. These may be 120 to 185 acres in size but are usually 30 to 45 acres. The mineral soil in the muck came chiefly from limestone or calcareous sandstone.

The upper 14 inches is black friable granular slightly acid well-decomposed organic material. Below 14 inches to a depth of 28 inches the muck is very dark brown, lumpy, and weakly acid to neutral. Below 28 inches down to depths of 3 or 4 feet occurs brown partly decomposed sedge and woody peat, somewhat mottled and slightly alkaline. Beneath the peat are bluish-gray fine sandy loams or silts that are alkaline, firm, and friable.

Included with Carlisle muck are a few small areas, 2 to 10 acres in size, of alkaline muck that are comparatively shallow and underlain by marl.

*Use and management.*—The small cultivated areas of this soil are ditched and used mainly for corn. The forested areas support mainly hardwoods. If areas of this muck could be adequately drained, they would be among the most productive and valuable in the county. Outside this county Carlisle muck is used intensively for such high value crops as celery, onions, carrots, and other vegetables. To date, adequate drainage of most areas in this county has not been feasible.

**Chagrin silt loam** (0-3% slopes) (Cc).—This is the most extensive soil of the Chagrin series. It occurs throughout the county. Small areas (2 to 15 acres) are in the western part of the county in the region where the soils have developed chiefly from glacial drift containing relatively large amounts of calcareous sandstone materials. They occur in the lake-plain region and in the smaller limestone valleys. In Harlem Valley the areas are generally larger (5 to 40 acres). The soil occurs on nearly level first bottoms adjacent to streams. It is well-drained, alkaline in the subsoil, slightly acid to medium acid at the surface, and suited to most crops commonly grown in the county.

The surface soil to a depth of 11 inches in cultivated fields is dark brown, friable, and of fine granular or crumb structure; it has a slight grayish-brown cast when dry and a medium organic-matter content. From 11 down to 24 inches is a lighter brown to yellowish-brown friable silt loam of good crumb structure. Down to 24 inches the soil is slightly to medium acid and has an abundance of roots. The subsoil below 24 and continuing to a depth of 36 inches is brown friable light silt loam that breaks up into large irregular fragments that are soft, friable, and alkaline. Below 36 inches are grayish-brown stratified sands and gravel that are firm in place, structureless, and alkaline. Roots are present throughout the profile but most abundant at depths of less than 12 inches. The grayish-brown stratified sands and gravel occur at the normal water level of the adjacent streams.

*Use and management.*—Approximately 56 percent of Chagrin silt loam is cultivated, and 30 percent is pastured. Although some idle areas are potential cultivated land, they are usually small and generally are associated with soils less well suited to cultivation. The vegetation in the forested areas consists mainly of elm, soft maple, oak, sycamore, willow, hickory, and basswood. Some hard maple, white and black ash, and birch are also present.

The cultivated areas are used intensively for corn, oats, and hay, and in some areas for vegetables. Regular rotations are not followed. Many farms use no fertilizer because the soil is sufficiently fertile to produce good yields. Manure is usually applied for corn or meadows. Small quantities of commercial fertilizer are used on the small acreage in vegetables (sweet corn, beans, tomatoes, beets, and carrots). Hay seedings include timothy, timothy and red clover, or alfalfa. Vegetable yields are high, especially where adequate commercial fertilizer is used.

Most of the pasture is rotated with tilled crops, but about one-fourth is permanent. Pasture vegetation includes wild white clover, Canada and Kentucky bluegrasses, timothy, red clover, and small percentages of quackgrass and other weeds. The pasture is usually well grazed, well managed, and more productive for a greater part of the summer than that on most other soils.

**Chagrin gravelly loam, alluvial fan phase (2-5% slopes) (Cb).**—This inextensive soil occurs principally in the eastern part of the county along the edge of the major valleys where the streams from the steeper uplands enter. It is usually in fan-shaped areas, the narrow end of each area pointing upstream. Texture is variable; it is lighter and more gravelly at the narrow end of the fan and heavier at the mouth. Inasmuch as the channels of these side streams are shallow, the soil is subject to more frequent flooring than Chagrin silt loam. Relief is gently sloping from the narrow end of the fan toward the tip, and drainage is good.

The soil profile is similar to that of Chagrin silt loam except for the lighter texture of the surface soil and the presence of gravel in all parts. The soil is also more open and porous throughout and less fertile. The apparent organic content of the surface soil is low. Surface and internal drainage are good. The soil is alkaline at an average depth of 24 inches. Included are few areas in the Harlem

Valley that are not true alluvial fans but do have a gravelly loam surface texture. The largest such area is northwest of Coleman Station.

*Use and management.*—The cultivated acreage of this soil is used for hay, corn, and oats. Crop yields, though good, average lower than those obtained on Chagrin silt loam. Lower yields result partly from lower water-holding capacity and partly from lower fertility. Pasture is usually poorer than on the silt loam; it includes more weeds but is still considerably better than that on most soils in the county.

**Charlton gravelly loam, undulating and sloping phases (3–15% slopes) (C<sub>F</sub>).**—These moderately deep well-drained soils were derived from glacial till composed chiefly of schist, with which some gneissic and granitic rock materials are mixed. Their relief is generally smooth. The principal areas are on flattened ridge tops in the Quaker Hill section. These are the dominant soils of the Charlton soil association.

The profile is strongly acid throughout and generally deficient in lime, phosphorus, potash, and organic matter. The subsoil and substratum are firm but not compact. Both surface and internal drainage are good. These phases are closely associated with the other phases of Charlton gravelly loam, with Charlton stony loam, moderately steep phase, and with the soils of the Hollis, Woodbridge, and Paxton series.

The surface soil under pasture sod has a rich-brown almost chocolate-brown color and a fine granular structure. It is mellow and about 10 inches thick in uneroded areas. The subsoil, starting below 10 inches and continuing to a depth of 20 inches, is friable light-brown or yellowish-brown gravelly loam. The lower subsoil, extending to a depth of 31 inches, is firm grayish-brown loam. Below 31 inches is the substratum, a very firm dark grayish-brown to olive-brown loam that is several feet thick and rests on the schist bedrock at depths of 4 to 6 feet. Roots penetrate all layers but are most abundant in the surface soil and upper subsoil. Throughout the profile occur many schist fragments and occasional pieces of quartz, gneiss, or granite.

The soil varies principally in the quantity of gravel in the profile and on the surface. A few areas are almost gravel-free. Most areas have been moderately eroded. Depth to bedrock also varies. Occasionally bedrock crops out, and sometimes it is as much as 10 feet from the surface.

*Use and management.*—Areas of Charlton gravelly loam, undulating and sloping phases, are usually large enough to be suited to power machinery and intensive cultivation.

Cultivated areas are used principally for corn, oats, and hay. Timothy is the chief hay crop, though some timothy and red clover are grown in mixture. Rotations vary from 5 to 7 years in length, though most operators use a 5-year rotation. Corn is grown 1 or 2 years in the rotation and followed by oats 1 year and hay 3 years. Hay is pastured 1 or 2 years on some farms before plowing again for corn. From 10 to 12 tons of manure and about 200 pounds of 20-percent superphosphate an acre are commonly applied before planting corn. From 1 to 1½ tons of lime with 150 to 200 pounds of 20-percent

superphosphate are used for oats and timothy-red clover seedings. Meadows to be mown for more than 3 years or meadows to be pastured are sometimes top-dressed with manure. Buckwheat and potatoes are sometimes grown.

Erosion is seldom serious on the gentler slopes but is noticeable where row crops have been run up and down the slope.

Much of the idle land is in areas bought for development purposes. The small percentage now forested consists mostly of plantations made on areas developed for summer estates. Used for planting are white and red pines, spruce, and fir. A few old second-growth forests occur; they include red and white oaks, chestnut, hard maple, yellow, black and white birches, ash, basswood, and hemlock.

Adequate fertilization and liming are the first needs of these phases. If rotations and management practices suggested in table 7 are followed, they are productive of most crops. Little success has been had with alfalfa, which apparently cannot tolerate the low fertility level of the subsoil. Ladino clover has been used successfully in other areas for hay and pasture and appears to be the most promising long-lived legume for seeding mixtures.

About 150 acres of Charlton stony loam, undulating and sloping phases has been included with these phases and is shown on the map by boulder symbol. The soil profile of this inclusion is similar to that of Charlton gravelly loam, undulating and sloping phases, but large boulders on the surface prohibit cultivation. This included acreage can be used for pasture, and if the stones were removed, it could be used like Charlton gravelly loam, undulating and sloping phases.

**Charlton gravelly loam, moderately steep phase (15–30% slopes) (Cb).**—This soil differs from Charlton gravelly loam, undulating and sloping phases, in having steeper slopes. The relief, though strongly sloping, is generally uniform. Runoff is rapid, but the soil is permeable and absorbs water rapidly. The areas range from 2 to 60 acres and average 20 acres in size.

The profile, strongly acid throughout, is similar to that of Charlton gravelly loam, undulating and sloping phases. The surface soil has been slightly more eroded and averages 7 inches in thickness. Both surface and internal drainage are good. This phase is closely associated with other phases of Charlton gravelly loam and with the shallow soils of the Hollis series.

*Use and management.*—Cultivated areas of this soil are used principally for corn, oats, and hay. The rotation is generally long, about 7 years in most areas. Corn and oats are each grown 1 year in the rotation; then hay is maintained until the crop fails, after which the meadows are pastured. Applications of fertilizer and lime are similar to those used on Charlton gravelly loam, undulating and sloping phases, but are made less frequently because the rotations are longer. Meadows are top-dressed with manure on some farms after the second or third cutting with good results, but this is not a common practice.

The soil should be cultivated across the slope on the contour in order to retard runoff, keep as much water on the land as possible, and control erosion. On long slopes strip cropping should be practiced. The permeable soil absorbs water rapidly and makes such practices es-

pecially effective. Where small areas of this soil are associated with gently sloping areas of Charlton gravelly loam, methods of management applicable to this soil should be followed on the adjacent more gently sloping areas. Erosion is rarely serious except during extremely heavy rains or where row crops are run up and down or diagonally across the slope.

The condition of rotation pastures is generally fair. In areas used for rotation pasture after the hay crop fails, timothy, Kentucky bluegrass, wild white clover, and some red clover are found. Areas that have been in pasture for some time generally have forage of poor quality. Many weeds, poverty oatgrass, and redtop generally constitute the stand. Most of the older pastures need lime and phosphorus; a few should be reseeded. The old pastures on this soil generally contain no legumes or bluegrass and are difficult to improve without reseeding, even though adequately limed and fertilized.

**Charlton gravelly loam, steep phase (30-45% slopes) (CE).**—The relief of this phase is steep but generally uniform. The areas, varying from 2 to 12 acres or more in size, are associated with other phases of Charlton gravelly loam.

The profile is similar to that of Charlton gravelly loam, undulating and sloping phases, but the surface soil is generally only 5 or 6 inches thick in cultivated or pastured areas. The soil is 4 to 5 feet thick over bedrock, and the underlying bedrock crops out more frequently than on the more gently sloping phases. The soil is acid throughout the profile.

A moderately large acreage of Charlton stony loam, steep phase, is included with this soil. It is similar in characteristics but generally too stony for cultivation and is best used for forest.

*Use and management.*—The cultivated areas of this soil, mainly on slopes of less than 35-percent gradient, are used principally for hay crops, oats, and pasture. Corn and other row crops are seldom grown. Hay seedings sometimes may be maintained for hay and pasture for 10 or 15 years. Few operators fertilize and lime while the soil is in hay and pasture, though some manure is commonly returned. After the hay crop fails, the meadows are generally pastured before reseeding. First-year clover and timothy hay may yield a ton an acre in good seasons. Yields decline rapidly after clover disappears from the stand. Ladino clover appears to be a long-lived legume that would maintain yields for longer periods if given good treatment.

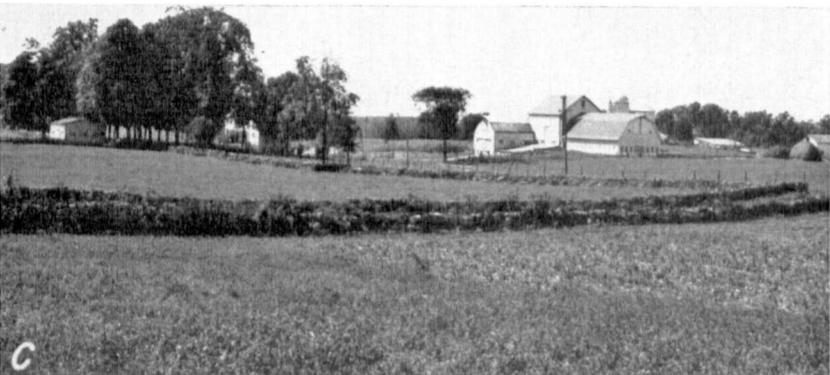
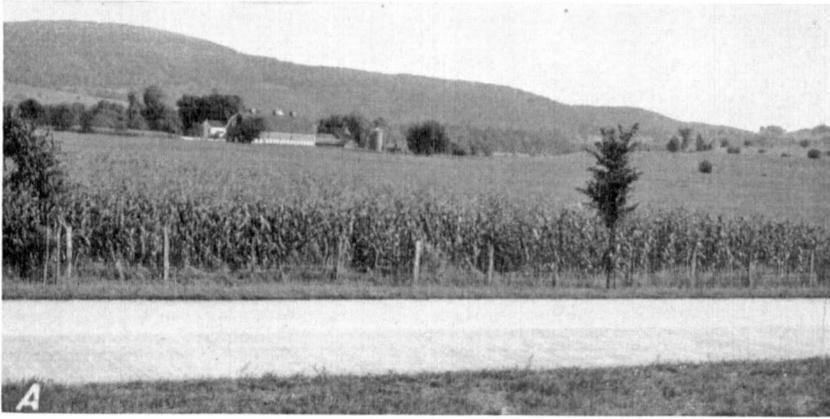
Pasture is generally poor and seldom receives lime or fertilizer. Redtop is the principal grass in old pastures, but the percentage is low in comparison with the poverty oatgrass, hawthorn, and other weedy growth. Rotation pastures, generally somewhat better, contain timothy, some Canada bluegrass, and wild white clover.

It probably would be well to reforest the steeper idle areas, though natural reseeding will occur in time. The forest is second-growth hardwoods in old wood lots, evergreen plantations in a few areas, and the first species in several of the successions of young forest growth that naturally develop on old abandoned areas of this soil (7).

**Charlton stony loam, moderately steep phase (15-30% slopes) (CG).**—This soil is mapped on the stony slopes of Quaker Hill and Chestnut Ridge in closer association with the Hollis soils than with



- A*, Alfalfa has winterkilled on moderately well to imperfectly drained Albia gravelly silt loam, gently sloping phase, in foreground but persists on well-drained Troy soil in background.
- B*, Crops on drumlins of well-drained Bernardston gravelly silt loam, sloping phase, and its moderately well to imperfectly drained associate, Pittstown gravelly silt loam, nearly level and gently sloping phases. Pasture on poorly drained Stissing and Mansfield soils in foreground.
- C*, In many valleys dairy farming centers on Copake gravelly loam, nearly level and undulating phases; forested areas are Rough stony land (Gloucester, Hollis, and Chatfield soil materials); pastured slopes are Gloucester gravelly loam, rolling phase.



*A*, Dairy farm on Copake gravelly loam, nearly level and undulating phases.  
*B*, Landscape showing billowy relief of some areas of Cossayuna gravelly loam, undulating and rolling phases.  
*C*, Fences of stone picked from the soil of a dairy farm.

other soils of the Charlton series. A few areas occur on the ridge tops. Many large loose angular and subangular masses of schist rock are on the surface. Outcrops of underlying schist bedrock occur more frequently, especially on steeper slopes, than on Charlton gravelly loam, moderately steep phase. Relief is uniform but strongly sloping.

The soil profile in pastured areas is similar to that of Charlton gravelly loam, moderately steep phase, except many schist rocks are on and in the soil. The soil is strongly acid and well-drained. It varies somewhat in depth, but bedrock occurs at an average depth of 5 feet. Erosion has been slight to moderate on most areas that have not remained in forest. On several small areas it has been severe, and most of the original surface soil has been lost.

*Use and management.*—Pasture on this soil is generally poor and overgrown with weeds and brush. Redtop and fescue are the best pasture grasses in the stand, but poverty oatgrass and weeds predominate. The principal care given pasture is the occasional removal of brush. Phosphorus, lime, or other fertilizers are usually not applied, partly because applying them by hand is difficult. Several acres of pasture are needed to support one cow for the pasture season. Improving the pasture with machinery is difficult because of stoniness, and, where more desirable soils are available, it would probably be better to reforest this soil. On some farms, however, this is the only soil available for pasture. Pasture could be greatly improved (see table 7) by removing brush and many of the loose stones, applying lime and phosphorus, and sowing adapted pasture mixtures.

A small percentage of this stony type on more gently sloping areas has had enough stones removed to permit cultivating and mowing around the remaining large stones and rock outcrops. Oats and timothy are the main crops on this acreage. Timothy is seeded with the oats and maintained until it fails.

The forest consists mostly of second-growth trees—beech, hard maple, white, red, and chestnut oaks, black cherry, shagbark hickory, basswood, hemlock, and ash.

**Chatfield stony loam, ledgy<sup>3a</sup> rolling phase (5–15% slopes) (Cr).**—This shallow soil has numerous outcrops of bedrock. It is well-drained but low in plant nutrients and droughty. It was derived from shallow deposits of glacial till composed chiefly of granite and gneiss rock materials. Relief is irregular and choppy. The moisture reserve is not great, and vegetation is injured in dry seasons.

This soil is associated with soils of the Gloucester, Sutton, and Whitman series and with large areas of rough, stony land in the mountainous regions underlain by crystalline rocks. The areas range from a few acres to 900 acres in size. They occur mainly on the Housatonic and Hudson highlands; smaller areas are on Stissing Mountain.

The surface soil in meadows is 8 inches of dark-brown or ruddy-brown loam of fine crumb structure. The subsoil, extending from below 8 inches to a depth of 16 inches, is loose friable light rusty brown gravelly loam. Next in profile is dark yellowish-brown gritty light silt loam, which rests on granite bedrock at a depth of about 24 inches. The soil is strongly acid throughout; roots penetrate all

<sup>3</sup>Ledgy indicates exposures of bedrock.

layers. In some areas the subsoil is slightly stained with rust brown and gray just above the zone of contact with the bedrock. Much gravel and many fragments of gneiss and granite occur everywhere in the profile.

*Use and management.*—The cultivated areas of this soil are on the gentler slopes and are used principally for hay. Oats and buckwheat are sometimes grown, but yields are low. Meadows, consisting mostly of wild grasses with a little timothy or redtop, are mowed for long periods without reseeding.

Pasture is poor. The principal grasses are poverty oatgrass and redtop, and there are many weeds and briars, sumac, and much brush. In summer, pasture usually produces almost no feed because moisture is lacking. The forest on this soil, mostly second-growth hardwoods, includes red, white, and post oaks, hard maple, chestnut sprouts, dogwood, chestnut oak, beech, yellow and black birches, ash, basswood, and some white pine and hemlock.

In most places the soil is best used for forest. Yields of field crops and pasture cannot be improved much because the soil is low in moisture-holding capacity. Outcrops make tillage extremely difficult.

**Chatfield stony loam, ledgy hilly phase** (15–30% slopes) (C<sub>H</sub>).—Except for steeper more irregular slopes, this soil is similar to the ledgy rolling phase of Chatfield stony loam. Outcrops of bedrock are also more numerous.

*Use and management.*—Most of this soil is forested; a small acreage is pastured. It is even more droughty than the ledgy rolling phase because runoff is greater and average depth to bedrock is usually less. The soil is best used for forest.

**Claverack gravelly loam** (0–5% slopes) (C<sub>J</sub>).—This moderately well-drained to imperfectly drained soil was derived from about 3 feet of alternating layers of sand and gravel over calcareous silt and clay. These heavy-textured compact materials in the substratum retard downward movement of water and cause periodic water-logging of the lower layers of sand and gravel. Nevertheless, drainage is good enough to permit successful use of the soil for the crops commonly grown on dairy farms. The sand and gravel from which the soil was derived consist mainly of acid slate and shale and calcareous sandstone with some limestone. The relief is nearly level. The soil occurs in small units of 2 to 30 acres throughout the lake plain region in the western part of the county. The most extensive areas are near Rhinebeck.

The 11-inch surface soil is dark grayish brown, friable, and granular. The upper subsoil, extending to a depth of 17 inches, is yellowish-brown friable gravelly loam of fine blocky structure. The surface soil and upper subsoil are strongly acid. The subsoil from a depth of 17 to 24 inches is brown gravelly sandy loam, mottled with yellow, gray, and rust brown. It is firm in place, friable, and only slightly acid. Below 24 inches and down to 36 inches is the lower subsoil, a yellowish-brown silt loam mottled with gray and rust brown. This lower subsoil breaks out into soft somewhat plastic nut-sized fragments and is neutral to slightly alkaline. Below 36 inches is very compact stratified grayish-brown silty clay that breaks

out into large blocky fragments. The upper part of this compact material is slightly alkaline but the lower part is strongly alkaline or calcareous. Roots penetrate the upper horizon most abundantly and are also present in the lower subsoil. Few roots are found in the silty clay substratum.

The soil varies in surface texture and in reaction of the subsoil. A few included areas closely associated with this soil and not of sufficient size to justify a separation have a fine sandy loam surface texture. The lower subsoil in some areas is not everywhere alkaline; it may be neutral or even slightly acid. The underlying silty clay, however, is always alkaline or calcareous.

*Use and management.*—This soil is suited to intensive cultivation if it receives adequate lime, fertilizer, and manure. The cultivated areas are used almost entirely for corn, oats, timothy, and clover. Alfalfa is grown in mixture with timothy and clover but is generally gone from the stand after 2 years of cutting. Rotations followed are somewhat varied. Frequently corn is planted 1 or 2 years and followed by 1 year of oats and 2 or 3 years of hay. From 6 to 8 tons of manure is applied for corn; meadows are top-dressed with 4 to 6 tons of manure if it is available. From 400 to 500 pounds of superphosphate is used in the rotation; it is applied for corn, oats, or meadow, and usually with the manure. The soil is acid, but few farmers use lime.

About half the pasture is rotated. It follows the second or third year of hay mowing and supports a fair to good cover consisting of bluegrass, timothy, red clover, some redtop, and a small percentage of weeds. Permanent pasture supports a poorer vegetation having a high percentage of weeds and poverty oatgrass.

Much of the idle land is on estates not now farmed. These idle areas are potentially suited to cultivation. The soil is poorly suited to orchards and is not used for commercial orchards.

**Colonie fine sandy loam, nearly level phase (0-3% slopes) (CL).**—This well-drained light-textured soil is free of stones and almost level. It has developed from thick deposits of acid and calcareous sands deposited over glacial lake sediments of silt and silty clay. The sand deposits came mainly from acid slate and shale and calcareous sandstone rock materials and are 5 to 7 feet or more deep over the silty clay.

Areas of this soil occur mainly in the level lake plain near Red Hook and Rhinebeck, though some are scattered throughout the lake-plain region from the Columbia County line south to Beacon. The total acreage is small. The areas range from 2 to 200 acres in size but most of them are small (30 to 50 acres).

The 12-inch surface soil under old sod is dark grayish-brown, mellow, and finely granular. The subsoil from 12 to 30 inches is friable yellowish-brown fine sandy loam. The surface soil and subsoil are medium acid and filled with roots. The soil extending from 30 to 68 inches is light-brown very fine sandy loam, firm but friable, well-penetrated with roots, and slightly acid or neutral. From 68 to 79 inches is a brown, slightly compact, slightly alkaline, fine sandy loam of firm fine blocky structure that has roots throughout its depth. The underlying stratified grayish-brown to light olive-brown silty clay

loam is alkaline in its upper layers and calcareous below. The clayey material may not occur above a depth of 10 or 12 feet.

The depth to an alkaline reaction in the subsoil varies within short distances in the same area. The subsoil is usually neutral within 42 inches of the surface. Staining is sometimes encountered in the sands immediately above the silty clay. The soil varies in texture and reaction of the subsoil.

Areas having a loamy fine sand texture were included in mapping. These areas are not so extensive as the fine sandy loam and, for the most part, are in large estates. Drainage in these places is inclined to be excessive. The largest area of the loamy fine sand occurs just northwest of Staatsburg along the Hudson River; smaller areas occur near Camelot and Stoneco.

*Use and management.*—Colonie fine sandy loam, nearly level phase, is at least moderately productive of a large number of crops and is highly responsive to good management that includes applications of manure, lime, and fertilizer. The large estates have much idle land and many are located along the Hudson and extend back from the river.

Cultivated areas are used chiefly for corn, oats, timothy, red clover, alfalfa, and fruit. Some truck crops and small fruits are also grown. The rotations followed are varied. On dairy farms corn is commonly grown 1 or 2 years and followed by 1 year of oats and 2 or 3 years of hay. When available, 8 to 10 tons of manure supplemented with 200 to 400 pounds of 20-percent superphosphate is applied before planting corn. Lime as needed, and 150 to 200 pounds of superphosphate is applied for oats used as a companion crop for timothy-red clover or timothy alfalfa seedings. Commercial fertilizer is used for truck crops and small fruits where little or no manure is available. Apples, peaches, and cherries are the principal orchard fruits. Many orchards are clean-cultivated and fertilized with manure and nitrate of soda.

The pastures, almost entirely rotated with tilled crops, usually support fair to good vegetation. The condition of the pasture depends upon treatment the hay meadow receives previous to pasturing and the number of years the soil is kept under sod. Without top dressings of manure or of manure and phosphate, the soil is soon depleted, the sod becomes poor, and many weeds appear. Idle areas generally are run-down and support a sparse growth consisting of weeds, principally goldenrod, and some grasses.

The native forest includes hemlock, hard and soft maples, white, red, black, and chestnut oaks, hickory, black birch, beech, and flowering dogwood.

**Colonie fine sandy loam, rolling phase (5-15% slopes) (CM).**—Gentle slopes and irregularly rolling areas occurring mainly adjacent to the Hudson River are occupied by this soil.

The surface soil in cultivated areas has been slightly to moderately eroded in most places and ranges from 7 to 8 inches in thickness. The soil profile is otherwise similar to that of Colonie fine sandy loam, nearly level phase, and has the same variations in surface texture and reaction. Under clean cultivation the soil tends to erode severely, but in its present use few areas are seriously eroded. Corn was the only row crop grown on this soil at the time of mapping.

*Use and management.*—The cultivated areas of this soil are used mostly for corn, oats, hay, and orchard fruits. Orchards are generally maintained in sod. The prevailing practices of tillage, crop rotation, and fertilization are similar to those used on the nearly level phase. Corn, however, is normally grown only once in the rotation. The soil is considerably more droughty than the nearly level phase, and crop yields are correspondingly lower.

The areas now idle have been cultivated in the past and are potentially suited to that use. Most of the idle areas are on estates, where farming has been discontinued.

Good management should provide rotations that include fewer row crops and more leguminous sod-forming crops that aid in maintaining the level of organic matter and nitrogen, retarding runoff, conserving water, and reducing erosion. The irregular relief makes strip cropping difficult. Good water control can be obtained by using adapted rotations that are adequately limed and fertilized.

**Colonie fine sandy loam, hilly and steep phases (15–35%) (Ck).**—These soils differ from the other phases of Colonie fine sandy loam principally in relief and position. They are not true terrace soils. They occur on steeper slopes in the glacial lake plain region of the county. The relief is strongly sloping and in many areas irregular. Slopes are dominantly in the 15 to 35 percent range but reach 60 percent in places. Only about 150 acres has a slope of less than 25 percent. The soil has been severely eroded in most cultivated areas and has lost more than 75 percent of the original surface soil. The areas usually cover 5 to 60 acres and occur in the western part of the county on the steeper slopes east of and adjacent to the Hudson River. They are associated with the other phases of Colonie fine sandy loam and with the soils of the Hudson and Hoosic series.

The present surface soil is light brown, loose, friable, and about 5 inches thick. The upper subsoil is friable structureless yellowish-brown fine sandy loam that extends to a depth of 20 inches. The lower subsoil is similar to that of the nearly level phase in thickness, color, reaction, and structure but occurs closer to the surface in most areas. The underlying clay usually occurs at depths greater than 42 to 60 inches.

The soil ranges in texture from fine sandy loam to light loam but usually has a light-textured subsoil. The principal area having a loam texture occurs about 1 mile south of Hyde Park on the breaks of the terrace west of United States Highway No. 9.

*Use and management.*—Many areas of this soil now forested were at one time pastured. The practice of pasturing forested areas has been mostly discontinued, and erosion is fairly well stabilized. Active erosion is evident on most idle areas. No gullies develop, but during heavy rains there is much sheet erosion. Erosion is best controlled under forest cover or a heavy sod.

The forest vegetation includes white pine, hemlock, hard and soft maples, white, red, and black oaks, black locust, hickory, black birch, beech, and flowering dogwood. Black locust comes back in idle areas if old seed trees are nearby.

**Copake fine sandy loam, nearly level and undulating phases (0–8% slopes) (CN).**—These phases are similar to the nearly level and

undulating phases of Copake gravelly loam in relief and in general soil characteristics except texture. The areas occur in the western part of the county on the Hudson River terraces south of Poughkeepsie. Other small areas are scattered outside of this general region. These soils are nearly level to undulating, free of stone and gravel, easy to work, and highly responsive to management.

The 12-inch surface soil under sod is dark brown, mellow, finely granular, and well penetrated with grass roots. The upper subsoil is structureless mellow very fine sandy loam that extends to a depth of 20 inches. The subsoil below 20 inches to a depth of 36 inches is firm but friable dark yellowish-brown gravelly fine sandy loam. This layer and those above are medium to strongly acid. The subsoil below 36 inches down to 48 inches is structureless dark yellowish-brown gravelly sand that is only slightly acid. Loose gray-brown gravelly coarse sand, about neutral in reaction, extends from 48 inches to a depth of 60 inches. From 60 inches to 18 or 20 feet is stratified slate-gray gravelly sand and coarse gravel coated with lime carbonate and somewhat cemented together. The gravel throughout the profile came from slate, shale, sandstone, limestone, and quartz.

The profile varies considerably in reaction. The surface soil is more strongly acid than that of Copake gravelly loam, nearly level and undulating phases. The alkaline material is usually at a depth of about 42 inches but it may be deeper in some areas. Calcareous materials occur at varying depths ranging from 5 to 8 feet below the surface. Roots, especially of alfalfa and red clover, penetrate all layers. These phases are droughty and less fertile than Copake gravelly loam, nearly level and undulating phases.

*Use and management.*—Copake fine sandy loam, nearly level and undulating phases, occupies small areas of 3 to 20 acres.

The cultivated areas are used for orchard fruits, alfalfa, timothy, red clover, corn, and oats. The rotations followed and fertilizer treatments used are similar to those for Copake gravelly loam, nearly level and undulating phases, but yields are somewhat lower.

Pastures are confined mainly to old meadows and are generally fair to good. They contain red clover, timothy, redbud, poverty oatgrass, Canada bluegrass, a little wild white clover, and daisy, goldenrod, wild aster, yarrow, mullein, and other weeds. Old permanent pastures, most of which are not treated, contain more weeds and poverty oatgrass. Pastures are damaged during very dry seasons because these phases are inclined to be droughty. Idle areas are suitable for cultivation but need much organic matter and fertilizer.

These phases are exceptionally well suited to early vegetables. They warm quickly in spring and are easy to work. They are productive of most crops when well managed but decline in productivity if management is poor.

**Copake gravelly loam, nearly level and undulating phases** (0–8% slopes) (Cr).—These are highly productive nearly level well-drained phases derived from stratified outwash sand and gravel that contains sufficient calcareous sandstone or limestone materials to make them calcareous in the deep substratum. The parent material also contains slate, shale, and schist, but less of these than are in parent material for the acid soils of the Hoosic series. The soils occur

on smooth or gently undulating terraces in the Copake soil association and in valleys in the central and western parts of the county. Areas vary from 2 to 70 acres in size. Slopes range from 0 to 8 percent but are mostly less than 5 percent.

The dark-brown gravelly loam surface soil is friable, granular, well penetrated with roots, and about 11 inches thick. The upper subsoil is a firm but friable yellowish-brown gravelly loam slightly heavier than the surface soil. The subsoil, from a depth of 20 to 38 inches, is dark yellowish-brown gravelly coarse sandy loam. To a depth of 38 inches the layers are medium to slightly acid. Below 38 inches down to 44 inches is loose grayish-brown fine gravel and sand, only slightly acid or neutral. The substratum occurs below 44 inches; it is stratified loose grayish-brown gravel and sand, calcareous, and slightly cemented by a lime-carbonate coating on the gravel below 50 or 60 inches. The gravel consists of sandstone, limestone, schist, quartz, slate, and shale. Roots penetrate all layers. Internal drainage is good.

These soils vary in reaction of the surface soil, depth to alkaline and to calcareous materials, and depth of the surface soil. The surface soil is moderately to strongly acid in some areas and slightly acid in others. The subsoil is seldom alkaline above 30 inches and usually is acid to a depth of 40 inches. The depth to calcareous materials varies from 4 to 8 feet. The surface soil ranges from 8 to 12 inches in thickness. It has been slightly to moderately eroded where gently sloping, but erosion is never severe. A few included areas have almost gravel-free surface soil.

*Use and management.*—Many farms are supported mainly by Copake gravelly loam, nearly level and undulating phases (pl. 1, C). Cultivated areas are used principally for corn, oats, and hay in support of dairying (pl. 2, A), and to some extent for fruit. The rotations vary as to the crops included and the length.

From 8 to 10 tons of manure supplemented with 200 to 300 pounds of 20-percent superphosphate is usually applied for corn. Lime is applied with 150 to 200 pounds an acre of 20-percent superphosphate on areas prepared for oats that are to be sown as a companion crop for seedings of hay plants. The quantity of lime applied varies from  $\frac{1}{2}$  to  $1\frac{1}{2}$  tons an acre. Alfalfa, timothy, and red clover are the principal hay crops. Once alfalfa is established, it is commonly maintained without fertilization for 4 or 5 years, or until the yields fail.

Pastures are confined to run-out meadows, which are pastured 1 or 2 seasons before plowing. They generally are fair to good and contain timothy, some red clover, bluegrass, redtop, wild white clover, and a small quantity of weeds. Few areas except small ones associated with soils of low productivity are left idle, but these are suitable for cultivation.

**Copake gravelly loam, rolling phase (5–15% slopes) (CR).**—This soil occurs in association with Copake gravelly loam, nearly level and undulating phases, but on the more rolling terraces and on the sloping faces of the level terraces. Its stronger slope and more rolling relief distinguish it from the nearly level and undulating phases. Areas are generally small (5 to 10 acres), though a few range from 25 to 35 acres in size.

The soil profile is similar to that of Copake gravelly loam, nearly level and undulating phases. Sheet erosion has been moderate; 25 to 75 percent of the original surface soil has been lost in most places. The average thickness of the present surface soil is 7 inches, but the range is from 4 to 10 inches. Erosion has been severe on a few included areas, which have lost most of the original surface soil.

*Use and management.*—Cultivated areas of this soil are used and managed in much the same way as the cultivated areas of the nearly level and undulating phases. Yields are usually less, however, for the soil is shallower over the gravelly substratum and lower in water-holding capacity. Runoff is also greater. Wherever feasible, crops should be planted across the slope and with the contour to retard runoff, conserve moisture, and control erosion. Most of the longer slopes are uniform and suited to strip cropping or contour cultivation. The undulating terrace areas have irregular relief that makes contour cultivation impracticable.

**Copake gravelly loam, hilly phase (15–25% slopes) (Co.)**—The hilly relief of this gravelly droughty soil is described as kettle-and-kame topography. The soil was formerly recognized as a member of a separate series (Schodack), but because of the similarity of soil profiles, it has been combined with the Copake series. The soil has developed from cross-bedded and stratified outwash sand and gravel deposited by glacial streams in hillocks or kames. The parent material, like that of other Copake soils, is composed of limestone, sandstone, slate, schist, shale, gravel, and sand. The soil contains sufficient lime to be alkaline in the deep subsoil and calcareous in the substratum. Internal drainage is inclined to be excessive.

The soil occurs in scattered areas of 5 to 10 acres in all of the major valleys and in many small ones. It is on low hills and knolls adjacent to the smoother Copake soils of the terraces and above the small bottoms along streams. The most extensive areas are in Harlem valley. The relief is choppy and irregular.

The surface soil, beneath a sod, is dark brown, granular, friable, and acid. The upper subsoil extending from 6 to 17 inches is friable yellowish-brown gravelly loam. Below 17 inches to a depth of 36 inches the subsoil is slightly acid firm but friable grayish-brown gravelly sandy loam. Below 36 inches down to 44 inches is the lower subsoil, a loose gray gravelly sandy loam that is neutral or slightly alkaline. The substratum occurs below 44 inches; it consists of loose cross-bedded and stratified grayish-brown sand and gravel 20 feet or more thick. Lime carbonate occurs at 6 feet, and the gravel is somewhat cemented with the lime coating.

Roots penetrate all layers, even down to the free lime zone. The gravel and small stone fragments consist of sandstone, limestone, slate, shale, quartz, and chert. The light-textured gravelly substratum occurs at a slightly shallower depth than in the nearly level and undulating phases, but in general this is a much more droughty soil, mainly because of greater runoff.

The soil varies considerably in reaction of the surface soil, depth to alkaline materials, and depth to lime carbonates. The surface soil varies from slightly to strongly acid; its reaction depends greatly on previous lime treatments. Most idle areas that have been

abandoned for some time, especially the light- or sandy-textured inclusions, have a strongly acid surface soil. The depth to alkaline materials ranges from 3 to 5 feet. Calcareous materials occur at varying depths in the same kame or knoll; the range is from 4 to 8 feet.

Included with this phase are several small areas having a gravelly fine sandy loam texture. These inclusions occur principally at the foothills of Honness Mountain southeast of Fishkill in an area a little way east of Camelot, and 1 mile south of Poughkeepsie.

*Use and management.*—Cultivated areas of this soil are used for corn, oats, and hay. Alfalfa hay is the principal crop. In the dairy areas, large quantities of manure are applied with superphosphate for the corn. From  $\frac{1}{2}$  to  $1\frac{1}{2}$  tons of lime, with additional superphosphate, is applied on fields prepared for oats and hay. Alfalfa and other hay crops are maintained until yields fail.

The pastures vary greatly. In Harlem Valley are mostly rotation pastures, which contain timothy, alfalfa, red clover, and wild white clover, mixed with some wild carrot, buttercup, daisy, plantain, goldenrod, mullein, and other weeds. Weeds, dewberries, and poor grasses abound in the permanent pastures, some of which are almost barren and have only scattered clusters of sumac.

The few areas forested have the young growth that comes in on abandoned tracts—aspens, white birch, black locust, red and black oaks, hard maple, white ash, and black birch.

The soil can be used advantageously for long rotations that include leguminous hay or pasture for 4 years or more. Such shallow-rooted legumes as red, alsike, or Ladino clovers should not be used. Once established, the deep-rooted legumes such as alfalfa penetrate to the high-lime zones and have access both to more moisture and more plant nutrients. Birdsfoot trefoil appears to offer considerable possibilities for this soil.

**Copake gravelly loam, steep phase (25–45% slopes) (Cs).**—Like the hilly phase, this soil was formerly a member of the Schodack series but has been combined with Copake soils because of profile similarity. It occupies steeply sloping hillocks or kames and is associated with the hilly phase, which it is similar to in most characteristics except steepness of slope. The soil profile is generally similar but slightly less deep to the substratum of sand and gravel. Some areas that have been in poor unimproved permanent pasture are moderately to severely eroded.

*Use and management.*—This soil is droughty and its steepness makes use of machinery difficult or impossible. Most areas are used for pasture, though a few on slopes of less than 35 percent are plowed at long intervals, reseeded to hay, and pastured after the hay crop fails. In most instances the best use of the soil is for pasture or forest.

**Cossayuna fine sandy loam, undulating and rolling phases (3–15% slopes) (Cr).**—These phases, mapped as one unit, occur in small areas in the northern and along the western edge of the region occupied by calcareous sandstone soils. Most areas adjoin or are near soils developed from outwash or lacustrine sediments. The upper layers are sandy; it is probable that the sand was blown from adjacent outwash and lacustrine areas. The relief is undulating or bil-

lowy—that typical of Cossayuna soils. A few areas with steeper slopes have been included.

The surface soil is dark-brown mellow finely granular fine sandy loam, medium to strongly acid, well penetrated by roots, about 11 inches thick, and much lower in gravel content than other Cossayuna soils. The surface soil in some areas is almost gravel-free. The subsoil from a depth of 11 down to 16 inches is acid friable light-brown gravelly fine sandy loam. Below 16 inches and to a depth of 26 inches the subsoil is yellowish-brown gravelly loam, firm in place but nevertheless friable. (This last layer and those below it are like those of Cossayuna gravelly loam phases.) Below 26 inches and to a depth of 35 inches occurs the deep subsoil, a heavy moderately compact light-brown or dark yellowish-brown gravelly loam or light silt loam. The substratum, beginning below 35 inches, is compact grayish-brown gravelly loam, slightly acid in the upper part, but becoming alkaline and, in some places, calcareous with depth.

The surface soil and subsoil layers above the substratum are acid. Bedrock occurs at varying depths but is usually 4 to 6 feet below the surface. Roots penetrate all parts of the surface soil and subsoil but are most abundant in the surface soil. Internal and surface drainage are good. There has been slight to moderate erosion in most areas that have been cultivated, but erosion does not seem to be a serious problem.

*Use and management.*—Over four-tenths of Cossayuna fine sandy loam, undulating and rolling phases, is cultivated. The idle land occurs mainly near or in city developments. Most of the acreage in forest has never been cultivated and supports fair stands of second-growth hardwoods. The areas cultivated in the northern part of the county are principally in fruit. Other cultivated areas are used for dairy-farm crops.

Five- or six-year rotations are used. Corn is commonly followed by 1 year of oats and 3 years of hay. Hay is occasionally manured the second year and pastured for 1 or 2 years thereafter. From 10 to 12 tons of manure supplemented with 200 to 400 pounds of superphosphate is applied for corn. About a ton of lime and 200 to 300 pounds of 20-percent superphosphate are applied to fields prepared for small grains, usually oats. The oats are used as a nurse crop for hay seedings.

Yields are somewhat lower than on the undulating and rolling phases of Cossayuna gravelly loam. Management needs are generally similar to those of Cossayuna gravelly loam, undulating and rolling phases.

**Cossayuna gravelly loam, undulating and rolling phases (3–15% slopes) (Cx).**—Much of the prosperity of the good farms in the Cossayuna soil association in the western half of the county depends upon these moderately deep well-drained undulating to rolling phases. They are among the more extensive upland soils. They have developed from glacial till containing chiefly calcareous sandstone but also some acid slate and shale and very small quantities of limestone. Close associates of these phases are other phases of Cossayuna gravelly loam and the Troy, Albia, Boynton, and Mansfield soils, which were derived from similar material.

These phases contain enough lime to be alkaline or calcareous in the deep subsoil, though their surface soil is medium acid. They range from 2 to 10 feet in depth but are dominantly about 5 or 6 feet deep. The bedrock crops out at wide intervals. Relief is undulating to gently rolling. Much of the area appears somewhat billowy when viewed from a distance (pl. 2, *B*). In most areas slopes are below 8 percent.

The cultivated surface soil is mellow and grayish brown; it contains considerable rounded quartz and sandstone gravel, small flat shale and slate fragments, and subangular flaggy pieces of calcareous sandstone and limestone. This layer varies from 8 to 14 inches in thickness but on most cultivated areas averages about 9 inches. It is underlain by a yellowish-brown or light-brown firm but friable gravelly loam subsoil, which rests on yellowish-brown compact gravelly silt loam at depths of 20 to 24 inches. The slightly compact layer, 7 to 10 inches thick, breaks out easily into firm small irregular blocks. Replacing this compact layer at an average depth of 32 inches is the deep substratum, a compact light grayish-brown or olive-brown gravelly loam glacial till that breaks into medium to large irregular firm blocks. This deep substratum varies from 2 to 6 feet in thickness and rests upon bedrock at an average depth of 6 feet. The underlying bedrock crops out in some areas. Such outcroppings are not frequent and interfere little with tillage.

Roots penetrate all layers but are most abundant in the surface soil. Both surface and internal drainage are well established but not excessive. There are many small stones and a few boulders throughout the profile and occasionally on the surface. Stone fences surrounding many of the fields indicate that much of the soil was once stony (pl. 2, *C*). The stones in the soil are mostly calcareous sandstone. Many of them, when broken, effervesce at the center if treated with hydrochloric acid. Upon weathering these stones probably contribute some lime to the soil.

Included with these phases are several areas with a silt loam texture that did not have sufficient total area to justify another type separation. Under good management, however, these areas are slightly more productive than the undulating and rolling phases of Cassayuna gravelly loam, the unit with which they were included.

The quantity of gravel in the surface soil varies in these phases, but no area has gravel enough to interfere greatly with cultivation. The soils also vary somewhat in quantity of original surface soil lost through erosion. Nearly all areas that have been cultivated for a long time are moderately eroded, whereas a few that are forested show no evidence of erosion.

*Use and management.*—In the northern part of the county Cassayuna gravelly loam, undulating and rolling phases, is intensively used for fruits; in the vicinity of Poughkeepsie, for vegetables; and in other parts of the county for dairy-farm crops. The pasture is mostly the rotation kind. The idle acreage is nearly all potentially good cropland. Actually, much of it is idle only temporarily. The forested areas are covered mainly with hardwoods—oak, maple, hickory, dogwood, and tulip, with some ash, basswood, hemlock, and beech.

Rotations vary considerably. A 5- to 6-year rotation is most commonly used in the dairy areas. Corn for 1 or 2 years, followed by oats for 1 year and hay for 3 years, is the general rotation. Hay meadows are sometimes pastured 1 or 2 seasons in addition. In the truck-crop areas no regular rotations are followed. In the fruit areas these phases are kept in one crop for long periods. Corn, oats, timothy, timothy and clover, clover, and alfalfa are the common crops grown in support of dairying. Most hay crops are mixtures rather than pure stands. The principal vegetables grown are sweet corn, tomatoes, cabbage, potatoes, and beans. Among the small fruits grown are grapes, strawberries, and some raspberries and blackberries; the total acreage in fruit is small.

About 10 or 12 tons of manure and 200 to 400 pounds of 20-percent superphosphate an acre are usually applied for corn. A ton of lime is commonly applied before oats used as a companion crop for hay seedings. Some farmers add 200 pounds of superphosphate for oats.

In truck-crop areas, where sweet corn instead of field corn is grown in the rotation, many growers apply 150 to 200 pounds of 5-10-5 fertilizer in the row at planting, in addition to the manure and phosphate. Where manure is not applied for the corn, 300 to 400 pounds of commercial fertilizer, either 5-10-5 or 4-12-4, is applied. Beans, sometimes grown in the rotation, are treated with manure and phosphate in the same way as corn. Tomatoes are sometimes substituted for corn, or are grown the second season in the rotation. In addition to the manure and phosphate usually applied for corn, tomatoes receive 200 to 300 pounds of 5-10-5; and where manure and superphosphate are not used, at least 500 pounds an acre of commercial 5-10-5 or 4-12-4 is applied.

In most areas surface water does not run off rapidly and erosion is not serious. On the stronger slopes cultivation should be done across the slope to retard runoff, conserve water supplies for plants, and prevent erosion. Strip cropping of the long slopes may be desirable. In most dairy areas alternate fields on long slopes are kept in sod. In truck-crop and fruit areas where large acreages are clean-cultivated, the danger of erosion is greater and more care should be taken to run the rows with the contour rather than up and down the slope. The natural relief on about 40 percent of these areas is billowy, so contour cultivation is impractical.

**Cossayuna gravelly loam, eroded undulating and rolling phases (3-15% slopes) (Cv).**—These phases, mapped as one unit, are closely associated with other phases of Cossayuna gravelly loam and occur in scattered areas throughout the Cossayuna soil association in regions occupied by calcareous sandstone soils. The total acreage is small; the largest areas are south and southeast of Hughsonville. The relief is generally billowy and induces rapid runoff of water. Few areas have been gullied, but serious sheet erosion has resulted from poor use and management. All areas have lost more than 75 percent of the original surface soil; some have lost all of it.

The present surface soil, developed from plowing the upper subsoil, averages 7 inches in thickness. It is more gravelly and lighter brown than the surface soil of the undulating and rolling phases. The subsoil from a depth of 7 inches down to 11 inches is light-brown friable

gravelly loam; below this lies slightly compact yellowish-brown silt loam 10 or 11 inches thick. The substratum is light grayish-brown gravelly loam. It occurs at about 22 inches, or at a shallower depth than in virgin areas of the undulating and rolling phases. The soil is acid in the upper layers, neutral or slightly acid in the upper substratum, and alkaline in the deep substratum.

*Use and management.*—Practically all of Cossayuna gravelly loam, eroded undulating and rolling phases, has been cleared and intensively cultivated, but only about three-tenths of it is now cropped. Most of the idle acreage could be cropped if it were well managed. Much of it has been out of production for some time and is run-down. The greater part of the forested land has reforested naturally after a period of cultivation. Nearly all cultivated land is used for general farm crops. The methods of management and crop rotations followed are practically the same as those used on areas of the undulating and rolling phases.

Long rotations that keep the soils in sod most of the time are desirable. Heavier applications of fertilizer and more frequent manuring than on the undulating and rolling phases are necessary to build up fertility. It may be necessary to eliminate corn from the rotation on the areas that are particularly erodible. Under proper management permanent pasture could be established and maintained. Adequately fertilized long-lived legumes such as alfalfa or Ladino clover should be used for areas kept a long time in hay or pasture. Clean cultivation of orchards should be avoided. Yields are lower than on the undulating and rolling phases.

**Cossayuna gravelly loam, hilly phase (15–30% slopes) (Cw).**—The small total acreage of this soil occurs in areas closely associated with other Cossayuna soils and with soils of the Albia, Staatsburg, and Troy series. Slopes average less than 21 percent. Surface water runs off rapidly if not carefully controlled. About 75 percent of the total area has at one time been cleared of forest and stone and intensively cultivated. Most areas are slightly to moderately eroded.

The profile is similar to that of the undulating and rolling phases, though the surface and subsoil layers are usually slightly thinner. Though the lower subsoil and substratum are compact, internal drainage is good. Both the surface soil and subsoil are acid; the substratum is neutral to alkaline.

Small areas of this soil frequently occur on short slopes adjacent to the undulating and rolling phases of Cossayuna gravelly loam. Methods of management suitable for this soil therefore should be used on the adjacent areas also. A few areas on long slopes are large enough to permit strip cropping. About 70 percent of the total acreage is on slopes uniform enough for contour cultivation; the rest is too irregular and undulating for such cultivation.

*Use and management.*—About a third of the cropland on this soil is in orchards; the rest is used for dairy-farm crops. Most orchardists use a sod to control runoff and erosion. Where orchards are cultivated, tillage is commonly done on the contour as much as possible, and sod strips are left between the trees.

Rotations on dairy farms generally last 6 or 7 years; they consist of 1 year of corn, 1 year of oats or wheat, 2 or 3 years of hay, and 2 or

3 years of pasture. Cultivation is done across the slopes if they are uniform, but for most effective control of runoff the rows should be run with the contour as closely as possible. Slopes that are too irregular should not be planted to clean-cultivated crops. Quantities and kinds of fertilizers applied each rotation are about the same as on the undulating and rolling phases, but this means a smaller average application each year because a longer rotation is used.

**Cossayuna gravelly loam, eroded hilly phase (15–30% slopes) (C<sub>U</sub>).**—Scattered areas of this soil occur with other phases of Cossayuna gravelly loam throughout the Cossayuna soil association. Slopes are for the most part very irregular. Few areas are deeply gullied, but sheet erosion has removed 75 to 100 percent of the original surface soil. On about a tenth of the total acreage, all of the original surface soil and more than 25 percent of the subsoil have been removed. Areas are chiefly small (5 to 10 acres), but a few cover 30 or 40 acres.

The profile is variable. The present surface soil was derived almost entirely from the original upper subsoil. In idle areas it may be very thin—only 2 or 3 inches thick. In cultivated areas it is usually a dark-brown gravelly loam about 6 inches thick. The subsoil starts below 6 inches and continues to a depth of 21 inches; it is a light yellowish-brown gravelly silt loam that is slightly compact in the lower half. The parent material, or substratum, occurring at approximately 21 inches, is a compact grayish-brown gravelly loam.

The upper layers of the profile are usually medium to strongly acid. The upper substratum may be slightly acid or neutral, but with depth it usually becomes alkaline or slightly calcareous. Underlying bedrock crops out in some areas, generally more frequently than on the undulating and rolling phases. The soil varies chiefly in depth and nature of its surface soil and in irregularity of relief.

*Use and management.*—About half of the cultivated area of this soil is in orchards now kept in sod; erosion has been reduced to a minimum in these orchards. The remaining cultivated acreage is used principally for dairy-farm crops. The smaller tracts adjacent to more gently undulating areas of Cossayuna gravelly loam are used under management methods described for Cossayuna gravelly loam, undulating and rolling phases; consequently, erosion is usually still active and considerable soil is washed away during periods of clean cultivation.

Since relief is mostly irregular and favorable to rapid runoff, use of a long rotation consisting mainly of sod-forming crops is desirable not only for protecting the soils but also for building up fertility. Clean-cultivated crops should be grown only when absolutely necessary to meet the needs of the farm unit. Row crops, if they must be grown, should be planted and cultivated across the slope. In dairy regions the establishment of permanent pasture is desirable if other soils suitable for cultivation are available. Permanent pasture is especially desirable for areas adjacent to other severely eroded or hilly soils.

Many pastures are rotated with other crops; those following hay generally furnish good grazing. The permanent pastures are generally in poor condition, though good ones can be established and maintained under good management, including controlled grazing.

Many idle areas would be suitable for pasture if properly fertilized and seeded. About a third of the idle acreage has grown up in weeds and brush. Most of the acreage now forested was once cleared but was abandoned and grew up to trees, principally hardwoods.

The area in pasture is about equally divided between permanent and rotation pasture. Permanent pastures are seldom treated, though good ones could be established and maintained with proper management. Yields of pasture and tilled crops are lower than on the undulating and rolling phases.

Most of the idle acreage is suitable for cultivation but is adjacent to abandoned soils of lower agricultural value. Approximately two-thirds of the forested acreage has never been cleared. The forests consist of hardwoods, principally of oaks, maples, dogwood, tuliptree, basswood, and ash. Pasturing of forested areas has resulted in moderate erosion.

In addition to maintenance of fertility by the use of legumes, manure, and fertilizer, control of runoff is of major importance. Runoff is normally rapid and results in erosion and in loss of water badly needed by plants. On areas that have irregular slopes, runoff must be controlled mainly by using the soil as much of the time as possible for close-growing crops such as hay and pasture. The effectiveness of such use depends upon maintenance of a high fertility level.

**Cossayuna stony silt loam, rolling phase (5-15% slopes) (Cz).**—This moderately deep well-drained soil is too stony for cultivation and mildly irregular in relief. It occurs in scattered units of 1 to 600 acres throughout the region occupied by calcareous sandstone soils. In its present condition it is practically nonagricultural, for many large boulders are scattered throughout the profile and on the surface.

Beneath the half an inch of leaf litter in forested areas lies half an inch of very dark-brown mulchlike mull. A 2-inch layer of mellow dark grayish-brown silt loam of fine crumb structure underlies the mull. Below 3 inches down to 14 inches is friable yellowish-brown silt loam of soft fine crumb structure. The subsoil from a depth of 14 to 28 inches is dark yellowish-brown heavy gravelly loam, firm in place but friable. From 28 to 37 inches the subsoil is slightly compact olive-brown heavy gravelly loam. It is underlain by dark olive-brown to grayish-brown gravelly loam that is compact in place. This is the substratum; it rests upon calcareous sandstone bedrock at an average depth of 5 feet, though the bedrock may be as deep as 10 feet or may outcrop locally.

The surface and subsoil layers are well penetrated by roots, especially the surface layer. Both surface and internal drainage are good. Throughout the profile are many pieces of gravel, stones, and boulders from sandstone, as well as some stones and gravel from limestone, shale, slate, and granite or gneiss. The surface and subsoil layers and the upper few inches of the substratum are acid; the lower substratum is alkaline.

*Use and management.*—Fully eight-tenths of Cossayuna stony silt loam, rolling phase, is forested. The rest has been cleared but is generally so stony that cultivation is difficult. Small areas of 2 to 3 acres cleared around and between the large rocks are cultivated. The pasture is of fair quality. Treated pasture supports good grasses. Idle areas are mostly covered with brush.

This soil is potentially as good for crops as Cossayuna gravelly loam, undulating and rolling phases. If it were cleared of forest and rocks and boulders, it would be suited to the same crops and need the same general management.

**Cossayuna stony silt loam, hilly phase (15–30% slopes) (Cr).**—In general profile characteristics and location, this soil is like the rolling phase, but it is steeper and more irregular in relief. It is well-drained and moderately well supplied with lime. Its stoniness prohibits cultivation. If the stones were removed and the forest were cleared away, its suitability for use and its management needs would be essentially the same as those of Cossayuna gravelly loam, hilly phase.

**Dover fine sandy loam, rolling phase (5–15% slopes) (De).**—This moderately deep well-drained neutral or only slightly acid soil was derived from glacial till consisting mainly of crystalline limestone. Some schist, quartzite, and gneiss are also present. The surface of the crystalline limestone or marble that underlies the soil is irregular. Although it is 4 to 6 feet below the surface in most places, it occasionally outcrops. The marble weathers readily to a sandy material when exposed above the soil. The soil occurs on low hills or knolls in Harlem valley. The general relief is gently rolling. About 150 acres with slopes between 15 and 30 percent are included. The soil is moderately eroded in most places.

The surface soil is dark-brown fine sandy loam, mellow, fluffy, well penetrated by roots, slightly acid, and 10 inches thick on the average. It has a slightly more sticky consistence when wet than its texture would lead one to suspect. The upper subsoil, extending to a depth of 19 inches, is lighter brown friable fine sandy loam well penetrated by roots. This layer is neutral or slightly alkaline. From a depth of 19 inches to 28 inches the subsoil is alkaline friable reddish-brown light loam, and from 28 inches down to 38 inches it is friable and calcareous grayish-brown or nearly gray gravelly sandy loam. Below 38 and continuing to 52 inches is loose light grayish sand that is strongly calcareous. Crystalline limestone bedrock occurs most frequently at about 50 inches, but its depth varies from place to place within the same area. The range is mainly from 4 to 6 feet, although most areas contain small patches where the depth to bedrock is 2 feet or less.

The texture of the subsoil layers varies somewhat. In places it approaches silt loam in texture and is fairly firm. The content of gravel is also variable. The surface soil, though generally slightly acid, is alkaline in some areas.

Included with this phase are areas of very fine sandy loam occurring in the northern part of Harlem Valley, half a mile south of the Columbia County line and outside of the general region of Dover soils. A few severely eroded areas covering a total area of 30 acres are included.

*Use and management.*—The cultivated areas of this soil are used principally for hay, mainly timothy, red clover, and alfalfa, and for corn and small grains. The length of the rotation varies because hay meadows are frequently harvested until yields begin to fail and then pastured for 1 or 2 years before plowing. About 10 to 12 tons of manure and 300 to 400 pounds of 20-percent superphosphate an acre

are applied for corn. Oats receive 100 to 200 pounds of superphosphate. Some farmers top-dress hay meadows with manure. Row crops and grain are generally planted across the slope in order to retard runoff and conserve soil moisture.

Rotation pastures are usually good; they contain considerable clover and bluegrass and few weeds. Permanent pastures are much better than the county average but vary according to the treatment received. Canada and Kentucky bluegrasses, redtop, and white clover are present in all permanent pastures. In neglected pastures, hardhack, crataegus, mustard, wild carrot, purple aster, mullein, goldenrod, and other weeds are present. Some operators top-dress pasture with superphosphate or ammophos and, occasionally, with manure. Most permanent pastures are seldom fertilized. In very dry periods, pasture plants are affected by drought, but they recuperate quickly after rains.

The forest is usually young and consists mostly of redcedar that has encroached on idle acreages and old abandoned pastures. Other species are hard maple, ash, gray, white, and black birches, white and black oaks, American elm, white pine, and black locust.

Conservation of moisture, maintenance of organic matter, and fertilization with phosphorus are good management practices for this soil, which is well suited to a wide variety of crops and responds well to good management. Most areas should be cultivated on the contour or across the slope, and long slopes more than 8 percent in gradient should be strip cropped.

**Dover fine sandy loam, hilly phase (15-30% slopes) (D<sub>A</sub>).**—This moderately deep well-drained sandy soil was derived from firm glacial till consisting mainly of crystalline limestone mixed with some schist, quartzite, and gneiss. Slope is the major factor limiting use, and erosion has been more active than on the more gently sloping areas of Dover fine sandy loam.

The profile is similar to that of the rolling phase, except the surface soil is generally slightly thinner. Erosion has removed most, or all, of the original surface soil from about 35 acres. In most areas the dark-brown mellow fine sandy loam surface layer is 6 or 8 inches thick. Next occurs 8 or 10 inches of lighter brown neutral friable fine sandy loam, which grades into gray calcareous gravelly fine sandy loam glacial till at 28 or 30 inches. In most places the crystalline limestone bedrock is at depths of 3 to 6 feet.

*Use and management.*—Cultivated areas of this soil are mostly in hay, timothy, red clover, and alfalfa but are used to a limited extent for corn, oats, and wheat. Most operators plant and cultivate across the slope and with the contour. This practice ordinarily retards runoff enough to prevent serious erosion. Manure and superphosphate are used for corn, and superphosphate for oats, in the same quantities as on the rolling phases. Yields are estimated to be only a little lower.

Pastures are similar to those on the rolling phase. Forests are young—few trees appear to be more than 20 to 25 years old. Apparently, few of them have been planted; they have grown in old abandoned pastures and meadows. Redcedar is encroaching on some of the idle areas and neglected pastures.

The soil is best suited to pasture or to a 5- or 6-year rotation consisting of at least 4 years of hay and not more than 1 year of intertilled crops. Alfalfa is well suited and should be included in seeding mixtures for long-term hay. Birdsfoot trefoil may prove equally well suited to hay mixtures and better suited to pastures. The lime requirement of the soil is low, but crops respond to phosphorus.

**Dover fine sandy loam, ledgy rolling phase** (5-15% slopes) (Dc).—Many outcrops of crystalline limestone characterize this very shallow soil that developed from shallow deposits of glacial till and materials weathered from the underlying crystalline limestone bedrock. The principal rock constituent of the glacial till is crystalline limestone, which weathers easily into a fine sandy loam. Other rock materials present in smaller quantity are schist, quartzite, slate, and gneiss.

The soil occurs on low hills and knolls that seldom rise more than 100 feet above the floor of the Harlem Valley. The relief is uneven. White sand is common on the surface where a rock outcrop is disintegrating. Where the surface of an outcrop joins the soil, several inches of disintegrating sandy material lie upon the soil. Both surface and internal drainage are good.

Beneath a pasture sod, the surface soil is a dark coffee-brown mellow or fluffy finely granular fine sandy loam, neutral or alkaline, well penetrated with grass roots, and about 9 inches thick. From 9 down to 17 inches, the subsoil is strongly alkaline, mellow, brown fine sandy loam. Below 17 inches to a depth of 21 inches the subsoil is light yellowish-brown fine sandy loam that is friable, mellow, and slightly calcareous. Below 21 inches and extending to 26 inches is strongly calcareous very light-gray fine sand, which rests on the crystalline limestone bedrock. Roots penetrate all layers but are most abundant in the surface soil.

The soil varies chiefly in depth. Outcrops of the underlying limestone are numerous, but in pockets between them the average depth of soil is about 24 inches. Nevertheless, the layers of bedrock are tilted on edge, and in pockets between outcrops the soil may be as much as 4 feet deep. The soil is moderately eroded in most areas. A few small included areas have been severely eroded.

*Use and management.*—The cultivated areas of this soil are shallow but contain fewer outcrops than normal for the entire soil. They are used principally for hay grown in rotation with corn and oats. From 10 to 12 tons of manure and 300 to 400 pounds of 20-percent superphosphate an acre are usually applied for corn, and 150 to 200 pounds of superphosphate for oats. Timothy, red clover, and alfalfa, the principal hay crops, are maintained from 3 to 5 years and then pastured 1 or 2 years before plowing. Top dressings of manure are sometimes applied to hay crops to maintain the stands longer. The soil is inclined to be droughty. Yields vary with the quantity of rainfall during the growing season. Cultivable areas like these are exceptions; the soil normally cannot be cultivated and is pastured (pl. 3, A).

Permanent pasture is generally good during early spring and very poor after July 15. Canada and Kentucky bluegrasses, redtop, and wild white clover are usually abundant. Chicory, thistle, wild

aster, wild carrot, and other weeds grow in the poorest pastures, and some brushy growth of hardhack, redcedar, and hawthorn is encroaching. Pastures need phosphorus but no lime.

The forests are young, and the stands are irregular. Redcedar, usually the dominant tree, occurs with some gray and white birches, locust, hard maple, and wild cherry. Redcedar and brush soon invade idle areas.

**Dover fine sandy loam, ledgy hilly phase (15-30% slopes) (DB).**—More strongly sloping and hilly areas associated with the ledgy rolling phase are occupied by this soil. The relief is irregular. Outcrops of disintegrating white limestone are conspicuous and somewhat more numerous than on less steeply sloping phases of Dover fine sandy loam. About 25 percent of this soil has been severely eroded; the rest, moderately eroded. The light fluffy surface soil, the shallowness of the profile, and the irregularity of relief makes danger of erosion great. Cultivation is extremely difficult and usually results in serious loss of soil.

The profile in moderately eroded areas is similar to that of the ledgy rolling phase. The surface soil in severely eroded areas is composed principally of subsoil material; it is light brown and about 6 inches thick. The subsoil, a light yellowish-brown fine sandy loam, extends to a depth of 12 inches. Below 12 inches lies a 4- or 5-inch layer of disintegrated bedrock, a light-gray fine sand that rests on the solid white limestone.

*Use and management.*—This soil is mostly in pasture and forest. Pasture is good in the spring but poor in summer. The bluegrass, redtop and wild white clover sods are usually heavy. About a fourth of the pasture is on eroded areas, and erosion is still active in places. Light applications of manure or phosphate would probably improve the pasture so it could hold the soil, but most pastures are not fertilized. The soil is droughty, and in dry seasons the vegetation is severely damaged. The forest is young and consists of the same species as are on the ledgy rolling phase.

**Dover fine sandy loam, ledgy steep phase (30-45% slopes) (DD).**—This soil has steep irregular slopes and many outcrops of the underlying rock. Areas vary from 2 to 70 acres in size.

The profile in the moderately eroded areas (65 percent of the phase) is generally similar to that of the ledgy rolling phase but thinner over bedrock in most places. The present surface soil in pastures is about 5 inches deep and grayish brown. Beneath the surface soil is about 3 inches of light yellowish-brown friable fine sandy loam subsoil, which rests at a depth of about 8 inches on very light-gray fine sand from disintegrated limestone. The solid bedrock normally occurs at depths of 10 to 15 inches.

*Use and management.*—Under forest this soil appears to be stabilized; slips develop only where forest is pastured. This soil is best used for forest in most places. Redcedar comes in rapidly and is the dominant species. Gray and white birches, white pine, black locust, and maple are also present. The forest is all young, which indicates that the soil was probably cleared at one time. Erosion is active in most pastures. The sod is not heavy enough to hold the soil; surface wash occurs and the soil slips on many of the steep slopes.

**Dutchess gravelly silt loam, undulating and rolling phases** (8-15% slopes) (Dк).—These phases are mapped as a unit. They are well-drained and acid and were derived from glacial till that consists mainly of acid slate and shale. Areas occur throughout the region of slate and shale, mainly in the Dutchess-Pittstown soil association. The relief varies from rolling to gently undulating. The slope range is from 3 to 15 percent, but the average slope is 8 percent. The areas vary from 2 to 100 acres in size. Associated with these phases are the Bernardston, Pittstown, and Nassau soils, which were derived from similar materials. Approximately 90 percent of these gravelly phases has been farmed, and an equal percentage has been moderately eroded. There has been no erosion on about half of the present forested area, which represents 15 percent of the total acreage.

In forested areas a thin layer of forest litter is underlain by about an inch of gray-brown granular mull. Beneath the mull is the surface soil, about 6 inches of dark-brown gravelly silt loam with a fine crumb structure. This layer is followed by about 6 inches of light-brown or light yellowish-brown gravelly silt loam that is friable and has a very fine crumb structure. The subsoil extends from a depth of 12 to 26 inches; it is a light-brown gravelly silt loam, firm in place but friable. The substratum, which begins below 26 inches, is slightly or moderately compact olive-brown light silt loam that rests upon shale bedrock at 48 inches. Throughout the profile materials from slate predominate, though some schist fragments and gravel from sandstone and crystalline rock are present. The mull and surface layers are strongly acid; the subsoil and substratum are moderately acid. Roots penetrate all layers but are most abundant in the mull and the upper 6 inches of mineral soil. Both surface and internal drainage are good.

The soils vary principally in depth and in content of gravel in the surface layers. Generally bedrock occurs between 4 and 6 feet; the range in depth is from 1 to 10 feet. Outcrops of the underlying rock are few. In some areas there is little gravel, but in others it is abundant. No area has gravel sufficient to interfere seriously with cultivation. Several stony areas, indicated on the map by stone symbol, are included with this unit.

*Use and management.*—About half of Dutchess gravelly silt loam, undulating and rolling phases, is cropped. The forested areas have chiefly a second-growth cover but a few have been reforested. The forest growth consists mostly of hardwoods of the oak-hardwood or the beach-maple-hemlock association. The trees are mainly red, white, scarlet, and yellow oaks, shagbark and pignut hickories, hard and soft maples, ash, basswood, hemlock, and chestnut.

About a fourth of the total acreage is idle, principally because of association with small areas of Nassau soils and other soils of low (or no) agricultural value and to a lesser extent because of occurrence in estates used as private hunting reserves. Some large areas of these soils isolated by areas of Nassau soils are intensively cultivated, whereas the associated Nassau soils are pastured.

Cultivated areas are used principally for pasture, hay, oats, buckwheat, corn, and potatoes. Yields vary with the quantity and quality of fertilizer, lime, and manure applied. Grasses are not so well suited as to soils derived mainly from limestone or calcareous sandstone, but the pastures contain much redtop and usually some

bluegrass and white clover. These soils are not so "strong" as the associated Bernardston soils but are good for most cultivated crops if their fertility level is maintained by fertilizer, lime, legumes, and manure. Many areas are badly depleted.

Management practices vary widely. On many farms no regular rotations are followed. Land for corn or potatoes is usually heavily manured, and phosphate may be applied. From 10 to 12 tons of manure and about 400 pounds of 20-percent phosphate are applied for corn. Varying quantities of lime,  $\frac{1}{2}$  to  $1\frac{1}{2}$  tons an acre, with or without phosphate, may be applied on fields prepared for oats to be used as a companion crop for a hay seeding. Meadows are generally mowed for 3 years. A 5- to 7-year rotation is used on the better farms: Corn is grown 1 or 2 years and followed by a small grain, usually oats, and 3 years of hay. Where there is sufficient acreage suitable for cultivation, meadows are frequently pastured 1 or 2 years after the third season of hay. From 1 to  $1\frac{1}{2}$  tons of lime and 200 pounds of 20-percent phosphate an acre are applied to ground prepared for oats. Hay meadows to be pastured are frequently top-dressed with manure.

The condition of pasture varies from poor to good, depending on management. The vegetation in unimproved pastures and idle fields includes poverty oatgrass, sweet vernal, redbtop, goldenrod, devils paintbrush, steeplebush, and other undesirable weeds and shrubs. With lime, phosphate, and manure, good permanent pasture generally can be established. On a few beef-cattle farms, there are several excellent pastures on these and the Pittstown soils. Rotation pastures are fair to good on the better dairy farms.

**Dutchess gravelly silt loam, eroded undulating and rolling phases (3-15% slopes) (Dg).**—The relief of this mapping unit is probably a little more irregular than that of the undulating and rolling phases, but slope gradients are similar. On most areas erosion possibly has been caused by improper use and management rather than by greater irregularity of relief. From 75 percent to all of the original surface and, in places, part of the subsoil have been lost. The present surface soil is composed almost entirely of subsoil materials, apparently very low in organic-matter content.

The present surface soil in cultivated areas is dark-brown gravelly silt loam, more gravelly than that of the uneroded undulating and rolling phases, friable, and about 6 inches thick. The subsoil extends from a depth of 6 to 18 inches; it is a firm but friable light-brown to yellowish-brown gravelly silt loam. The subsoil rests on the compact olive-brown gravelly silt loam substratum, which occurs 26 to 48 inches below the surface in uneroded areas of the undulating and rolling phases of Dutchess gravelly silt loam.

*Use and management.*—The cultivated parts of these soils are used in much the same manner as cultivated areas of the undulating and rolling phases, but yields are normally considerably lower. Fertility and organic matter are low. Longer rotations made up to greater extent of hay crops and heavier applications of manure and fertilizer are necessary for reestablishing high productivity. Six-year rotations that include only a year of cultivated crops should be used; the soil should be kept in sod the greater part of the rotation. The

general irregularity of relief sometimes makes contour cultivation not practical.

Some improved permanent pastures are established, but most pastures are poor. Erosion is active on many of them because there is not enough vegetation to retard runoff and hold the soil. Reseeding and applications of lime, fertilizer, and manure are needed for establishment of good pasture. With lime and fertilizer, a few pastures could be improved without reseeding.

A small acreage having a loam to gravelly loam texture has been included; its crop yields are slightly lower than those of the undulating and rolling phases.

**Dutchess gravelly silt loam, hilly phase (15-30% slopes (D<sub>H</sub>).**—This soil is associated with other soils of the Dutchess series and with Nassau, Bernardston, and Pittstown soils in the central part of the county.

The profile is like that of the undulating and rolling phases, but the surface soil of most cultivated areas may be slightly thinner. Except for those areas that have remained continuously in forest, the soil is moderately eroded, having lost 25 to 75 percent of the original surface soil. The gravel content of the surface soil varies, and to some extent the relief. In a very few areas the surface soil contains little gravel.

*Use and management.*—Areas of this soil under cultivation are used and managed in about the same way as areas of the undulating and rolling phases. Cultivation and planting of row crops is done across the slope, approximately with the contour wherever feasible. Row crops are normally included only 1 year in the rotation. Yields are generally lower than on the undulating and rolling phases, partly as a result of greater runoff and less water left available for crops.

The relief is so irregular on about 10 percent of the total area that contour cultivation of row crops is impractical. Elimination of row crops from the rotation is a desirable way of controlling erosion on these irregular areas. On the rest, cross-slope cultivation is feasible, but strip cropping is difficult, and in many areas the slopes are short and do not need contour cultivation. Rotations should be long with as many sod-forming crops and as little clean cultivation as feasible.

**Dutchess gravelly silt loam, eroded hilly phase (15-30 percent slopes) (D<sub>F</sub>).**—Practically all of the original surface soil and in places part of the subsoil have been eroded from this soil. The profile is moderately deep—2 to 8 feet deep over bedrock. Relief is irregular, and the slopes are mostly short. The areas are closely associated with gently sloping or undulating areas of Dutchess gravelly silt loam. They average 6 acres in size but range from 1 to 30 acres. The smaller areas are closely associated with large areas of the undulating and rolling phases, so they are managed like those phases. Severe sheet erosion has resulted from improper management; the entire original surface soil has been lost from most areas. A few gullies also occur.

The present surface is composed almost entirely of subsoil materials low in organic-matter content. In cultivated areas the surface soil is about 6 inches thick and dark brown. The soil profile is, in general,

similar to that of the eroded undulating and rolling phases. The amount of gravel present on the surface varies, but slate and shale fragments are generally abundant.

*Use and management.*—Dutchess gravelly silt loam, eroded hilly phase is not productive in its present condition but can be made as productive as the hilly phase if well managed. It should be used for pasture or hay as much as possible to control erosion and build up fertility and moisture-holding capacity. Liberal fertilization and liming are needed, and use of manure is especially desirable. Cultivation should be across the slope and on the contour whenever possible.

Most pastures are in poor condition and need lime, phosphorus, and manure. Reseeding of the poorer pastures may be necessary. The better pastures contain bluegrass, redbtop, timothy, and wild white clover and have a sod sufficiently heavy to hold the soil. Erosion is active on poor pastures, and occasionally shallow gullies occur. Most pastures are native; few are rotated with tilled crops.

Weeds and brush have grown on about two-thirds of the idle area. Most of the present forest is on areas once cleared and later abandoned. The stands are composed principally of hardwoods, some of which are common in old forest stands on Dutchess gravelly silt loam, undulating and rolling phases. Many temporary trees such as poplar, birch, and pin cherry are in the stand. A few idle areas have been reforested. By use of fertilizer and lime, some of the idle areas could be brought back into use for pasture or hay.

**Eel and Lobdell silt loams, undifferentiated (0-2% slopes) (EA).**—These are nearly level moderately well-drained to imperfectly drained soils of the first bottoms. They are flooded almost every spring, and the receding waters leave deposits of silty materials that have washed mainly from soils derived from glacial drift containing calcareous sandstone or limestone. The Lobdell soil occurs in the western part of the county in the region where the soils developed chiefly from reworked calcareous sandstone; the Eel soil occurs in the southern and western parts of the limestone valleys in association with soils derived from drift containing abundant limestone. Lobdell silt loam is associated with the well-drained Chagrin soils on the first bottoms of the calcareous sandstone regions; Eel silt loam, with the well-drained Genesee soils of first bottoms in the limestone regions. The two soils were not differentiated when the county was mapped, but their general distribution is the same as that of the Genesee and Chagrin soils.

Beneath sod, the surface soil of Eel silt loam to a depth of 5 inches is grayish-brown, friable, and neutral or only slightly acid. From a depth of 5 to 13 inches is friable dark-brown neutral silt loam of angular fine blocky structure. The subsoil extending from 13 to 20 inches is dark grayish-brown neutral silt loam that is firm in place but breaks into soft subangular fragments. From 20 down to 30 inches is strongly mottled gray, yellow, rust-brown and grayish-brown neutral to alkaline silt loam that breaks into soft medium angular fragments. Below 30 inches lies gray stratified sand and gravel that is moderately alkaline or calcareous. Roots occur throughout the entire profile but are most abundant in the surface soil and upper subsoil. Internal drainage is slow.

Lobdell silt loam varies from Eel silt loam mostly in reaction of the surface soil and, in some areas, in texture. The surface soil is usually moderately to strongly acid. Acidity decreases with depth, and below 36 inches the substratum is generally neutral or moderately alkaline. Where the Eel soil occurs in limestone valleys the alluvium is derived chiefly from limestone rock materials and the surface soil is nearly neutral, or possibly alkaline.

In the Hudson Valley several areas have a very fine sandy loam surface texture. Along the stream flowing to the Hudson River from the village of Staatsburg, the surface texture is fine sandy loam. A few gravelly areas are indicated on the map by gravel symbol. Small included areas near Cokertown have a shallow organic surface layer and layers of organic material in the lower subsoil. The areas of all inclusions are too small to justify separation.

*Use and management.*—Eel and Lobdell silt loams, undifferentiated, are used for nearly all the crops commonly grown in the county in support of the dairy industry.

The native forest on both soils consists mainly of elm, soft maple, black ash, willow, alder, sycamore, hickory, and gray birch, with some hard maple, white oak, and hemlock.

The cultivated areas are managed much the same as the associated areas of Genesee or Chagrin soils. No regular rotations are followed. Corn is grown for 1 or 2 years and followed by oats for 1 year and hay for an indefinite period. Most operators realize that the soils are not well suited to alfalfa, because of their restricted drainage, and use seeding mixtures of alsike clover, redtop, and timothy. Alfalfa and red clover are included in some seeding mixtures.

About 50 percent of the pasture on these soils is rotated with tilled crops. The vegetation in permanent pastures includes Kentucky bluegrass, wild white clover, timothy, redtop, quackgrass, and some buttercup, yellow dock, and other weeds. The pasture varies but is usually good when upland pastures have dried up. A few of the permanent pastures are poor, especially where small areas of these soils occur in close association with poorly drained or permanently wet Wayland soils, on which willow and alder have encroached.

The soils are suited to intensive cultivation and need few special practices to control water. Control of stream-bank erosion is needed in some areas, and keeping cover crops on bare land is advisable to control scouring during spring floods.

**Elmwood fine sandy loam** (0-5% slopes) (EB).—Areas of this soil have developed from deposits of acid fine sand laid down over glacial lake clay. The soil occurs in small areas on gently sloping to nearly level relief along the edges of the glacial lake plain and adjacent to the upland soils. It is associated with Hudson, Rhinebeck, Madalin, Albia, and Cossayuna soils. The sands vary from 30 to 50 inches in thickness over the clay. The clay restricts internal drainage. The soil is gravel-free and acid.

The surface soil, about 10 inches thick, is strongly acid dark-brown fine sandy loam. Under sod it has a weak fine-granular structure and is well penetrated by grass roots. The 10- to 19-inch upper subsoil is light yellowish-brown friable fine sandy loam of fine crumb structure; it is well penetrated by grass roots and strongly acid. The lower sub-

soil, extending from 19 to about 36 inches, is strongly acid light-brown fine sandy loam, strongly mottled with rust brown and gray. It is firm in place and breaks out into small easily crushed irregular fragments. Roots penetrate this layer but are most abundant in its upper few inches. Below about 36 inches occurs a grayish-brown strongly mottled silty clay loam that retards internal drainage. This strongly mottled layer is moderately acid, tight, and compact and it breaks out into large fragments. With depth, the mottling becomes less pronounced, and the material shows definite stratification.

The soil varies chiefly in thickness of the surface soil (7 to 11 inches) and depth to the silty clay loam substratum (30 to 50 inches). Mottling of the subsoil usually begins 18 to 24 inches from the surface.

*Use and management.*—Cultivated areas of this soil are used principally for dairy-farm crops (corn, oats, and hay), and to some extent for apples, peaches, and small fruits. A 5- to 6-year rotation consisting of corn for 1 or 2 years, oats for 1 year, and hay for 3 years is commonly followed. The rotation is varied at times by pasturing meadows 1 or 2 years after the second or third year of mowing. From 8 to 10 tons of manure, commonly supplemented with 150 to 200 pounds of 20-percent phosphate, is used for corn. From 150 to 200 pounds of 20-percent phosphate and 1 to 1½ tons of lime are used on oats sown as a companion crop for seedings of hay mixtures. Hay mixtures seeded with the oats include timothy, alsike and red clovers, and redtop. From 300 to 600 pounds of 20-percent phosphate is generally used in the rotation. Lime, which is needed for legumes, is not used by all farmers. Orchards are usually maintained in sod and top-dressed with manure and nitrate of soda. Strawberries are the principal small fruit.

Most pasture is used in a crop rotation and supports fair vegetation. The few native pastures are usually poor and support poverty oatgrass, timothy, redtop, daisy, plantain, goldenrod, and other weeds, and some brush and briars. Most of the native pastures need reseeded and fertilization.

The natural forest includes shagbark and pignut hickories, hard and soft maples, beech, birch, red oak, white ash, and poplar.

As most drainage is effected internally, there is not much erosion. After heavy rains, washing is sometimes evident in cornfields and strawberry beds on the more sloping areas. Maintenance of fertility is the principal management needed. The soil has a high requirement for lime, and probably for potash, where it is heavily cropped. Use of legumes and manure in the rotation is needed for maintaining supplies of organic matter and nitrogen. Under good management the soil is at least moderately productive of most general farm crops and most vegetables and small fruits.

**Genesee fine sandy loam (0-3% slopes) (G<sub>A</sub>).**—This nearly level soil occurs in first bottoms in the lime-till regions and is commonly flooded in spring. Receding waters leave thin deposits of rich material, which has been washed from soils of the uplands that developed from glacial till containing large amounts of lime. Areas are small (5 to 80 acres) and occur principally in the Harlem Valley along Tenmile Creek and its tributaries.

The surface 9 inches is rich brown, mellow, and crumb structured. Extending from 9 down to 14 inches is friable fine sandy loam of fine

granular structure. The subsoil from a depth of 14 to 60 inches is firm structureless light-brown fine sandy loam. This subsoil material has a light-grayish cast throughout that is apparently derived from the color of the parent limestone rock materials. In many cases the lower part of the subsoil is stratified sand and gravel.

The soil is alkaline throughout—more alkaline than Chagrin silt loam. It is well drained. Surface texture varies from a silt loam to a sandy loam. Fine sandy loam is the dominant texture; areas of silt loam and sandy loam are too small in total acreage to justify separation.

*Use and management.*—The cultivated areas of Genesee fine sandy loam are managed and operated much the same as cultivated areas of Chagrin silt loam. They produce well, even though cropped intensively without fertilizer. Corn, vegetables, hay, and especially alfalfa are well suited. Small grains are subject to lodging and rust when moisture is abundant but yield well in dry years.

In general, intensive use of Genesee fine sandy loam for row crops and corresponding heavy fertilization are good practices. If they are followed, more sloping and erodible soils of the uplands can be kept a long time in hay.

**Gloucester gravelly loam, rolling phase (5–15% slopes (Gc).**—This strongly acid moderately deep well-drained soil has developed from glacial till composed chiefly of gneiss and granite materials. The relief is generally smooth. The soil is deficient in almost all plant nutrients and low in organic matter. It occurs in areas containing a few to 100 acres, mainly on ridge tops, lower slopes of small valleys in mountainous areas, or lower slopes of foothills fronting the Housatonic and Hudson highlands and Stissing Mountain. Closely associated with this soil are other phases of Gloucester gravelly loam, Gloucester and Chatfield stony loam, and Sutton silt loam.

The surface soil in cultivated areas is about 10 inches of rich-brown mellow gravelly loam having a fine crumb structure. The upper subsoil, extending from 10 to 21 inches, is yellowish-brown friable gravelly loam. Below 21 to a depth of 36 inches lies the lower subsoil, a friable light yellowish-brown gravelly loam. The substratum, beginning below 36 inches, is firm but friable strongly acid grayish-brown gravelly sandy loam. It rests on bedrock at a depth of about 5 feet. The profile is strongly acid throughout and contains loose stones and boulders of granite, gneiss, and quartzite. Internal drainage is good but inclined to be excessive.

The soil varies chiefly in thickness of its surface soil, which ranges from 8 to 12 inches deep and in most places has been moderately eroded. The subsoil is firm but not compact in most places; it is loose and droughty in a few.

Included with this phase are soils developed chiefly from quartzite rock materials. These included areas of gravelly fine sandy loam have profiles similar to that of this soil but somewhat lighter in texture and of more grayish cast. They are strongly acid, well-drained, and moderately deep. The principal areas of this inclusion occur at the base of the Housatonic Highlands east of the Harlem Valley, at the base of the Hudson highlands, south of Poughquag, west of Whaley Pond, and on Stissing Mountain.

*Use and management.*—Management practices for cultivated areas of this soil are not uniform. Rotations are irregular and fertilizer treatments differ. Corn, oats, buckwheat, and hay are the principal crops. Manure is applied to improve the yields of corn and hay. Some operators use phosphate, but many do not. The soil responds well to both superphosphate and lime. The more successful operators follow a 5- or 6-year rotation—corn is planted 1 or 2 years and followed by 1 year of oats and 3 years of hay. About 8 to 12 tons of manure and 300 pounds of 20-percent phosphate an acre are applied for corn. Usually 1 ton of lime and an additional 200 pounds of 20-percent phosphate are used on fields prepared for seedings of oats and hay. Soil tests show that heavier applications of lime are needed for successful growth of red clover sown in mixture with timothy.

Most of the pastures are neglected and very poor. Redtop, sweet vernal, and small quantities of poverty oatgrass grow in the better ones. Some weeds grow in all pastures but in the poorer ones there is more poverty oatgrass and weeds than of desirable grasses. The poorest pastures are neglected and overgrown with briars and hawthorn.

Most forests are young and consist of temporary forest species—aspens, gray and white birches, and pin cherry. The species present indicate that the soil was once cleared and farmed. The older forests, also second-growth, contain oak, maple, ash, basswood, tuliptree, dogwood, black and yellow birches, beech, chestnut sprouts, hemlock, and hickory.

Good management centers about heavy fertilization and liming, liberal use of manure, and production of legumes. This soil needs more lime, nitrogen, and potash than most others in the county. If adequately limed and fertilized, alfalfa will make a good stand, but it seldom lasts more than one or two seasons. Ladino clover has been used successfully as a long-lived legume on similar soils, though yields after a few seasons have been low. Birdsfoot trefoil offers some promise where hay or rotation pasture is to remain for long periods.

**Gloucester gravelly loam, hilly phase (15–30% slopes) (Gb).**—Strongly sloping areas, usually adjacent to the more gently sloping areas of Gloucester gravelly loam, rolling phase, are occupied by this soil. Relief is generally uniform. Areas are usually small (about 10 or 12 acres). They are scattered throughout the regions of gneiss, granite, and quartzite on Stissing Mountain and in the Hudson and Housatonic highlands.

The soil profile is similar to that of the rolling phase. The average depth of the surface soil, however, is only about 7 inches in cultivated and pastured areas, as this soil has been more severely eroded.

Included with this soil in mapping are areas that have developed principally from quartzite material (described under Gloucester gravelly loam, rolling phase) and a few small areas so severely eroded that most of the original surface soil has been lost.

*Use and management.*—The cultivated areas of this soil are used chiefly for hay, but to some extent for oats and corn. Hay crops are seeded and maintained without fertilization until they fail. Mostly weeds and native grasses grow in the meadows. Management varies greatly. Manure is commonly the only fertilizer used. Tillage is

usually done across the slope for ease of operation, to retard runoff, and to control erosion. Yields could be increased 50 to 75 percent by applying 1½ tons of lime and 500 to 600 pounds of 20-percent phosphate in a 5- to 7-year rotation.

Pastures are similar to those on the rolling phase; they are neglected, and the soil is depleted. Most of the forest consists of second-growth hardwood. The species are similar to those in second-growth forests on the rolling phase. About 5 percent of the total area is overgrown with young forest that has come in on old abandoned areas.

Good management centers about use of the soil for hay and pasture, with liberal fertilization, liming, and use of manure. Row crops should not be grown more than 1 year in 6. All tillage should be on the contour if possible, and on long slopes strip cropping is needed if row crops are grown.

**Gloucester gravelly loam, steep phase (25-45% slopes) (Gd).—**This steep excessively drained soil of low fertility is distributed throughout the crystalline rock region. It occurs on steep slopes of Stissing Mountain and on the Hudson and Housatonic highlands in association with other Gloucester soils and with rough stony land. Relief is irregular. Sheet erosion has been severe on about a third of the soil. Areas that have remained in cut-over forest are only slightly eroded.

The profile is similar to that of the rolling phase, but the surface soil is shallower, or 5 to 6 inches thick. Included with this soil are areas that developed from quartzite materials like those described for the rolling phase of Gloucester gravelly loam.

*Use and management.*—Most of this soil was once cleared for pasture or crops, but it was too steep for such uses. Fertilizer and lime are necessary to maintain good pasture, and these are difficult to apply on the steep slopes. Most pastures are untreated, poor, and actively eroding. Redtop, sweet vernal, and poverty oatgrass are the principal grasses; weeds, briars, and brush are generally more abundant than the grasses. Applying lime and superphosphate and seeding of bluegrass and wild white clover would improve these pastures.

Aspen, gray and white birches, and pin cherry soon encroach on idle areas, and considerable time passes before species valuable for timber replace them.

**Gloucester stony loam, rolling phase (5-15% slopes) (Gr).—**Areas of this soil occur throughout the region of crystalline rocks. They occupy the slopes and ridge tops on East Mountain and on the Housatonic and Hudson highlands. Associated with this soil are Gloucester gravelly loam, rolling phase, Chatfield and Sutton soils, and areas of rough stony land. Relief is mild, but loose stones of gneiss and granite, huge boulders, and a few outcrops of underlying rock make the soil unsuitable for cultivation.

The profile is similar to that of Gloucester gravelly loam, rolling phase, except for many stones and boulders on the surface and in the soil. In undisturbed forest there is a black almost pure organic layer, a very thin zone of transition, and then the yellowish-brown mineral soil.

Included with this soil are areas developed mainly from quartzite rock materials like those described as inclusions with Gloucester

gravelly loam, rolling phase. The stones and boulders on these included areas are mostly angular or subangular quartzite.

*Use and management.*—Pastures on this soil are generally poor and contain much poverty oatgrass, redtop, and sweet vernal. Some pastures previously used for hay contain timothy and redtop. Devils-paintbrush, wild aster, creeping cinquefoil, strawberry, goldenrod, other weeds, laurel, huckleberries, and hardhack are frequently more abundant than pasture grasses. The only treatment most pastures receive is the occasional cutting and removal of brush. Usually several acres are required to pasture one cow for the grazing season. Removing loose stone, adding lime and superphosphate, and sowing some bluegrass and wild white clover would make pasture as productive as that on Gloucester gravelly loam, rolling phase. Removal of loose stone would also make the areas suitable for cultivation.

Much acreage now idle is overgrown with brush and aspen, gray and white birches, and pin cherry. The old forests consist of second-growth hardwoods, among which are red, white, and chestnut oaks, hard and soft maples, black and yellow birches, ash, basswood, beech, black cherry, and tuliptree.

**Gloucester stony loam, hilly phase (15–30% slopes) (G<sub>E</sub>).**—Many large stones and boulders on the surface and imbedded in the soil are the chief characteristic differentiating this soil from Gloucester gravelly loam, hilly phase. The stones make use of power implements for cultivation, fertilization, or liming very difficult or impossible. If they were removed, the soil would be suited to the same uses and would need the same management as Gloucester gravelly loam, hilly phase. Most of this soil is forested or idle; a few small areas are in poor unimproved pasture.

**Gloucester stony loam, steep phase (30–45% slopes) (G<sub>G</sub>).**—Like other phases of Gloucester stony loam, this soil has many loose stones and boulders on the surface and in the profile. It is steep and excessively drained like the steep phase of Gloucester gravelly loam. Steep slopes and stoniness make cultivation difficult, and droughtiness and low fertility make even the best of the pastures poor.

This phase is associated with other Gloucester soils, Chatfield soils, and areas of rough stony land in the Hudson and Housatonic highlands and on East Mountain. This soil is best used for forest.

**Hollis channery loam, rolling phase (5–15% slopes) (H<sub>D</sub>).**—This soil has developed from shallow deposits of glacial till and small quantities of material weathered from the schist bedrock. The principal constituent of the parent till materials is schist; minor ones are gneiss, granite, and slate. The relief is irregular. Outcrops of the underlying bedrock occur but are numerous on only about 200 acres. The soil contains channers—thin flat stone fragments up to 6 inches long. The soil is associated with other Hollis soils and with members of the Charlton, Woodbridge, Paxton, and Whitman series. It occurs in areas 3 to 70 acres in size in the eastern part of the county on the ridge tops and slopes of Quaker Hill and Chestnut Ridge.

The surface soil in meadows is dark-brown mellow loam about 6 inches thick. The subsoil extending to a depth of 14 inches is light-brown friable loam. From that depth down to 20 or 30 inches is the lower subsoil, a light-brown firm heavy loam. The lower subsoil rests

on soft partly disintegrated schist bedrock. The profile is strongly acid throughout; surface and internal drainage are good. Roots penetrate all layers but are most abundant in the surface soil.

*Use and management.*—Regular rotations are not followed on this soil. Timothy hay is the principal crop. Buckwheat, oats, and corn are sometimes grown. Manure is the main fertilizer. Some of the more successful farmers apply superphosphate and manure for oats-and-timothy seedings. Meadows are mowed until the timothy fails and weeds dominate. Sometimes meadows are top-dressed with manure after the second season of mowing.

Pastures are usually untreated and poor. The principal grasses are redtop, meadow fescue, and poverty oatgrass. The percentage of grasses is often lower than that of weeds and brush. In the better pastures brush is controlled and redtop and poverty oatgrass predominate. Pastures could be improved by adding lime and phosphate and sowing Kentucky or Canada bluegrass with wild white clover. Midsummer pasture can be improved little, because moisture is lacking. The areas now pastured are principally those adjacent to other soils better suited to production of the corn, oats, and hay needed in dairy farming.

Most idle areas are overgrown with brush. The older abandoned areas are reverting to forest. The trees that come in naturally are usually poplar, gray and white birches, and pin cherry—species of little commercial value that will be replaced by other trees as the forest grows older.

On farms where this soil must be used for crops, management should center around production of hay. Alfalfa is very poorly suited. Ladino clover-grass mixtures produce both a fair first cutting of hay and more aftermath pasture, for a longer period of years, than mixtures now used. The shallow soil holds relatively little water, so runoff is abnormally great for such mild slopes and erosion is serious. If intertilled crops are grown, planting should be done on the contour and long slopes should be strip-cropped.

**Hollis channery loam, eroded rolling phase (5–15% slopes) (H<sub>B</sub>).**—This soil occurs on slopes similar to those of the rolling phase but has been severely eroded. From 75 percent to all of the original surface soil has been lost. Outcrops of the underlying schist bedrock are more numerous, as the depth of the soil to bedrock is much less. The principal areas occur on Chestnut Ridge; some severely eroded tracts occur near Quaker Hill. Areas vary from 4 to 60 acres in size.

The present surface soil, composed almost entirely of subsoil materials, is light-brown mellow loam. In pastured areas it is about 4 inches thick. Below 4 inches to a depth of 9 inches the subsoil is friable heavy loam of lighter brown color than the surface soil. Below 9 inches and continuing to 15 inches the subsoil is firm light-brown heavy loam, which rests on partly weathered schist bedrock. The soil is 15 to 18 inches deep over bedrock.

*Use and management.*—Hollis channery loam, eroded rolling phase, was at one time entirely cleared of forest and used for pasture and cultivated crops. It is now depleted and of little agricultural value. Areas now in use are rapidly being abandoned except where they occur

in association with better Charlton or Paxton soils, which are well suited to cultivation. Areas of it associated with these better soils are usually in pasture. The pastures are even poorer than those on Hollis channery loam, rolling phase.

The older abandoned areas have reverted to forest consisting mostly of species that have little commercial value, with some hard maple, black birch, and white pine admixed.

**Hollis channery loam, eroded hilly phase (15-30% slopes) (HA).**—This is a droughty shallow soil having irregular relief. It occurs on the slopes of Quaker Hill and Chestnut Ridge. The original forest consisted of hardwoods of the oak and the beech-maple-hemlock associations (7). Approximately 45 percent of the area was once cleared of forest and either pastured or cultivated. Severe erosions has resulted on many of the cleared areas.

The soil profile in forested areas is similar to that described for Hollis channery loam, rolling phase, except for a thin grayish-brown layer of leafmold and mull above the surface soil. The profile of most cleared areas is similar to that of the eroded rolling phase of Hollis channery loam. The content of plant nutrients is low.

*Use and management.*—This soil is poorly suited to crops because of erosion hazard, steepness of slope, and low productivity. Probably many areas should be reforested, but on farms that need pasture, the soil can be made to produce fair yields in spring. The present pastures are poor, and erosion is active on nearly all of them.

**Hollis channery loam, ledgy hilly phase (10-30% slopes) (Hc).**—Areas of this soil occur throughout the region occupied by soils derived from schist materials. They range from large to small and occur mainly on lower slopes of Chestnut Ridge and Quaker Hill. Irregular relief and numerous ledge outcrops of bedrock make cultivation almost impossible. The soil is shallower than the hilly phase; it averages 18 inches in depth.

Beneath the forest litter there is black humus and a thin mull layer, together measuring about an inch thick. Below this layer and down to 5 inches is yellowish-brown mellow finely granular loam. The subsoil below 5 inches to a depth of 14 inches is lighter yellowish-brown heavy friable loam. Below 14 inches begins the lower subsoil, a firm light-brown heavy loam. It usually rests on schist bedrock at about 18 inches, but varies from a few inches to 3 feet in depth. Scattered throughout the profile are schist fragments and a few large schist rocks. The profile is strongly acid throughout, and tree roots penetrate all parts of it.

*Use and management.*—Hollis channery loam, ledgy hilly phase, is about eight-tenths in forest, its best use. Cultivated areas occurring on the more gently sloping areas make up a small acreage. Pastures are on all ranges of slopes and generally poor. The forests consist of white, red, and chestnut oaks, striped, red, and hard maples, yellow, gray, and black birches, hemlock, beech, aspen, and chestnut sprouts. Mountain-laurel is the principal undergrowth.

**Hoosic fine sandy loam, nearly level and undulating phases (0-8% slopes) (HE).**—Areas of this mapping unit are large and occur mainly on terraces in the valleys of the Hudson River and Fishkill

Creek. They are associated with areas of other Hoosic soils. The soil is nearly level, acid, and contains little gravel in the upper part of its profile.

The surface soil is dark-brown fine sandy loam, mellow, friable, and about 12 inches thick. The upper subsoil is firm but friable light yellowish-brown fine sandy loam that generally contains a few small pebbles. At 24 inches this layer grades into light yellowish-brown gravelly loam, which continues to a depth of 36 inches. Extending downward from 36 inches to a depth of 48 inches is the lower subsoil, a grayish yellow-brown gravelly sandy loam that is loose and structureless. The substratum, below 48 inches, is stratified grayish-brown gravel and sand. The soil is strongly acid throughout, well-drained, and penetrated by roots in all layers.

*Use and management.*—Use and management practices for this soil are like those for Hoosic gravelly loam, nearly level and undulating phases. Yields are generally similar for corn and small grains but slightly lower for hay and pasture. Potatoes are sometimes grown. Pastures are mainly confined to old meadows and are fair to good. They contain some weeds but support fair stands of timothy, red and wild white clovers, redtop, and Kentucky bluegrass.

The soil warms up readily and can be worked early in spring. This factor and its gravel-free sandy surface soil make it exceptionally well suited to early vegetables and small fruits. The soil does not have high natural fertility, but crops respond greatly when it receives fertilizer and lime.

**Hoosic gravelly loam, nearly level and undulating phases (0–8% slopes) (Hg).**—These are acid deep well-drained soils of the nearly level terraces that lie above flood level in the valleys. They have developed from stratified outwash sand-and-gravel parent material composed chiefly of acid slate, shale, and sandstone, with which small quantities of calcareous sandstone, limestone, and acid crystalline rock materials have been mixed. Areas containing a few to 200 acres or more are mapped on the higher terraces in most of the valleys of the county west of Harlem Valley. Relief is generally smooth; few slopes exceed 5 percent. The gravel is seldom sufficient to interfere seriously with cultivation. The pieces of gravel are 1 to 3 inches in diameter.

Beneath a heavy meadow sod the surface soil is dark brown, mellow, and finely granular to a depth of 8 inches. It is a slightly lighter brown mellow and friable gravelly loam from 8 down to 14 inches. The subsoil between 14 and 24 inches is yellowish-brown friable heavy gravelly loam or light gravelly silt loam. From 24 to 36 inches the subsoil is light yellowish-brown to light-brown gravelly coarse sand that is loose in places. Below 36 inches are strata of grayish-brown and gray fine sands, coarse sands, and gravel. The soils are acid throughout; internal drainage is good and locally may be excessive.

These phases vary greatly in depth to the loose stratified substrata of sand and gravel. In many places they are not well developed, the subsoil is more open and loose, and the substrata occurs 30 inches below the surface. This is particularly noticeable south of Fishkill, east of Hopewell Junction, and southeast therefrom toward East Fishkill. Included are areas near Fishkill and Rhinebeck having a silt loam texture. These heavier textured soils are not extensive but

are somewhat more productive than the dominant gravelly loam areas.

*Use and management.*—Cultivated areas on these phases are used for many crops—vegetables, small fruits, orchard fruits, corn, oats, and hay. Rotations vary greatly with the type of farming. The soils are not naturally highly productive but respond well to manure, fertilizer, lime, and other management practices. The lime requirement for the successful growth of red clover varies from 1 to 2 tons an acre. In the dairy regions, 8 to 10 tons of manure and 300 to 400 pounds of 20-percent superphosphate an acre are applied for corn, which may be grown 1 or 2 years in the rotation. Lime is applied when the soil is prepared for the oats-and-hay seeding. Commercial fertilizer is used on truck crops and small fruits. The kind and quantity used depend upon the crop. Sweet corn, beets, carrots, tomatoes, and green beans are the principal vegetables; strawberries, raspberries, and blackberries, the principal small fruits; apples, peaches, and cherries, the principal orchard fruits. Fruit yields vary, depending upon the variety and the age of the trees. This is one of the best soils of the county for apples (pl. 4, A).

Pastures are confined mostly to old meadows, which are commonly pastured 1 or 2 years before plowing for a new crop rotation. They are fair to good and include timothy, clover, redtop, bluegrass, and some weeds. The few permanent pastures are seldom treated and contain many weeds such as goldenrod, devils-paintbrush, sweetfern, and poverty grass, as well as some redtop, bromegrass, bluegrass, and timothy.

The high percentage of idle land is more a matter of ownership than of quality of the soils. Much of the idle acreage occurs in estates that are no longer farmed. Most of the forest is made up of young hardwoods that have encroached upon old idle areas. A few areas have been reforested with spruce, red, Scotch, and white pine, and fir seedlings.

Good soil management should center on maintenance of organic matter and fertility. On dairy farms alfalfa should be the first choice as a long-lived legume for hay mixtures. The soil requires heavy applications of lime and phosphorus, however; and considerable evidence of potash deficiency has been found. Green or barnyard manure is needed to help maintain the organic matter if the soil is cropped intensively. On many farms it is good management to concentrate on intertilled crops for several years in succession, with proper measures to maintain fertility, in order that more strongly sloping and erodible land can be used for close-growing crops for longer periods.

**Hoosic gravelly loam, rolling phase (5–15% slopes) (H<sub>H</sub>).**—Rolling terraces and sloping terrace faces are occupied by this soil. The relief is more uneven or billowy than that of the nearly level and undulating phases. The soil is closely associated with almost level areas of Hoosic gravelly loam. The areas are small—2 to 25 acres.

The soil profile is similar to that of the nearly level and undulating phases. The surface soil, on the average, is shallower, principally because of moderate erosion. The depth to the open gravelly substratum is normally slightly less, and the soil is slightly more gravelly and open throughout the profile.

*Use and management.*—Cultivated areas of this phase are used much the same as those of the nearly level and undulating phases, but yields of field crops are usually lower because of greater droughtiness. Yields of apples are essentially the same. Orchards are generally maintained in sod.

Good soil management should center on maintenance of organic matter and soil fertility through the use of manure, legumes, fertilizer, and lime. In addition, cross-slope cultivation should be practiced to retard runoff and conserve soil and water wherever the irregular slopes permit.

**Hoosic gravelly loam, hilly phase (15-25% slopes) (Hf).**—In general profile characteristics this droughty soil is similar to the nearly level and undulating phases of Hoosic gravelly loam. Slopes, however, are steeper and very irregular. The soil was formerly classified as Otisville gravelly loam, but is now placed in the Hoosic series because of general similarity of profile. It is an acid soil developed from cross-bedded or stratified outwash sand and gravel, which typically accumulated as kames or eskers. The parent materials came principally from slate, shale, and sandstone rocks. Some schist, quartz, granite, gneiss, and occasionally limestone rock materials are also present in small quantities. The small scattered areas occur in all the major valleys west of the Harlem Valley on low gravelly hills or knolls or on terrace escarpments.

The gravelly loam surface soil, beneath a heavy sod, is dark brown or grayish brown, mellow, strongly acid, and about 7 inches thick. The upper part of the subsoil, to a depth of 23 or 28 inches, is yellowish-brown gravelly loam in which the gravel content increases with depth. The lower part, extending to a depth of about 40 inches, is loose grayish-brown gravelly loam in which the grayish color becomes more pronounced with depth. The substratum, beginning below 40 inches and continuing to a depth of several feet, consists of slate-gray and brown stratified gravel and sand. In the deep substratum, 10 to 15 feet below the surface in many places, there is considerable lime carbonate in the form of a coating on the gravel. This lime is usually too deep to be of agricultural importance, especially since the surface and subsoil layers are moderately to strongly acid. The gravel throughout the profile is generally rounded or subangular and ranges from 1 to 3 inches in diameter. The soil is well penetrated by roots, and both surface and internal drainage are good to excessive.

The soil varies principally in the depth of the surface layer, texture of the subsoil, and reaction. The depth of the surface soil varies because of moderate erosion in cleared areas. In most areas the soil is strongly acid throughout, but in some, especially those near limestone regions, it is only slightly acid in the deep subsoil. As for most soils on kames, the subsoil varies considerably in texture, even within short distances on the same kame or hill. The range is from firm gravelly loam to loose gravelly loam and gravelly sandy loam.

*Use and management.*—Cultivated areas of this gravelly soil are used mostly for hay crops but also to some extent for corn and oats. Regular rotations are not commonly followed. Usually superphosphate and heavy applications of manure are used for corn. From 1 to 2 tons of lime are applied to fields prepared for oats and the hay

seeding, which usually consists of timothy and red clover. Meadows are sometimes top-dressed with manure after the second year of mowing. Hay meadows are mowed until yields fail and are then pastured or again plowed for corn.

The pastures vary in quality. Rotation pastures following mowings are usually best and contain timothy, redtop, some red clover, poverty oatgrass, and some weeds. Permanent pastures usually contain more of weeds and poverty oatgrass than of desirable pasture grasses. Pastures usually are poor in the hot summer months because moisture is lacking.

The forested areas contain mostly hardwoods and some white and pitch pines. Red, white and black oaks, hard maple, tuliptree, white ash, yellow and black birches, and shagbark hickory are the principal forest trees. A few areas have been reforested with red pine and Norway spruce.

Conservation of moisture and maintenance of soil fertility are the main management problems. The irregular choppy relief is generally unsuited to contour tillage and strip cropping. One of the best uses is long-term hay and pasture. A deep-rooted legume such as alfalfa is needed to survive the droughtiness of the soil that occurs during most summers. Alfalfa, however, has been only moderately long-lived on similar soils. Birdsfoot trefoil is a promising legume for hay and pasture mixtures. It tolerates a lower fertility level than alfalfa, but a stand is more difficult to establish. Any hay seeding should contain either alfalfa or birdsfoot trefoil mixed with grasses, and to be successful it must be supplied with lime and phosphorus and, in places, potash.

**Hoosic gravelly loam, steep phase (25-45% slopes) (Hk).**—Although this soil differs from the hilly phase in having steeper slopes, it is essentially the same in profile characteristics. Like the hilly phase, it typically occurs on kames. It was classified as a member of the Otisville series before 1944. It is associated with other Hoosic soils and occurs in small areas in most of the valleys west of Harlem Valley.

*Use and management.*—The steep irregular slopes of this soil cause rapid runoff, and the result is serious erosion and loss of water badly needed by crops. Machinery is difficult to use. As a result of droughtiness, the soil usually produces poor yields of either crops or pasture, and in places it is better used for forest. On many farms, however, the soil occurs as small areas within areas of better soils that are used for pasture and crops. In such places it may be used for long-term hay or pasture.

**Hoosic gravelly sandy loam, nearly level and undulating phases (0-8% slopes) (Hl).**—These phases occur chiefly on the level terraces of the Hudson River and Fishkill Creek—that is in Poughkeepsie and southward toward Camelot and New Hamburg and near Fishkill and Hopewell Junction. Small areas, however, are on terraces in the western half of the county. The soils are not so extensive as the nearly level and undulating phases of Hoosic gravelly loam. They are loose, open, and inclined to be droughty.

The surface soil to a depth of 12 inches is brown to dark brown and friable. Beneath sod it has a fine crumb structure. The ap-

parent organic-matter content is low. The upper subsoil extends to a depth of 20 inches; it is a firm but friable gravelly yellowish-brown sandy loam. The lower subsoil which reaches to a depth of 36 inches, is light-brown loose gravelly sand. Below 36 inches lies sand, grayish-brown loose stratified gravelly sand, and gravel.

The soils are strongly acid throughout and excessively drained. Roots penetrate all layers easily. The soils vary somewhat in texture and structure of the subsoil. South of Poughkeepsie there are areas having fine sandy loam to light silt loam subsoil to a depth of 3 feet. These soils retain moisture better and have slightly higher reaction. In most areas, however, the subsoil is loose below depths of 20 to 24 inches.

*Use and management.*—These phases warm early in spring and produce well until dry weather comes. The cultivated areas are used chiefly for corn, oats, and hay grown in support of dairying. The rotations followed last 5 to 6 years. Corn is grown 1 or 2 years in the rotation and followed by oats, which is used as a companion crop for a hay seeding. Usually 10 to 12 tons of manure are applied for corn. Meadows are top-dressed with 4 to 6 tons of manure after the first or second season of mowing. Hay is commonly harvested about 3 years; then the meadows are pastured 1 year or plowed again for corn. Varying quantities of superphosphate are used on corn and oats, and 1 to 1½ tons of lime are spread on soils prepared for oats and the hay seeding. The highest yields are obtained where the soils have received lime and heavy applications of manure supplemented with some superphosphate.

Pastures are confined mainly to old meadows and are only fair. Some of the acreage has been abandoned because of low productivity. The areas now forested have a growth of aspen, gray and white birches, scrub oak, and wild cherry that has gradually encroached on areas idle for some time. Some pitch and white pines grow on the older forested areas.

**Hoosic loam, nearly level and undulating phases (0-8% slopes) (Hm).**—These are level acid well-drained soils occurring on the level terraces along the Hudson River and Fishkill and Wappinger Creeks. They are not so extensive as the nearly level and undulating phases of Hoosic gravelly loam. Only a few areas on terrace faces exceed 5 percent in slope.

Beneath a sod the surface soil is dark brown, finely granular, and well penetrated by roots. It is about 11 inches thick, and underlying is a yellowish-brown light loam or fine sandy loam that extends to a depth of 17 inches. This underlying layer is friable and well penetrated by roots. From 17 down to 24 inches the subsoil is friable brown sandy loam; from 24 down to 34 inches it is loose grayish-brown coarse gravelly sand. The gravelly sand rests on grayish-brown loose fine sand, which continues down to 44 inches. The substatum begins at 44 inches and goes down several feet; it is grayish yellow-brown stratified gravel, sand, and silt.

The soil is well-drained, strongly acid, and penetrated by roots throughout the profile. It is generally more retentive of moisture than the gravelly loam and gravelly sandy loam Hoosic soils. The subsoil varies in texture, as it does in most Hoosic soils. It ranges

from heavy loam to light silt loam. The depth to coarse open material varies from 20 to 36 inches.

*Use and management.*—When properly managed, these phases are among the best in the county. The cultivated areas are used and managed much the same as the nearly level and undulating phases of Hoosic gravelly loam, with which these soils are closely associated. Need for fertilizer, lime, manure, and other soil-improving practices is the same. In the vicinity of Red Hook, Rhinebeck, and Poughkeepsie, these soils are used for vegetable crops, small fruits, and nursery stock. Yields of most crops are about the same or slightly higher than those obtained on Hoosic gravelly loam, nearly level and undulating phases. The soils, owing to the absence of gravel, handle easily for vegetables, nursery crops, and small fruits and warm up early in spring.

Pastures are confined mainly to old meadows and contain timothy, alsike clover, redbtop, and Kentucky bluegrass, as well as some wild white clover, poverty oatgrass, and weeds. Few areas remain in pasture more than 2 years. Most idle areas are suitable for cultivation and apparently have not been idle long or are temporarily fallow.

**Housatonic silt loam** (0–2% slopes) (H<sub>1</sub>N).—This poorly drained soil has developed from stream-deposited sediments that washed from areas of shale, slate, schist, or crystalline rock materials. It occurs along streams on low places in the first bottoms and is flooded frequently. Areas are usually small; the largest contain 40 acres. Closely associated with this soil are Pawlet and Saco soils and, in some areas, Poultney soils.

The dark grayish-brown granular silt loam surface soil beneath old meadows extends to 9 inches. From 9 down to 13 inches the soil is lighter grayish-brown silt loam, mottled with gray and yellow, that breaks into small soft irregular fragments. From 13 down to 21 inches the soil is light grayish-brown plastic silty clay loam, strongly mottled with yellow, gray, and rust brown. The soil extending from 21 to 42 inches is compact silty clay loam, strongly mottled with gray, yellow, and rust brown. Below 42 inches lie stratified layers of gravelly sand, silt, and silty clay.

Drainage is poor. Roots are most abundant in the surface layer; very few occur in the heavy silty clay loam subsoil. The profile is acid in all parts. A few gravelly areas are included and indicated on the map by gravel symbol. Also included are a few small scattered areas totaling about 40 acres that have a fine sandy loam texture.

*Use and management.*—Cultivated areas of this soil are used mostly for hay crops of timothy and redbtop. Corn and oats are sometimes grown but they frequently fail. Deep-rooted legumes are not grown successfully. A few areas have been ditched to facilitate drainage. No regular rotations are followed; meadows are usually maintained until hay yields are low and weeds predominate. Sedges and reeds are usually present in old meadows and pastures. Timothy hay yields about a ton an acre; yields are best in areas that have been artificially drained. Few areas are protected from overflow.

The condition of pasture varies. In the better managed well-grazed pastures there are high percentages of timothy, and redbtop, with some reeds, sedges, poverty oatgrass, and cinquefoil. In the

poorer pastures weeds predominate and alders and willows have invaded.

Ladino clover is a legume that will tolerate the wetness of this soil. With it, areas in hay and pasture can be made much more productive. The position of the soil generally prevents establishment of good artificial drainage, but in many places open ditches can improve the soil for hay. The soil needs lime and phosphorus, but its organic matter and nitrogen levels are high.

The native forest consists of trees that thrive on wet land—elm, black ash, soft maple, sycamore, willow, and alder. A few gray birch, ash, basswood, and hard maple are also present.

**Hudson fine sandy loam, gently sloping phase (2-8% slopes) (Ho).**—Like others of its series, this soil overlies layers of silt, clay, and fine sand. It is not so extensive as other types of the Hudson series, but it ranks next to Hudson silt loam, gently sloping phase, in agricultural importance. It occurs on the level to gently sloping areas in the lake-plain region in the western part of the county. Most of it is in the vicinity of Rhinebeck and Rhinecliff. Closely associated with it are other Hudson soils and the Melrose, Claverack, and Colonie soils.

The surface soil in cultivated areas is medium to strongly acid dark grayish-brown mellow fine sandy loam about 9 inches thick. A yellowish-brown fine to very fine sandy loam—open, porous, and well filled with roots—extends to a depth of 20 inches. The subsoil starting at 20 inches and continuing to a depth of 30 inches is very light-brown, fine sandy loam to silt loam. This layer is friable but breaks out into irregular nutlike fragments; it is well penetrated by roots and medium acid. The lower subsoil extends from a depth of 30 to 36 inches; it is similar to the layer above in appearance but only slightly acid. Immediately above the substratum the lower subsoil may be lightly stained with yellow, rust brown, and gray. The substratum, beginning below 36 inches, is olive-brown stratified silty clay, silt, and very fine sand with a blocky structure. The upper part is alkaline, but that below 5 or 6 feet is calcareous. A few roots are present in the upper part.

The soil varies principally in subsoil texture, which ranges from silt to very fine sand. To some extent the reaction of the lower subsoil varies. The range is from slightly acid to slightly alkaline. The soil is free of gravel in all layers.

*Use and management.*—Cultivated areas of this soil are used principally for corn, oats, and hay—crops needed on dairy farms. A few acres are used for vegetables, strawberries, and nursery stock. Most of the acreage now idle is potentially suitable for cultivation but occurs in large estates, parts, or all, of which are no longer farmed.

The prevailing practices of tillage, rotation, and fertilization are similar to those described for Hudson silt loam, gently sloping phase, but rotations seldom exceed 5 years, and where available, slightly heavier applications of manure are applied for corn. Yields are somewhat lower than on Hudson silt loam.

Most permanent pastures have only a fair vegetative cover, which includes a moderate percentage of Canada and Kentucky bluegrasses, a trace of wild white clover, some timothy and redtop, and many undesirable weeds. With top dressings of phosphate and lime, most pasture could be greatly improved.

The native forest is similar to that on Hudson silt loam, gently sloping phase. In addition there is more black locust, especially on abandoned areas that have reverted to forest.

This soil is highly responsive to fertilization. Good management should center on practices that will maintain organic matter, which disappears rapidly under intensive cropping, and that will supply nitrogen, phosphorus, potash, and lime. Alfalfa is well suited, and early vegetables produce well. The soil is subject to erosion, even on mild slopes. Rotations and tillage practices should be designed to control runoff.

**Hudson silt loam, gently sloping phase (2–8% slopes) (Hr<sup>4</sup>).**—Characteristic of this soil is a uniform gradation from grayish-brown in the surface soil (cultivated areas) to light-brown in the upper subsoil, to darker brown in the lower subsoil, and to brown in the stratified substratum. The soil has developed from glacial lake sediments of silt and clay that were originally laminated or stratified and contained free carbonates. Areas are on nearly level and gently sloping parts of the glacial lake plain of the Hudson soil association. In most places slopes do not exceed 5 percent. The soil is most closely associated with the rolling and hilly phases of Hudson silt loam but is also associated with phases of Hudson silty clay loam and soils of the Rhinebeck, Madalin, and Livingston series, which have developed from similar materials.

In cultivated areas the 8-inch surface soil is light grayish brown, crumb-structured, and friable. The subsoil, to a depth of 15 inches, is friable light-brown to yellowish-brown silt loam having a medium angular blocky structure. The surface soil and upper subsoil are usually medium acid. Between 15 and 30 inches the subsoil is silty clay loam that grades from light brown to dark brown, has a medium nut structure, and is plastic when wet. In the lower part of this layer, which is slightly acid or neutral, there is some evidence of the original stratification. From 30 to 70 inches the lower subsoil is brown silty clay that is firm in place, stratified, and neutral or slightly alkaline. Below 70 inches begins the substratum, an olive-brown silty clay loam that is stratified and strongly alkaline. This substratum is calcareous at a great depth.

In cultivated fields and pastures the apparent organic content of the surface soil is low. In the surface and upper subsoil layers root penetration is most abundant to a depth of 25 inches. Alfalfa and tree roots extend to greater depths, then follow cleavage planes between soil blocks. Although internal movement of water is slow, the soil is apparently well drained and shows no mottling.

The soil varies somewhat in depth of the surface soil (8 to 14 inches) and in texture of the subsoil. Most cultivated areas are moderately eroded. Strata or lenses of fine sand are occasionally found in both the subsoil and substratum. South of Beacon the surface texture in places approaches a loam. Included also are a few small areas on which erosion has been more severe. These have lost over 75 percent of the original surface soil.

*Use and management.*—About half of Hudson silt loam, gently sloping phase, is cultivated. Probably one-fifth of the cultivated land is used for fruit, and the rest for crops grown in support of dairying and poultry farming.

Corn, oats, alfalfa, and clover-and-timothy hay are the common crops grown in support of dairying. Apples are the principal fruit, though some strawberries are grown. A 5- or 6-year rotation is generally followed on dairy farms. Corn is grown for 1 year and commonly followed by 1 year of oats and 3 years of hay. Meadows are frequently pastured 1 or 2 years after the second or third season of mowing. From 8 to 10 tons of manure and 200 pounds of superphosphate an acre are applied for corn. Oats receive 100 to 200 pounds of superphosphate when they are seeded. For leguminous crops a ton of lime an acre is applied by the more successful farmers on the corn stubble or when the soil is prepared for oats. Meadows to be pastured 1 or 2 years of the rotation are commonly top-dressed with 4 to 6 loads of manure supplemented with superphosphate.

Most farmers make little effort to retard runoff by special practices. Erosion, though not severe, is evident in most fields used for clean-cultivated crops. Greater care should be taken to run the rows of clean-cultivated crops across the slope near or with the contour. If row crops are grown, strip cropping is needed on areas that have appreciable slope. Most orchards are maintained in sod and receive manure and nitrate of soda.

The native vegetation includes white pine, white oak, elm, flowering dogwood, red and white maples, and tuliptree. Well-grazed native pastures contain high percentages of Canada and Kentucky blue-grasses and wild white clover.

**Hudson silt loam, hilly phase** (15-30% slopes) (Hr).—Areas of this soil extend from the high lake plain down to the Hudson River. They are adjacent to the river or in tributary valleys whose small streams flow into it. The soil is cut by many V-shaped small valleys or draws.

The soil profile is similar to that of the gently sloping phase, except the various layers are shallower. The tight plastic olive-brown silty clay loam substratum that occurs below 60 inches in the gently sloping phase is more commonly found in this soil at depths of 30 to 50 inches.

Beneath a shallow layer of leaf litter and a thin very dark-brown granular mull, the surface soil in forested areas is dark grayish-brown friable silt loam to a depth of 4 inches. It is underlain to a depth of 6 inches by lighter grayish-brown friable silt loam. From 6 down to 10 inches is light-brown thin platy silt loam. From 10 to 20 inches is slightly acid heavy silt loam having a small irregular blocky structure. From 20 to 30 or 50 inches is a darker brown silty clay loam having moderate to strong medium blocky structure, plastic consistence, and neutral reaction. This layer rests upon the olive-brown plastic silty clay substratum at 30 to 50 inches. With depth, the substratum becomes distinctly stratified, and it is calcareous.

Surface and internal drainage are good. Surface drainage is rapid in cleared areas but retarded by litter in forested areas. Tree roots are most abundant in the upper 20 inches but a few follow the cleavage planes of the soil fragments down to 36 or 40 inches.

This soil varies chiefly in depth to the tight silty clay loam substratum, but to some extent in surface and subsoil texture. In some areas thin strata or lenses of fine sand are encountered in the subsoil. South of Beacon the surface soil approaches a loam in texture.

*Use and management.*—Hudson silt loam, hilly phase, is chiefly in forest. The small areas that are cultivated are adjacent to and worked in the same way as the rolling phase of Hudson silt loam. Well-managed pasture generally supports a sod heavy enough to stabilize erosion. Erosion is active in idle areas and unimproved pastures. Areas reforested with evergreens seem to accumulate sufficient litter in a few years to retard runoff and stabilize erosion. It would seem advisable to reforest permanently idle areas. Native vegetation is the same as on the gently sloping phase.

**Hudson silt loam, rolling phase** (10–15% slopes) (Hs).—Inextensive areas of this soil are closely associated with areas of the gently sloping phase but occur on more strongly sloping or rolling relief.

Profile characteristics are similar to those of the gently sloping phase. The surface soil has on the average been slightly more eroded, and surface drainage is more rapid because slopes are greater. A few areas have not been pastured or cleared of forest and have no apparent erosion.

The profile varies in about the same way as that of the gently sloping phase. Included, in addition, are a few small areas south of Beacon and a fairly large one just north of Staatsburg and east of the New York Central Railroad on which erosion has been severe. The total acreage of these areas was too small to justify separation. Much of the area north of Staatsburg remains in cultivation; the other areas are idle or have been reforested.

*Use and management.*—About four-tenths of Hudson silt loam, rolling phase, is cultivated. The few orchards are maintained in sod, and erosion is generally stabilized. The other cultivated areas are used principally for corn, small grains, and hay—crops needed in dairying and poultry raising. Rotations, fertilizers, and management practices used are similar to those for the gently sloping phase, but yields are generally lower.

The soil is highly erodible and should be plowed and cultivated on the contour. On long slopes, wherever feasible, strip cropping is needed. A winter cover crop should also be used after row crops. Following corn, a few farms use winter wheat instead of oats in the rotation and thereby maintain a cover on the soil during the winter. Fall plowing generally results in serious soil loss.

**Hudson silty clay loam, gently sloping phase** (2–8% slopes) (Hv).—This soil resembles Hudson silt loam, gently sloping phase, but is much heavier textured throughout its profile. Areas are scattered throughout the entire lake-plain region in the western part of the county, but the total acreage is small.

In forested areas beneath a thin layer of leaf litter there is a 3-inch surface soil of dark grayish-brown coarsely granular silty clay loam. From 3 down to 10 inches is pale-brown silty clay loam that is firm, plastic, and moderately acid. The subsoil, beginning at 10 inches and continuing to 20 inches, is firm light-brown silty clay loam with nut or blocky structure. This layer is heavy, plastic, and moderately acid, but some roots penetrate it. The subsoil extending from 20 to 30 inches is brown silty clay loam that breaks out into large blocky fragments. This material is plastic, shows some evidence of lamination, and is slightly acid. The substratum, beginning below 30 inches,

is distinctly stratified or laminated plastic tight silty clay loam. The strata of clay vary in color from olive brown to brown. The upper strata are neutral or slightly alkaline, and with depth, the lower strata become strongly calcareous. At 55 inches lime concretions are present in the clay. The few roots that penetrate the lower subsoil and the upper substratum follow along the cleavage planes between soil fragments. Internal drainage is slow, but the soil appears to be well-drained.

The soil varies principally in thickness of surface soil and texture of subsoil. The surface soil in most cultivated areas averages 5 inches in thickness, in contrast to an average of 10 inches in virgin areas. Probably 95 percent of the soil was once cleared of forest and cultivated. Erosion has removed 50 to 75 percent of the original surface soil from most of these cleared areas. A very small area has been included from which most of the surface soil has been eroded. In some places strata or lenses of fine or very fine sandy loam are encountered in the subsoil and substrata.

*Use and management.*—The cultivated areas of Hudson silty clay loam, gently sloping phase, are used for corn, small grains, and hay. Prevailing practices of tillage, crop rotations, and fertilization are about the same as those used on Hudson silt loam, gently sloping phase. The soil is maintained in sod longer, as a 6-year rotation is more commonly practiced. The soil is difficult to work and cultivate because it is heavy and plastic. In very dry seasons it bakes and cracks.

Even though slopes are mild, this soil tends to erode easily under clean cultivation. Care should be taken to plow and plant on the contour to retard runoff. Erosion is severe in only a few places, but small rills develop in open cultivated fields during heavy rains. These rills are especially noticeable in cultivated fields where rows run up and down the slope. At present, few farmers run rows of corn across the slope. It is generally advisable to use the soil as much as possible for hay and rotation pasture, as it is highly productive when well managed. Alfalfa is a good long-lived legume if enough lime and phosphorous are supplied.

The pastures contain considerable bluegrass and wild white clover when properly grazed, but if not cared for, mainly goldenrod, wild carrot, dock, chicory, and thistle.

**Hudson silty clay loam, eroded rolling phase (10-15% slopes) (Hr).**—Rolling areas of Hudson silty clay loam and silt loam from which most of the original plow layer has been lost through erosion make up this phase. The areas are closely associated with the uneroded Hudson soils but are more strongly rolling or sloping.

The grayish light-brown surface soil in cultivated areas is a mixture of the remaining surface soil with that part of the lighter brown subsoil turned up in plowing. The subsoil and substrata are similar to those of Hudson silty clay loam, gently sloping phase, or Hudson silt loam soils, but occur at shallower depths. There are a few deep gullies, but sheet erosion is evident in most cultivated fields, in poorer meadows, and in pastures. Included with this phase are one or two small areas of Hudson silty clay loam, rolling phase, on which erosion has been less serious. The acreage of these included areas is too small to justify separation.

*Use and management.*—Corn, small grains, or hay are the crops grown on this soil. The practices of tillage, rotation, and fertilization are similar to those used on Hudson silt loam, rolling phase. A 6-year rotation is usually practiced, but the meadows are frequently pastured an additional 2 or 3 years. Elimination of row crops and use of a long rotation that keeps the soil under a heavy sod are desirable for controlling runoff and building up organic matter. Soil tests indicate the need of lime, but many operators do not use it. Crop yields are considerably lower than on Hudson silty clay loam, gently sloping phase.

Most pastures are fair to good and support a bluegrass-and-wild white clover vegetation with a low percentage of weeds. Where properly managed and not overgrazed, a sod heavy enough to control runoff can be maintained.

**Hudson silty clay loam, hilly phase (15–30% slopes) (Hv).**—This strongly sloping to hilly soil occurs in the western part of the county on slopes that extend from the high terraces down to the Hudson River and along streams that have cut deep valleys back into the uplands. The most extensive areas are along the east bank of the Hudson River.

The soil has a much thinner solum than the gently sloping phase, and its substratum occurs closer to the surface. Beneath a very thin leaf litter the surface soil in a virgin area is about 2 inches of dark grayish-brown coarsely granular silty clay loam. From 2 down to 6 inches is pale-brown plastic silty clay loam. The subsoil from 6 down to 12 inches is light-brown firm plastic silty clay loam that breaks out into small angular fragments. From 12 to 24 inches is very compact dark-brown to weak reddish-brown silty clay loam that breaks out in large blocky fragments and shows evidence of the original layers of silt and clay. Below 24 inches is very tight plastic stratified silty clay, varying from olive brown to weak reddish brown in different layers.

The surface soil and subsoil are acid. The upper part of the substratum is neutral or slightly alkaline; the lower part, with depth, becomes strongly alkaline and then calcareous.

The soil varies chiefly in thickness above the unweathered substratum. On many of the steeper slopes the subsoil is only a few inches thick, whereas on the more gentle slopes it is about 24 inches thick. The unweathered clay of the substratum ranges from neutral to calcareous. Lenses of very fine sand are found in both the subsoil and substratum. Included are about 250 acres seriously eroded, and 100 acres with a silt loam surface soil.

*Use and management.*—The hilly phase of Hudson silty clay loam should be used for pasture or long-term hay as much as possible. Cultivated areas erode severely, but under forest and pasture the soil is generally well stabilized. Most pastures support a good cover of bluegrass, wild white clover, and redtop. Controlled grazing is more desirable, as overgrazing frequently causes sheet erosion. An alfalfa-grass mixture, reseeded only when the stand runs out, can be used if enough lime and fertilizer are applied to insure a good sod.

**Hudson silty clay loam, steep phase** (30% slopes) (Hw).—This heavy-textured soil occurs on steep slopes extending from the uplands down to the Hudson River. It is associated with Hudson silty clay loam, hilly phase, and other Hudson soils.

The soil profile is similar to that of Hudson silty clay loam, hilly phase. It is characterized by a thin acid solum of silty clay loam over layers of relatively unweathered calcareous silt and clay. The soil is highly susceptible to erosion when cleared and is subject to slips and landslides on the steeper slopes even when under forest. Practically all of it is in forest, its best use.

**Kendaia silt loam** (0–3% slopes) (KA).—This poorly drained soil has developed from moderately deep or deep glacial till composed chiefly of limestone, with which some slate, sandstone, schist, and gneiss rock materials are intermixed. The soil occurs on very gentle slopes or nearly level areas on the lower parts of slopes and at the heads of streams in the limestone valleys. Internal drainage and surface runoff are slow. The soil commonly occurs between areas of very poorly drained Lyons soils in the depressions and areas of better drained gently sloping or rolling Amenia, Pittsfield, Stockbridge, Dover, and Wassaic soils.

The 10-inch surface soil is dark brown or dark grayish brown in pasture areas. It is friable, breaks up into small irregular fragments, is slightly alkaline, and contains numerous roots. The subsoil from 10 down to 17 inches is brownish-gray silt loam mottled with gray and rusty brown. It is firm or slightly compact, alkaline, and becomes more strongly mottled with depth. From 17 down to 26 inches the subsoil is very compact light-brown heavy gritty loam strongly mottled with yellow, rust brown, and gray. This layer is calcareous and contains many partly decomposed limestone pebbles. Extending from 26 to 36 inches or more, the substratum is very compact calcareous grayish-brown gravelly loam mottled with yellow and rust brown. This layer extends to several feet, and mottling decreases with depth. Bedrock seldom outcrops. Pieces of gravel, predominantly from limestone, are present throughout the profile. Few roots penetrate below 17 inches.

*Use and management.*—Kendaia silt loam has poor natural drainage. A few areas of it have been drained artificially. A few small fields occurring among larger areas of better drained soils have been ditched. The cultivated areas are generally small and lie adjacent to areas of the better drained Pittsfield, Stockbridge, Amenia, or Dover soils. They are used like these associated soils but produce lower yields.

Pasture is generally fair to excellent. As on nearly all the limestone soils, bluegrass and wild white clover are abundant. Few weeds grow in the better permanent pastures. A few operators top-dress with superphosphate to stimulate the growth of bluegrass and wild white clover and thus crowd out the weeds. Hardhack is sometimes a pest. In poorer pastures plantain, thistle, and other weeds, some cedar, and other trees and brush are present.

Undrained areas are better suited to pasture than to cultivated crops. Corn, small grains, and vegetables are frequently drowned out during temporary flooding. Alfalfa is seldom a success. Ladino clover in

mixtures with grasses would be highly productive of hay and pasture if open-ditch drainage were provided. If the soil were adequately drained, corn and late vegetables could be grown successfully. The soil is fertile, but poor drainage restricts its use.

**Livingston silty clay loam (0-3% slopes) (L<sub>A</sub>).**—This wet soil has developed from glacial lake sediments, mainly silt and clay. It occupies nearly level or slightly depressed areas in the lake plain near the Hudson River and in smaller glacial lake areas south of Pine Plains and New Hackensack and in the vicinity of Hopewell Junction. It is the most poorly drained soil of the lake-plain region and occurs in close association with Madalin, Rhinebeck, Melrose, and Claverack soils. The individual areas are usually small, though some include 20 or 25 acres.

The surface soil in old pastures is very dark-brown or black coarsely granular silty clay loam. The apparent organic-matter content is high, and roots are abundant. There is considerable staining or mottling with light gray, yellow, and rust brown. The reaction varies from slightly acid to neutral or slightly alkaline within short distances in the same area. The subsoil, extending from 10 or 12 to 30 or 35 inches, is dark grayish-brown or brownish-gray silty clay or silty clay loam strongly mottled with gray, yellow, and rust brown. It is tough when moist and breaks out into large blocky pieces. The entire subsoil is alkaline. The substratum consists of stratified light gray-brown calcareous silty clay.

*Use and management.*—A few areas of this soil are tilled or ditched and used principally for hay crops or pasture. Regular rotations are followed only where small units of 2 or 3 acres are associated with better drained soils. Most meadows and pastures are poor. Pastures contain reeds and rushes, and in most permanent pastures alder and willows are found.

If adequate open-ditch drainage were provided, Ladino clover with grasses would produce good yields of hay and pasture. The soil is fertile and not subject to serious erosion. Nevertheless, it warms up slowly in spring when drained artificially and is difficult to keep in good physical condition. In most places it is probably best used for trees or pasture.

**Lyons silt loam (0-3% slopes) (L<sub>B</sub>).**—This very poorly drained soil has developed from glacial till composed principally of limestone rock materials mixed with some slate, schist, gneiss, or sandstone. It occupies level areas or depressions, frequently at the heads of streams or adjacent to poorly drained alluvial soils and muck areas. Natural drainage is very poor, and the soil is wet most of the year unless artificially drained. Drainage is poorer than on the associated Kendaia soils. The soil is very dark colored. It is closely associated with the other limestone soils of the county. It occurs mainly in long and narrow areas of 2 to 30 acres in the Harlem Valley but is also found in the limestone areas in the valleys of Fishkill, Wappinger, and Little Wappinger Creeks.

The very dark grayish-brown or almost black surface soil, about 8 inches thick, has a fine granular structure under sod, a high organic-matter content, numerous roots, and a slightly acid reaction. The upper subsoil, extending from 8 down to 14 inches, is alkaline brown-

ish-gray silt loam mottled with yellow and rust brown. From 14 to 25 inches the subsoil is pale brown gravelly loam or fine sandy loam strongly mottled with yellow, gray, and rust brown. The lower subsoil, extending from 25 to 36 inches, is calcareous bluish-gray gravelly light silt loam that is strongly mottled with yellow and brown. Below 36 inches and continuing to a depth of several feet is the substratum, a slightly compact strongly calcareous light-brown gritty silt loam stained with yellow and gray.

Several areas having a surface soil of light silt loam or loam texture are included. Also included because of small total acreage were scattered areas covered with loose stones and boulders.

*Use and management.*—Pastures on this soil are variable but generally only fair. They include weeds, fern, reeds, rushes, wild iris, wild aster, and bluegrass and redtop. In poorer pastures shrubby cinquefoil and other brush are abundant. In the few pastures artificially drained, bluegrass, redtop, and wild white clover abound and there are fewer weeds.

Cultivated areas are generally small and are worked with areas of adjacent better drained soils. Where this soil has proper artificial drainage it produces good crops. Open ditches are most commonly used; few areas are drained by tile. Good open-ditch drainage permits use of Ladino clover-grass mixtures for hay and pastures. Such drainage is inadequate for corn, small grains, and vegetables. The soil is fertile and would be excellent for corn and midseason or late vegetables if it were tile drained. Red maple, American elm, white ash, and white cedar are the principal trees on forested areas.

**Madalin silt loam** (0–3% slopes) (M<sub>A</sub>).—The largest areas of this heavy soil occur east of Madalin and northeast of Upper Red Hook. They are closely associated with areas of Madalin silty clay loam and of Rhinebeck and Livingston soils.

This poorly drained soil has developed from glacial lake sediments, mainly silt and clay. Relief is very gently sloping to nearly level. Both internal and external drainage are slow, but the soil is not permanently wet like Livingston silty clay loam.

The 8- or 9-inch surface soil in old meadows is slightly granular dark grayish-brown silt loam that is slightly acid. The upper subsoil, extending to a depth of 16 inches, is pale-brown silt loam strongly mottled with gray, yellow, and rust brown. It has a fine blocky structure and is slightly acid and plastic; a moderate number of roots penetrate it. The subsoil beginning below 16 and continuing to a depth of 27 inches is pale-brown heavy silt loam to silty clay loam strongly mottled with yellow, rust brown, and gray. This material breaks out into large irregular fragments that are medium hard and plastic. It is alkaline and is penetrated by few roots. The lower subsoil may have lenses of fine sandy loam. The sands, where found, are structureless; the silt and silty clay loam have a blocky structure. The material is dominantly brownish gray but is strongly mottled. The substratum consists of stratified alkaline or calcareous silt and clay varying in color from olive brown to slightly reddish brown. Thin layers of fine sand may be present.

The soil varies principally in thickness of surface layer (6 to 9 inches). Nearly all gently sloping areas have been slightly or mod-

erately eroded. The reaction of the upper part of the subsoil is somewhat variable; the lower subsoil is always alkaline. The soil is all poorly drained internally, but surface drainage is only moderately slow in most areas. The lower part of the surface soil is sometimes slightly stained with yellow and rust brown. This staining is not found uniformly throughout a field or area.

*Use and management.*—Cultivated areas of this soil are used principally for hay. Regular rotations are not followed. Corn, oats, and wheat are sometimes grown. Yields depend a great deal upon the season. In very wet seasons crop failure is almost certain. Manure is usually applied for corn at the rate of 6 to 10 tons an acre and is also used as a top dressing on meadows. The rate of application varies with the quantity of manure available and the acreage that needs top dressing. Fields are usually kept in hay until the desirable grasses disappear. Alfalfa and red clover are very poorly suited. Hay seedings generally are a mixture of timothy, redtop, and alsike clover. Superphosphate is used on corn, grain, and meadows. On corn and meadows it is usually applied with manure. From 150 to 200 pounds of superphosphate may be applied for grain.

Yields vary a great deal. Pears and small fruit are grown on a few areas, usually under a system of ridging; that is, the plantings are made on the crests of ridges. Home gardens are most successful when grown under a similar system—the soil is plowed up in narrow ridges and the vegetables are seeded on the crests.

Permanent pastures are usually poor and contain high percentages of weeds and sedges and frequently some willows. The natural forest includes elm, black and white ash, soft and hard maples, white pine, and hemlock.

**Madalin silty clay loam (0-3% slopes) (Mb).**—This soil is closely associated with Madalin silt loam and its associates. It is poorly drained, and its heavier texture makes it generally less productive and more difficult to drain than Madalin silt loam.

In cultivated areas the profile is similar to that of Madalin silt loam except for texture of the surface soil and upper subsoil, which is silty clay loam for both. Under a pasture or old meadow the surface soil is coarsely granular and more consistently stained with yellow and gray in the lower part than is the surface soil of Madalin silt loam. The cultivated areas on gentle slopes are slightly to moderately eroded. Internal drainage is very slow, and during heavy rains most of the water runs off the surface.

*Use and management.*—The tillage and fertilization usually followed on Madalin silty clay loam are similar to those used for Madalin silt loam, but little or no fruit is grown. The soil is more difficult to work than Madalin silt loam. Corn and oats generally yield less than on Madalin silt loam; hay yields are about the same or slightly less. Timothy alone, or timothy, alsike, and redtop, is the common hay crop.

**Made land (Mc).**—Most of this land type occurs south of Poughkeepsie. It consists of clay dumps, remnants of clay pits abandoned by brick industries, brick dumps, railroad fills, and embankments and dumps around slate and limestone quarries. Low areas within and near Beacon and Poughkeepsie and in many smaller villages are

filled in with material from building excavations and trash. In most of the brickyard pits the raw soil surface is exposed and erosion is very active. In places these clay exposures support a heavy growth of sweetclover. The material in the various dump areas is raw and covers the original land surface to several feet. This land type is of no agricultural value.

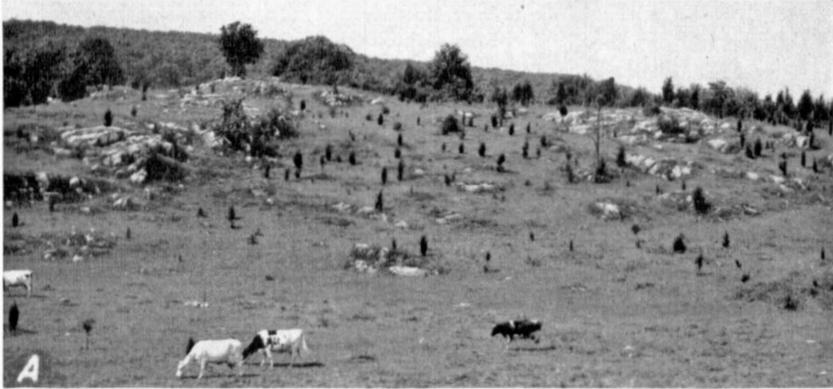
**Mansfield silt loam (0-3% slopes) (Md).**—This soil occupies depressions and flats formed of glacial till that is composed largely of materials derived from calcareous sandstone and acid shale. The soil usually occurs near the heads of streams or adjacent to muck or other poorly drained soils. Areas are wet except where ditched or otherwise drained. Drainage is poorer than that of the associated Boynton soils. The dark color of the surface soil indicates a relatively high accumulation of organic matter under the wet condition that prevails. The soil is closely associated with the better drained soils developed from calcareous sandstone as well as with those developed from acid slate and shale. Its reaction varies correspondingly. In the region of calcareous sandstone this soil tends to be slightly alkaline or neutral in the subsoil, but it is not uniformly so, even in the same area. In the region of slate and shale, however, the soil is generally acid.

Some areas are included that have silty clay loam surface soil and subsoil. These areas occur mainly where the soil materials were derived chiefly from calcareous sandstone. Their use suitability is similar to that of the silt loam. Some areas having numerous loose boulders or outcrops of bedrock are also included because of their small total extent. They are indicated on the map by either the boulder or outcrop symbol.

The 8-inch surface soil, dominantly dark gray or nearly black, is stained with bluish gray and rust brown. In pastures and forests it is granular and mellow and rests on a strongly mottled gray, yellowish-brown, and rusty-brown firm silty clay loam, which grades into gray or bluish-gray heavy glacial till below 24 inches. Sandstone and shale fragments occur throughout the profile. Drainage is very poor.

*Use and management.*—Most cultivated areas of this soil occur as narrow strips between areas of better drained soils. Such areas are usually drained with ditches and cultivated with the associated soils. A few areas are tile drained. Pastures vary a great deal. Where the soil is drained with ditches or tile and properly managed, good pastures can be established, but pastures are usually poor and include much brush, coarse sedges, and weeds (pl. 3, B). Many areas are being abandoned and are growing up to brush and forest. Forested areas include elm, ash, soft maple, hemlock, and alder. Weeds grow thickly on idle areas drained by open ditches; undrained areas are covered with rushes and sedges.

**Merrimac gravelly fine sandy loam, nearly level and undulating phases (0-8% slopes) (Me).**—These droughty sandy soils are low in plant nutrients. They have developed from very sandy and gravelly glacial outwash parent materials that consist mainly of acid crystalline rock material with which some acid slate, shale, and sandstone are admixed. They occur on the smooth nearly level terraces and gently



*A*, Pasture on Dover fine sandy loam, ledgy rolling phase, showing encroaching cedars.

*B*, Pasture on very poorly drained Mansfield silt loam (center) ; associated well-drained Dutchess soils in foreground.

*C*, Outcrops in pasture on Nassau slaty silt loam, undulating and rolling phases.



A, Apple orchard on Hoosic gravelly loam, nearly level and undulating phases, near the Hudson River.  
B, Fair pasture on Staatsburg gravelly loam, very ledgy rolling phase.

rolling or sloping terrace faces. The principal areas are on the terraces along the Hudson River in the vicinity of Beacon, in Clove Creek valley, and in the southern part of Harlem Valley.

The surface soil, beneath a sod, is about 10 inches thick, dark brown, and of fine crumb structure. It is underlain by very friable yellowish-brown gravelly fine sandy loam that extends to 16 inches. From 16 down to 32 inches, the subsoil is friable yellowish-brown sandy loam. The substratum, below 32 inches, is loose grayish-brown stratified gravelly coarse sand, gravel, and fine sand. The soil is strongly acid throughout, excessively drained, and easily penetrated by roots. The surface texture varies from a gravelly loam to gravelly fine sandy loam.

*Use and management.*—Nearly all the native hardwood-and-white pine forest has been removed from this soil.

The cultivated areas are used mainly for hay, but to some extent for corn and oats. Few areas appear well-managed. Meadows are generally poor and contain mostly native grasses with a small quantity of timothy. No regular rotation is followed. Where corn is grown, heavy applications of manure (10 to 12 tons an acre) and varying quantities of superphosphate are used. Although the soil is low in lime, few operators use it, even though clover is used in the seedings. Buckwheat is sometimes grown. Pastures are generally neglected and contain mostly poverty oatgrass, bromegrass, and many weeds, briars, and sumac.

Methods of management that will enable these soils to hold more moisture for crops are essential. The organic-matter content should be maintained by turning under green crops and using stable manure liberally. The soils warm up early in spring and if fertilized heavily can be used successfully for early vegetables. Clovers cannot be grown successfully without heavy applications of lime.

**Merrimac gravelly sandy loam, hilly phase (15-30% slopes) (Mr).**—Hilly relief and lighter texture distinguishes this soil from Merrimac gravelly fine sandy loam, nearly level and undulating phases. Areas occur on low hills and knolls near Pawling north of the Putnam County line and in the valley of Clove Creek. Slopes range mainly from 15 to 30 percent, though some areas having slopes of 50 or 60 percent are included. The soil is very droughty and is deficient in most plant nutrients.

The 4-inch surface soil in cut-over forested areas, beneath a very thin leaf litter and raw humus mat, is dark grayish-brown, loose, acid, and filled with roots. It is underlain by yellowish-brown gravelly sandy loam or fine sandy loam, which, to a depth of 10 or 12 inches, is friable and structureless. The subsoil, from 10 down to 30 inches, is loose structureless light yellowish-brown gravelly coarse sand. From 30 to a depth of 40 inches occurs loose grayish-brown very fine sand or coarse sand. Below 40 inches are stratified loose grayish-brown to dark grayish-brown coarse sand, gravel, gravelly sand, and fine sand. The profile is strongly acid throughout. Tree roots penetrate deep into the subsoil and substratum. Internal drainage is very rapid.

*Use and management.*—At one time most of the hilly phase of Merrimac gravelly sandy loam was cleared and farmed; now only a small proportion is cultivated.

Pastures are poor and contain mostly poverty oatgrass and many weeds. The soil is not well suited to pasture grasses, and returns probably do not justify the cost of improvement.

Forested areas include red, chestnut, and scrub oaks, hard maple, beech, black, gray, and white birches, shagbark hickory, wild cherry, white and pitch pines, and dogwood. Forest trees send their roots deep into the soil and appear to thrive. Forestry is probably the best use in most places.

**Muck, acid deep phase (0-2% slopes) (Mg).**—This is the most extensive of the organic soils. Most areas include 25 to 50 acres but a few large ones cover 95 to 100 acres. The more extensive areas are north of Millerton along Webatuck Creek, south of Pawling along the east branch of the Croton River, southeast of Pleasant Valley, north and southwest of Clove, and northwest of Fishkill. The acid deep phase is often adjacent to areas of this phase. This muck, to a depth of 24 inches or more, is composed of disintegrated grassy and woody vegetable matter that is fairly well decomposed and is mixed with some mineral matter. It is dark brown or black in color and granular. At varying depths, usually below 24 to 30 inches, the grassy and woody materials are not so well decomposed and the plant materials can be identified. This underlying fibrous or woody peat is brown and little mixed with mineral material. The underlying peat is often 3 to 5 feet or more deep and rests on bluish-gray fine sand, silt, or silty clay.

*Use and management.*—Few areas of Muck, acid deep phase, have been cleared. At the time of mapping no areas were cultivated. The muck is low lying and, for the most part, permanently wet. Draining and developing of most areas for cultivated crops would be difficult. A small acreage has been cleared of forest and developed to some extent, principally for pasture. Pastured areas support a rank growth of swamp grasses, rebel weed, and many other water-loving plants. The forest vegetation is generally scrubby and includes mostly alder, elm, red maple, tamarack, hemlock, black ash, and hop-hornbeam. Some white and red ash, willow, swamp white oak, and pignut hickory occur.

A few areas are being developed commercially. The muck and underlying peat are dredged out of the swamps and bogs, screened, dried, and trucked away. The muck and peat are sold principally for development of lawns and golf courses.

Where adequate drainage systems can be established, the muck is potentially good for such intensive cash crops as potatoes, onions, and celery. These crops require heavy fertilization and liming. Areas of similar muck in other parts of the State have been drained and are highly productive of high-value cash crops. Most areas in Dutchess County are so situated, however, that suitable outlets for ditches are difficult to establish. The feasibility of adequate drainage should be thoroughly investigated by a competent drainage engineer before any attempt is made to reclaim them.

**Muck, acid shallow phase (0-2% slopes) (Mh).**—Areas of acid shallow muck are commonly associated with areas of acid deep muck, although many small areas occur alone. The organic material is usually black, well-decomposed, and granular. It commonly rests upon bluish-gray sand, silt, or silty clay materials. The average

thickness of the muck is 18 inches, though it varies from 6 to 30 inches in nearly all areas. In most areas the original vegetable matter cannot be identified. There is no peat underlying the muck.

*Use and management.*—Approximately 7 percent of Muck, acid shallow phase, has been cleared of forest, ditched in places, and used for cultivated crops. Some cleared areas are pastured. The pasture and forest vegetation are similar to those found on the acid deep phase. Most areas of this muck are too shallow to justify the expense of clearing and drainage.

**Nassau-Cossayuna gravelly loams, undulating and rolling phases (3–15% slopes) (Nc).**—Areas of Nassau and Cossayuna soils are so intermingled in this complex that they could not be separated on the soil map. Small intricately shaped areas of the shallow Nassau soil, which has numerous small outcrops of bedrock, are intimately associated with areas of the deeper moderately productive Cossayuna soil. In figure 2 a typical area of the complex is shown at a large scale and in it the bodies of included soils and of rock outcrops are separated. The Nassau soil included is typical of Nassau slaty silt loam, undulating and rolling phases; the Cossayuna soil is similar in most respects to Cossayuna gravelly loam, undulating and rolling phases, but is usually not so deep and is commonly derived from material containing less calcareous material.

The complex is closely associated with soils of the Cossayuna, Staatsburg, and Nassau series. Areas are scattered throughout the entire region of calcareous sandstone rocks but are most common in the center of the region in an area extending northeast from Poughkeepsie through Campton School and Lent toward the Dutchess-Columbia County line. The areas range from 5 to 40 acres or more in size but usually contain 15 to 20 acres. Relief is irregular or billowy. Slopes are seldom uniform. Outcropping ridges of the underlying bedrock occur frequently and extend in a general northeast-southwest direction. Surface drainage is good, and runoff from clean-cultivated areas is moderately rapid.

*Use and management.*—Shallowness, rock outcrops, and irregular relief make Nassau-Cossayuna gravelly loams, undulating and rolling phases, somewhat poorly suited to intensive use. Yields are lower than on the deeper soils of the same region, but on many farms these are the best soils available for cultivation and are intensively used. A few cultivated areas are surrounded by better soils and are worked with them. About 15 percent of the cultivated area is in fruit; the rest is used for corn, small grains, and hay. A 5- or 6-year rotation is commonly followed; a year of corn is followed by a year of oats or wheat and 3 years of hay.

Fertilizing and liming practices are the same as those used on soils of the Cossayuna series. Most hay consists of a legume-grass mixture, but some alfalfa is grown alone.

Old forest stands are composed mostly of hardwoods. Red, black, scarlet, yellow, and white oaks, tuliptree, hard and soft maples, dogwood, ash, and basswood predominate. Some white pine, cherry, black locust, beech, birch, and hemlock are present. On areas that have recently reverted to forest, temporary species such as aspen, pin cherry, birch, and black locust predominate.

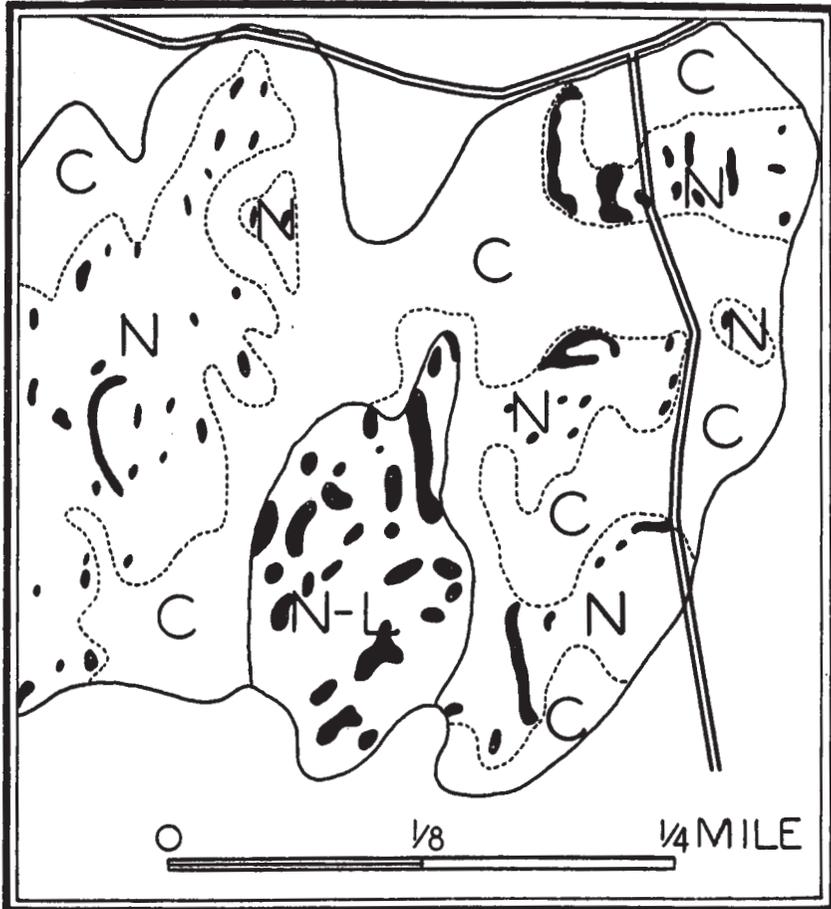


FIGURE 2.—Composition of Nassau-Cossayuna gravelly loams, undulating and rolling phases, and of Nassau slaty silt loam, ledgy undulating and rolling phases. Solid lines are boundaries that appear on the county soil map; dotted lines are boundaries between Nassau gravelly loam, undulating and rolling phases (N) and Cossayuna gravelly loam, undulating and rolling phases (C) in the complex of Nassau-Cossayuna gravelly loams, undulating and rolling phases. The area marked N-L is Nassau salty silt loam, ledgy undulating and rolling phases. Small black areas are outcrops of bedrock.

Hay meadows are sometimes pastured 1 or 2 years after the second year of mowing. About two-fifths of the pasture, that used in crop rotations, furnishes good grazing during years of normal rainfall. During unusually dry periods pastures are more affected by drought than those on the deeper soils. Old permanent pastures are usually neglected and have received little or no fertilizer or lime since they were first seeded. Desirable pasture grasses, as bluegrass and wild white clover, are usually present but in low percentages compared with other less desirable grasses and weeds. These permanent pas-

tures could be greatly improved by liming and fertilization. Reseeding of the poorer pastures may be necessary.

The complex needs a rotation that provides a leguminous sod-forming crop at least 4 out of 6 years. The legume is needed to maintain supplies of nitrogen and organic matter and to retard runoff. Alfalfa in mixtures with grasses can be used successfully if well limed and fertilized. Lime and phosphorus are needed for establishing legumes. Potash commonly becomes deficient after several years of intensive cropping. The uneven topography is poorly suited to strip cropping and similar measures for control of runoff, so reliance must be placed on using sod-forming crops in the rotation. Tillage should be as nearly on the contour as possible.

**Nassau-Cossayuna gravelly loams, eroded undulating and rolling phases (3-15% slopes) (NB).**—This complex, like that of Nassau-Cossayuna gravelly loam, undulating and rolling phases, consists of Nassau and Cossayuna soils. It differs in having lost soil material through erosion—the plowed layer is made up at least partly of subsoil material. As a result, the shallow Nassau soil of this complex commonly has more outcrops of bedrock. Supplies of organic matter and nitrogen are usually lower than in the uneroded soils, and crop yields are correspondingly lower.

*Use and management.*—Almost all of this land has been pastured or cultivated at some time. The areas now cultivated are mainly on farms that depend on the relatively uneroded Nassau-Cossayuna complex or on Cossayuna soils for most of their cropland.

Productivity can be restored to a large extent through good soil management. Heavy manuring and use of long rotations that include a minimum of clean-cultivated crops and a maximum of leguminous hay or pasture are needed to build up the organic matter and restore nitrogen. Liberal liming and fertilization with phosphorus and potash are needed if legumes are to be effective. Runoff should be controlled largely by the use of sod-forming crops. Cultivation should be as nearly on the contour as possible, but the uneven relief makes strip cropping impractical in most areas. If good management cannot be provided, the soils will continue to erode seriously and become still lower in productivity.

**Nassau-Cossayuna gravelly loams, eroded hilly phases (15-30% slopes) (NA).**—The eroded hilly phases of Nassau gravelly loam and Cossayuna gravelly loam occur in such close association they could not be separated on the soil map. Probably 75 percent of the area is the Nassau soil. The relief is usually very irregular and hilly. More than 60 percent of the acreage has lost practically all of the original surface soil through erosion. Most of the rest is moderately eroded.

The Nassau soil of the complex is more commonly a loam than a silt loam. The Cossayuna soil of the complex is generally not so deep as Cossayuna gravelly loam, undulating and rolling phases; it averages about 3 or 4 feet thick over bedrock. The proportion of Nassau soil is greater in this complex than in Nassau-Cossayuna gravelly loams, undulating and rolling phases.

*Use and management.*—Nassau-Cossayuna gravelly loams, eroded hilly phases, are poorly suited to tilled crops, but fair pasture can be

established with proper liming and fertilization. Most pasture is now run-down through lack of fertilizer and lime but still supports some desirable forage—Canada bluegrass, redbtop, and wild white clover. If the complex is used for crops, long rotations consisting largely of leguminous hay and pasture crops are needed. Adequate liming and fertilization are necessary to permit establishment and maintenance of good stands of legumes. Alfalfa can be used successfully in mixtures with grasses under these conditions. Manure should be used liberally, especially in eroded areas.

**Nassau slaty silt loam, undulating and rolling phases** (3–15% slopes) (Ng).—These shallow well-drained soils were derived from glacial till that consisted mainly of acid slate and shale materials. Areas range from a few acres to 200 acres in size and are most extensive in the central and western parts of the county. These phases are closely associated with other Nassau soils but occur on more gentle relief. Other close associates of these phases are the Dutchess, Bernardston, Pittstown, Stissing, and Mansfield soils. Relief ranges from gently sloping or undulating to rolling and is generally very irregular. Viewed from a distance, large areas have a billowy appearance. Outcrops of underlying rock are common but do not interfere seriously with cultivation in most places (pl. 3, *C*). The average depth of soil over bedrock is about 24 inches but this varies because the rock surface is undulating. The bedrock outcrops in some places and lies 3 or 4 feet below the surface in others. The size and number of outcrops ordinarily found in areas of Nassau slaty silt loam are shown in figure 2. In the shallower cultivated areas, the weathered slaty bedrock is often broken up by plowing and mixed with the soil.

In undisturbed forested areas there is an inch of black organic matter beneath the forest litter. Below this layer and down to 5 inches is friable granular yellowish-brown slaty silt loam. Firm light yellowish-brown slaty silt loam starts at 5 inches and continues to 20 inches. It is followed by 3 or 4 inches of olive-brown partly decomposed slate of heavy silt loam texture that breaks out in angular fragments similar to the original shale fragments. This olive-brown layer rests on slate bedrock.

The profile is strongly acid throughout; roots penetrate all parts of it but are most abundant in the surface layers. The areas that have been cultivated or pastured are moderately eroded; those that have remained in forest are not eroded. The cultivated areas vary to some extent in number of shale and slate fragments on and in the surface soil.

Included with this unit are shallow soils of a loamy texture that developed almost entirely from shale. These areas occur in the western part of the region of slate and shale. Shallow silt loam soils developed almost entirely from slate in the central and eastern part of the region are also included. Areas in which these soils predominate are referred to locally as "slate land." Both inclusions have little agricultural value.

*Use and management.*—Cultivated areas of these phases are usually closely associated with and are worked with larger areas of deeper Dutchess and Bernardston soils. These slaty phases are poorly suited to most crops at best, and without manure, phosphate, and lime, yields

are very low (pl. 5, *A* and *B*). The abandoned areas are chiefly in the north-central part of the county.

No regular methods for management or crop rotation are followed on these soils by the average farmer. On most farms the soils are depleted and, when fertilized, frequently receive only manure and a little lime, or perhaps just the manure. After meadows are established they are usually mowed for a number of years, or until they are depleted and contain mostly weeds. Pastures are usually very poor and contain chiefly poverty oatgrass, redtop, and weeds (pl. 5, *C*). The rotation pastures and a few permanent pastures on better farms are in fair condition. Yields vary a great deal.

The native forest consists mostly of the hardwoods common in the oak and the beech-maple-hemlock associations. The principal species are white, scarlet, yellow, chestnut, red, post, and black oaks, pignut and shagbark hickories, flowering dogwood, tuliptree, black cherry, sassafras, basswood, sugar, soft, and mountain maples, white, black, and yellow birches, chestnut, beech, ash, and hemlock.

These soils are deficient in all major plant nutrients supplied by lime and fertilizer. They hold little water, so runoff is great and erosion occurs. They should be kept in sod at least 4 out of every 6 years to control runoff and to maintain supplies of organic matter and nitrogen. Alfalfa stands are generally short-lived. If adequate lime and fertilizer are applied, birdsfoot trefoil offers some promise of being a long-lived legume suitable for hay and pasture. Both crops and pasture are severely injured by drought during mid-summer. Where better land is available for crops, these soils should be used for spring pasture or forest.

**Nassau slaty silt loam, eroded undulating and rolling phases** (3-15% slopes) (Nd).—The phases of this complex are similar to Nassau slaty silt loam, undulating and rolling phases, in relief, occurrence, and general setting. Outcrops of underlying slate and shale are somewhat more numerous because sheet erosion has exposed them where the soil covering was thin. During the time most areas of this complex were cleared and farmed, much of the original surface soil was eroded away, and in many areas part of the subsoil was lost as well. The most extensive areas are in the north-central part of the county, although fair-sized ones are scattered throughout the region of slate and shale in close association with other phases of the type.

The profile is usually more shallow than that of Nassau slaty silt loam, undulating and rolling phases. The present 6-inch surface soil in cultivated fields is dark yellowish-brown or dark-brown friable very slaty silt loam, a large part of which is material from the original subsoil. Below 6 inches to a depth of 12 inches the subsoil is firm but friable light yellowish-brown silt loam; from 12 to 15 inches it is gray-brown slaty silt loam, firm in place and composed mostly of weathered slate, that rests on bedrock. The soils are well-drained and permeable to air and moisture. Roots penetrate all layers but are most abundant in the topmost layer.

The soils vary principally in depth, which ranges from 12 to 18 inches over bedrock. The amount of shale or slate in the surface layer also varies, but that layer is generally very slaty or shaly.

*Use and management.*—These soils are very poor for cultivation and should be reforested where possible. Erosion is active on most

idle areas; the native vegetation is generally so sparse it does not materially retard runoff. A few areas have been reforested, and the forest cover and leaf litter effectively stabilize against erosion.

A good pasture sod will also prevent erosion. Pastures are severely affected by drought, however, and overgrazing during dry seasons injures them. A few fair to good permanent pastures have been established but in most years they yield little feed after July 15. Most pastures are poor and neglected. Nevertheless, on many farms these are the best soils available for pasture. Establishment of even fair spring pasture requires liberal liming and fertilization with phosphorus, and in many areas reseeding may be necessary.

**Nassau slaty silt loam, ledgy undulating and rolling phases** (3-15% slopes) (N<sub>F</sub>).—These very shallow soils have numerous outcrops of bedrock that make cultivation extremely difficult. They, like Nassau slaty silt loam, undulating and rolling phases, are well-drained soils developed from a thin mantle of glacial till that was derived from acid slate and shale. They occur throughout the region of slate and shale soils and are practically unsuited to cultivation. Outcrops of underlying shale or slate bedrock are large and occur frequently; in extreme cases, 40 to 60 percent of the land surface is barren rock. The size and extent of outcrops ordinary in an area are shown in figure 2. The rock outcrops are generally smooth and occur as ridges having northeast-southwest axes. The soil in areas between outcrops varies from a few inches to 24 or 30 inches in thickness. Relief is irregular or billowy. Both surface and internal drainage are moderately rapid.

Beneath the litter in forested areas is an inch of very dark-brown, fine, granular humus. Between rock outcrops the soil to a depth of 10 inches is yellowish-brown heavy loam that is mellow and friable. From 10 inches downward, the profile grades through lighter brown loam or silt loam into a thin layer of light-gray weathered slate that rests on bedrock at 15 or 18 inches in areas of average soil depth. Within a few feet the bedrock may be at the surface or 30 inches below it.

*Use and management.*—Most of Nassau slaty silt loam, ledgy undulating and rolling phases, is in forest or poor unimproved native pasture. The pastures occur mainly where these phases are associated with better soils, as those of the Dutchess series. The few cultivated areas of these phases are usually small inclusions in fields dominated by deeper soils.

The deeper pockets of soil between outcrops support fair pasture early in spring if lime and phosphorus are supplied. Most areas require seeding for establishment of desirable species. Pastures in these phases usually produce little after July 1, regardless of treatment, because the shallow profile cannot hold enough water to support good growth during the warm midsummer months. Where better soils are available for pasture, these phases should be used for forest.

The forest trees are mostly hardwoods of the oak and the beech-maple-hemlock associations. The trees do not grow so vigorously as on the associated Dutchess soils.

**Nassau slaty silt loam, ledgy hilly phase** (15-30% slopes) (N<sub>E</sub>).—Like the ledgy undulating and rolling phases of Nassau slaty silt loam, this is a very shallow soil characterized by many outcrops



*A*, Trees encroaching on abandoned field of Nassau slaty silt loam, undulating and rolling phases.  
*B*, Isolated dairy farm on Nassau soils, adjacent to idle land of plate 5, *A*.  
*C*, Weedy pasture typical of that on untreated acid soils such as Nassau slaty silt loam, undulating and rolling phases (foreground) and Nassau slaty silt loam, ledgy hilly phase (background).



of bedrock. Its slopes are steeper, however, and its relief is irregular. The landscape is a series of uneven hills with strongly sloping sides. Throughout each area occur numerous conspicuous outcrops; the soil profile between the outcrops is similar to that of Nassau slaty silty loam, ledgy undulating and rolling phases.

*Use and management.*—This ledgy hilly soil usually cannot be cultivated with ordinary farm machinery. Its shallowness and low water-holding capacity prevent establishing good pasture. The cost of increasing the normally low content of lime and phosphorus is greater than the returns to be expected from pasture. The soil is best suited to forest in most places.

**Ondawa gravelly loam, alluvial fan phase (0-5%) (O<sub>A</sub>).**—This soil occurs at the base of steeper uplands adjacent to the major valleys in the central and eastern parts of the county. It occupies fanlike deposits of material washed from the uplands. The streams level off upon entering the major valleys, drop their alluvium, and form the fans. The fan-shaped areas are narrowest where a stream enters a major valley; they spread out in the valley itself.

This soil is variable in texture within each area; the range is from gravelly sandy loam to silt loam. The lighter textured areas occur at the narrow end of the fans that extend up small side streams. Most areas are small (3 to 15 acres). The soil is acid and well-drained. Its profile, though more variable in texture and thickness of layers, is similar to that of Poultney loam.

*Use and management.*—The cultivated areas of Ondawa gravelly loam, alluvial fan phase, are managed in the same way and used for the same crops as Poultney silt loam. This soil is more subject to flooding during heavy rains than the Poultney, for stream channels through it usually are not well developed. Crops are occasionally damaged by floods. Estimated average yields are lower than those obtained on Poultney loam or silt loam, but this soil is one of the better ones in the county. Its management needs are similar to those of Poultney loam, though additional practices to control stream-bank gouging and shifting of stream channels are required. Most pastures are poor as a result of inferior management. Willows and alders are frequently abundant in them.

**Palmyra gravelly loam, nearly level and undulating phases (0-8% slopes) (P<sub>B</sub>).**—In most places these well-drained phases are nearly level and relatively fertile. They have developed from glacial outwash materials that consist chiefly of limestone but include smaller quantities of schist, slate, sandstone, quartz, gneiss, and granite. The underlying material is loose and structureless.

The soils occur in the limestone valleys, principally in Harlem Valley; they are on terraces high above the flood plains of the present streams. Associated with them are the imperfectly drained Braceville soils of the terraces, the Genesee soils of the flood plains, and the limestone soils of the uplands. These Palmyra soils differ from the Copake soils in having a higher content of lime and a more clayey subsoil. Free lime carbonates occur within 3 feet of the surface.

The surface soil beneath a sod is about 10 inches of dark-brown to dark grayish-brown granular, neutral, gravelly loam. A thin pale-brown silty or sandy layer begins at a depth of 10 and continues to

12 or 14 inches. The subsoil, to a depth of 24 or 30 inches, is brown to yellowish-brown heavy gravelly loam or heavy gravelly silt loam, either of which is friable and has a faint reddish shade in many areas. This layer, more clayey than those above or below, is slightly alkaline in the upper part but becomes strongly alkaline or faintly calcareous with depth. From 24 or 30 downward to 36 or 40 inches the subsoil is strongly calcareous grayish-brown gravelly light loam or gravelly sandy loam. The substratum, starting below 36 to 40 inches, consists of gray calcareous stratified sand, gravelly sand, and gravel somewhat cemented together with lime carbonate.

Aeration is good. Roots penetrate all layers but are most abundant in the surface soil. The soil is not so retentive of moisture as is desirable. Crops are occasionally damaged during long dry periods.

*Use and management.*—The cultivated areas of these soils are used principally for corn, oats, alfalfa, red clover, and timothy. A corn-oat-hay rotation is generally followed but its length is varied considerably. Corn is commonly grown 1 or 2 years in the rotation, followed by 1 year in oats, and then by hay, which is maintained until yields decline. Most meadows are pastured one or two seasons before plowing. Manure is used for corn, and lighter top dressings of it are applied on old meadows. Superphosphate is used for corn and oats and occasionally with the top dressings of manure applied to meadows.

Pastures are confined mainly to old meadows and are generally good or excellent. They include a small proportion of weeds and timothy, red clover, bluegrass, wild white clover, and redtop. Pastures are damaged during long dry periods.

On these soils farmers can afford to grow row crops frequently in the rotation if they apply enough manure and fertilizer. By concentrating row crops on these soils they can use sloping soils to greater extent for hay. These soils need phosphorus and practices that maintain organic matter and nitrogen. Lime is abundant in them, and potash deficiency is not common if manure is used. No special practices of tillage are needed to control runoff.

**Palmyra gravelly loam, hilly phase (15–25% slopes) (P<sub>A</sub>).**—This hilly droughty soil contains much lime. It was originally classified as Groton gravelly loam, for it occupies knolls and hills unlike the topography for Palmyra soils of the terraces. Nevertheless, its profile and parent material are similar to those of Palmyra gravelly loam, nearly level and undulating phases. The parent material is limestone rock material, with some schist, slate, and crystalline rock admixed. Relief is irregular and rolling to hilly—that typical of kame deposits. Internal drainage is good to excessive. The main areas occur in the limestone valleys, chiefly in the Harlem Valley. They range from 2 to 30 acres in size and are closely associated with areas of other Palmyra soils.

The surface soil is 6 to 8 inches thick, dark brown, granular, friable, and neutral or slightly acid. From 7 down to 12 inches is pale-brown friable heavy gravelly loam or light silt loam varying from slightly acid to slightly alkaline. The subsoil extending to depths of 24 or 30 inches is gravelly heavy silt loam, higher in clay than horizons above or below. The substratum consists of strongly calcareous stratified grayish-brown gravel, coarse sand, fine sand, and gravelly sand.

The gravel throughout the profile consists mainly of limestone, with some quartz, slate, schist, gneiss, and granite rock materials intermixed. The pieces of gravel on the surface are usually small and, in most places, do not interfere greatly with cultivation.

*Use and management.*—Cultivated areas of this soil are used mainly for hay but to some extent for corn and oats. Alfalfa does well and is the main hay crop. Red clover and timothy are also grown. The rotations followed vary in length. Corn and oats are usually grown in the rotation only 1 year each. Alfalfa is maintained for several years, or until yields fail. The soil requires heavy applications of manure for corn and top dressings of fertilizer for hay. From 200 to 500 pounds of 20-percent phosphate, with manure as available, is normally used in the rotation. Phosphate and manure are applied mainly for the corn and oats.

Pastures vary from excellent to poor. Rotation pastures support bluegrass, wild white clover, red clover, alfalfa, timothy, reedtop, and a few weeds. In the well-cared-for permanent pastures, Canada and Kentucky bluegrasses, wild white clover, and orchard grass are growing. Old pastures that have been neglected often have a greater proportion of goldenrod, wild aster, mullein, Canada thistle, and other weeds than of desirable grasses. Most pasture could be greatly improved without reseeded by applying top dressings of manure and superphosphate.

The forested areas include white ash, hard maple, red and white oaks, redcedar, gray and white birches, and aspen.

This phase needs a long rotation, one that keeps leguminous hay or pasture on it at least two-thirds of the time. Little or no lime is required, but phosphorus must be supplied. Manure is highly beneficial, for it helps maintain supplies of organic matter, nitrogen, and potash. The uneven topography makes strip cropping extremely difficult, but the soil should be worked across the slope. Control of runoff must be accomplished by maintaining supplies of organic matter at a high level and keeping a vigorous protective sod-forming cover on the soil. The soil is droughty, so as much water as possible should be kept on it.

**Palmyra gravelly loam, steep phase (25–45%) (Pc).**—Its slopes are steeper and its profile is generally slightly thinner and lighter colored, but in other respects this soil is similar to the hilly phase of Palmyra gravelly loam. The steep irregular slopes make use of farm machinery very difficult and cause very rapid runoff. The soil is droughty.

*Use and management.*—This soil is poorly suited to cultivation but fair for pasture. If crops must be grown, a long-lived legume such as alfalfa should be seeded and left for long periods. Small grains should be sown as soon as the stand of alfalfa fails. Wherever possible the soil should be used for pasture or forest. Fertilizer needs are similar to those of Palmyra gravelly loam, hilly phase.

**Pawlet silt loam (0–3% slopes) (Pd).**—The level flood plains of streams are occupied by this moderately well-drained soil. It has developed from fine sediments that were washed from nearby uplands and deposited on the first bottoms during floods. The material con-

sists chiefly of slate, shale, schist, or crystalline rock materials. The most extensive areas are along Fishkill Creek and its tributary streams in the southern part of the county. Associated soils are the well-drained Ondawa and the poorly and very poorly drained Houstonic and Saco.

The surface soil in pastures is 9 inches of dark grayish-brown friable silt loam of fine granular structure. The upper subsoil, extending to a depth of 20 inches, is a light-brown silt loam, friable, well-aerated, and of fine crumb structure. The lower subsoil, from 20 down to 30 inches, is grayish-brown silt loam strongly mottled with gray, yellow, and rust brown. It is compact and saturated with water periodically, and in some places contains strata of firm to compact fine sandy loam. Below 30 inches lie water-sorted gray silts, sands, and gravel from schist, slate, and crystalline rock materials.

The soil is medium to strongly acid throughout the profile. Drainage is moderately good. Roots are most abundant in the surface and upper subsoil, though a few are in the compact lower subsoil.

The soil is predominantly silt loam, though some areas having a gravelly silt loam texture are indicated on the soil map by gravel symbol. Included with Pawlet silt loam are about ten small areas on alluvial fans along the major valleys in the eastern part of the county. These included areas are less productive than Pawlet silt loam and subject to more frequent flooding. About 70 percent of their acreage is pastured or in forest. A few areas with loam or fine sandy loam surface soils are also included. These cover a small acreage and are similar to Pawlet silt loam in suitability for use.

*Use and management.*—The cultivated areas are used mainly for corn, oats, and timothy hay. No regular rotations are followed. Corn is frequently grown 2 years or more in succession and followed by 1 year of oats, with which timothy is seeded. Manure, the chief fertilizer, is applied mostly for corn. The quantity used varies greatly, or from none at all to 6 or 7 tons an acre. Timothy is generally seeded alone or with redtop. No areas are artificially drained. This is one of the better soils in the county, though yields are generally lower than on the well-drained Poultney silt loam.

The better pastures have been limed and usually support good sods consisting of timothy, Kentucky bluegrass, redtop, some wild white clover, and a low percentage of undesirable weeds and grasses. The poorer pastures contain mostly weeds such as plantain, yarrow, wild carrot, buttercup, wild strawberry poverty oatgrass, and quackgrass and little of the better pasture grasses. Willows and alder brush are common in poor pastures.

The forest vegetation includes willow, alder, soft and hard maples, elm, sycamore, and black ash.

**Paxton gravelly loam, gently sloping and sloping phases (3-15% slopes) (WG).**—These very deep well-drained soils are associated with the shallower Charlton gravelly loam, undulating and sloping phases, with other Paxton and Charlton soils, and with less well drained Woodbridge, Whitman, and Hollis soils. In the southern part of the county they are associated with Gloucester and Chatfield soils. They have developed from deep deposits of glacial till composed mainly of schist with which slate, gneiss, quartzite, and granite are mixed. Areas 2 to 100 acres in size occur on low hills or knolls on

the slopes and in the interior valleys near Chestnut Ridge and Quaker Hill. Relief is generally uniform. Many of the areas on top of Chestnut Ridge that are closely associated with the shallower and less well-drained soils have been abandoned. The substratum and lower subsoil are very compact, but permeable to moisture.

The 9-inch surface soil is dark-brown mellow gravelly loam. It is underlain by yellowish-brown friable gravelly loam that grades downward into pale yellowish-brown firm heavy gravelly loam or light silt loam. Below 25 inches lies the substratum which is pale grayish-brown very compact gravelly silt-loam.

The soil is strongly acid throughout the profile. Roots are most abundant in the surface layer but are present in the subsoil. Few roots occur in the very compact till below 25 inches. Throughout the soil profile and on the surface are pebbles of gneiss, quartzite, and granite and fragments of slate, schist, and shale. A few small areas contain enough stones to interfere seriously with cultivation. These are shown on the map by stone symbol.

*Use and management.*—The cultivated areas of these phases are used principally for corn, buckwheat, oats, hay, and pasture. The rotations followed vary in length and in the crops used. Corn is commonly planted 1 or 2 years in the rotation and followed by oats with which hay is seeded. The soils dry out moderately slowly in spring. Buckwheat is frequently planted when they have dried out too late for planting oats.

From 8 to 10 tons of manure supplemented with superphosphate is applied for corn. Oats seeded with a hay mixture receive 150 to 200 pounds of 20-percent phosphate and 1 or 1½ tons of lime an acre. Hay crops are commonly maintained until yields fail; then the meadows are pastured. Yields vary greatly, depending on the management.

Farms on these and the associated shallow Hollis, moderately well-drained Woodbridge, and very poorly drained Whitman soils are usually in poor condition. Exceptions are farms on which the Paxton soils occur in large areas and predominate in the soil association. Buildings are rundown, and livestock is usually poor.

Pastures are generally poor and usually contain redtop, sweet vernal, and poverty oatgrass. In the poorer pastures, blueberries, spirea, ferns, mountain-laurel, and other brush are present. The better pastures support some Canada and Kentucky bluegrasses and occasionally some wild white clover. The pastures need both lime and phosphate.

Idle areas are usually overgrown with brush and weeds. Young white and gray birches, pin cherry, hard and soft maples, and hawthorns are present in many areas. The farm buildings on these idle areas are usually rented or owned by summer vacationists. The forested areas have a growth of red and hard maples, white ash, cherry, black birch, white and black oaks, beech, and some hemlock.

Lime and phosphorus are needed on these phases. Even when they are applied, lack of potash is commonly found to be limiting. With adequate fertilization and liming, a 4- or 5-year rotation that includes 2 years of a legume-grass hay is well suited. Although the soils are well-drained, alfalfa does not persist. Ladino clover is a better long-lived legume if seedings are to be maintained several years. Runoff

is moderately rapid but can be controlled mainly by using adapted rotations and fertilizing so the crops will grow vigorously. Crops should be worked on the contour, however, and strip cropping should be used on long slopes.

**Paxton gravelly loam, moderately steep phase (15-30% slopes) (W<sub>H</sub>).**—This deep well-drained soil has uniform slopes and occurs in association with the gently sloping and sloping phases, principally on the western slopes of Chestnut Ridge and on the southern part of Quaker Hill.

The profile is similar to that of Paxton gravelly loam, gently sloping and sloping phases, but the surface soil is generally thinner. Erosion has been more severe in cleared areas, though the acreage of severely eroded soil is small. Some included stony areas are shown on the map by stone symbol.

*Use and management.*—Crop rotations and lime and fertilizer treatments used for this soil are similar to those used for the gently sloping and sloping phases. Most farmers run crop rows across the slope. Yields are considerably lower than those on the gently sloping and sloping phases.

Pasture sods are usually so light that they do not hold the soil in place. The pastures are run-down, weedy, and in many places overgrown with brush and briars. Lime and phosphate are needed on nearly all pastures; many of them should be reseeded. With proper management, good pastures can be established and maintained.

Idle areas are generally overgrown with weeds. Young trees, especially white and gray birches and wild cherry, are rapidly encroaching.

This soil needs at least 4 years of leguminous hay or pasture in each 6-year rotation. Ladino clover appears to be a good legume for such long-term stands, but birdsfoot trefoil may be superior. Success with any legume depends on heavy liming and fertilization with phosphorus. Potash may also be needed. Cultivation should be on the contour, and fields should be strip-cropped to retard runoff.

**Pittsfield gravelly loam, sloping phase (5-15% slopes) (P<sub>r</sub>).**—As it has developed from deep deposits of glacial till consisting mainly of limestone material, this soil has a high lime content. It occurs on the lower slopes and small drumlinlike knolls in the major limestone valleys, especially in the eastern part of the county. Areas vary from a few to 100 acres in size. The slopes are generally uniform. Both internal and external drainage are moderately rapid. The water-holding capacity is good.

The surface soil under sod is about 10 inches of mellow finely granular dark-brown gravelly loam. The subsoil extending from 10 to 18 inches is brown gravelly loam, lighter in color than the surface soil, firm in place, and friable. Below 18 inches down to a depth of 25 inches the subsoil is firm friable slightly reddish-brown gravelly loam. The deep subsoil, extending from 25 to 42 inches, is very firm or slightly compact but friable grayish-brown gravelly loam. Below 42 inches lies the deep glacial till substratum, a slightly compact darker grayish-brown gravelly loam.

The surface soil and upper subsoil layers are slightly alkaline or neutral. The subsoil below 18 inches is strongly alkaline, and at 33

inches it is calcareous. The deep substratum is strongly calcareous. Roots penetrate all layers but are most abundant in the surface soil and upper part of the subsoil.

The amount of gravel in the surface soil varies. Near Northeast Center and Millerton the soil is a gravelly fine sandy loam. A few scattered areas are nearly gravel-free at the surface. Most areas are moderately gravelly—not so gravelly as to interfere seriously with cultivation. A few areas shown on the map by stone symbol have loose stones or boulders on the surface that interfere with cultivation. In and near Clove Creek valley the soil is a heavy gravelly loam or light gravelly silt loam.

*Use and management.*—Cultivated areas of this soil are used principally for grasses, alfalfa, red clover, and timothy, though corn and oats are also grown. The length of the rotations varies. From 8 to 10 tons of manure supplemented with superphosphate are applied for corn. Soil prepared for oats receives 150 to 200 pounds of superphosphate. Hay crops are seeded with the oats and maintained for 3 to 5 years. After hay yields begin to fail, the meadows are sometimes pastured 1 or 2 years, before plowing.

Most pastures are excellent and of the rotation type. They support a heavy sod consisting of Canada and Kentucky bluegrasses, wild white clover, and redtop. In a few places some hardhack has encroached.

Management should center about the maintenance of a high fertility level. Lime is not needed, but phosphorus must be supplied. Supplies of nitrogen and organic matter can be maintained by growing leguminous hay crops and applying manure. The need for potash can normally be met with the manure available on dairy farms. A row crop should not be grown more than once in 4 years, and then the rest of the rotation should consist of small grains and hay. Run-off is moderately rapid in most areas, so tillage should be on the contour. The longer slopes are well suited to strip cropping. A small included acreage with slopes of less than 8 percent in gradient may not need strip cropping.

**Pittsfield gravelly loam, moderately steep phase (15–30% slopes) (P<sub>E</sub>).**—Areas of this soil are associated with the sloping phase. They range from 2 to 50 acres or more in size. Most of them have been cleared and are slightly to moderately eroded. Six or seven small areas that have lost most of the original surface soil are included. Also included is about 150 acres on which large stones and boulders are numerous enough to interfere seriously with cultivation. These stony areas are indicated on the soil map by the boulder symbol. Slopes are dominantly between 15 to 30 percent, though a few areas are steeper. The profile is similar to that of the sloping phase.

*Use and management.*—Steep and severely eroded areas included with this soil are either pastured or in forest. The cultivated areas are chiefly on uniform slopes. Cultivation and planting are usually done across the slope. Otherwise, the methods of management and fertilization followed are the same as on the sloping phase. Yields are estimated to be slightly lower than on the sloping phase.

Both permanent and rotation pastures are generally good. They support heavy sods of bluegrass, redtop, and wild white clover.

Hardhack occurs in some places and, if uncontrolled, becomes a serious pest. The forest is second-growth hardwood and cedar. The principal trees are red, white, scarlet, and yellow oaks, hard maple, hickory, and redcedar.

Runoff is rapid, and the soil is subject to washing. Rotations should include a leguminous hay or pasture crop at least 4 out of every 6 years. Clean-cultivated crops should not be grown more than once in 6 years. All operations should be on the contour. Slopes should be strip-cropped, and diversion ditches should be built at regular intervals if row crops are used. The soil need not be limed, but it requires phosphorus.

**Pittsfield-Wassaic gravelly loams, undulating and rolling phases (3-15% slopes) (Pl.)**.—Both soils of this complex have developed from glacial till composed chiefly of dolomitic limestone mixed with some slate, shale, calcareous sandstone, schist, and crystalline materials. The till was deposited over the irregular surface of the limestone bedrock. The bedrock crops out in some places. Depressions in the rock surface between the outcrops are filled with deep deposits of calcareous till, 8 or 10 feet thick, that give rise to the Pittsfield soils. Outcrops of the underlying limestone bedrock are not frequent but are a minor hindrance to the use of farm machinery. The soil adjacent to these outcrops, and in numerous places where no outcrop occurs, is only 24 to 30 inches thick. All gradations of thickness occur between these shallow Wassaic soils and the deep Pittsfield soils. The relief is uniformly sloping in some places, rolling in others.

This complex occurs in all the valleys where limestone is present. It is more extensive than the soils of the Pittsfield series. The principal areas are in the Fishkill-Clove valleys, the Harlem Valley, the Wappinger and Little Wappinger Creek Valleys, and in the Shekomeko Valley. Associated with the complex are soils of the Pittsfield, Wassaic, Amenia, Kendaia, and Lyons series.

Both soils are well-drained and fertile, but they differ greatly in water-holding capacity. The deeper Pittsfield soil dominates the complex.

*Use and management.*—Timothy, red clover, and alfalfa grown for hay are the principal crops on these soils, though some corn and oats are produced. Manure and superphosphate are the principal fertilizers. From 8 to 10 tons of manure supplemented with superphosphate is commonly used for corn. About 200 pounds of 20-percent phosphate is applied for oats, which are used as a companion crop for hay seedings. Hay is usually harvested until the yields fail; then the meadows are pastured. The rotations vary in length.

The pastures, both rotation and permanent, are generally good. Some farmers apply additional superphosphate to meadows that have been in hay for some time and then use them 1 or 2 years for pasture. Phosphorus is less frequently used on permanent pasture. Bluegrass, redtop, and wild white clover grow in nearly all pastures. Old neglected pastures have these desirable plants, as well as sumac, hardhack, mullein, goldenrod, St. Johnswort, and dewberries.

Idle fields occur throughout the county, many in suburban areas. The soils are potentially suited to agriculture. Where idle, they usually have a fair covering of sod beneath the encroaching herbs,

shrubs, and trees. Older idle areas gradually revert to forest of redcedar and some gray and paper birches.

The complex is potentially good for agriculture, though yields are reduced by the areas of shallow soil. It is well suited to a 4-year rotation of corn, oats, and 2 years of hay. Alfalfa is the most productive long-lived legume. The soils need little lime, even for alfalfa. Phosphorus is necessary for best yields. To hold water for crops and reduce washing, the sloping areas should be worked on the contour and strip-cropped where feasible.

**Pittsfield-Wassaic gravelly loams, hilly phases (15–30% slopes) (Pg).**—This complex consists of two well-drained soils high in lime content. One of the soils is 8 or 10 feet thick over bedrock; the other, only 20 or 30 inches. In places bedrock crops out on the shallower soil. The surface soils of both have been moderately eroded in most places. Closely associated with this complex are the gently rolling Pittsfield-Wassaic gravelly loams.

The soil profiles are similar to those of Pittsfield gravelly loam, sloping phase, and Wassaic gravelly loam, rolling phase. The surface soils are usually a little thinner, however, and slightly acid or neutral. The subsoils are alkaline. The deep substrata are alkaline or calcareous. Internal and surface drainage are good.

The soils vary principally in texture of their subsoils, which in some areas are gravelly loams or gravelly fine sandy loams. Gravelly silt loam subsoils predominate. Several small areas that have been severely sheet eroded are included.

*Use and management.*—The cultivated acreage of this complex is used mostly for timothy, red clover, and alfalfa hay, corn, and small grains. From 8 to 10 tons of manure supplemented with superphosphate is applied for corn. About 200 pounds of 20-percent phosphate is applied for oats, which are used as a companion crop for seedings of hay. A top dressing of superphosphate is applied to pasture on some farms. Row crops and oats are generally planted across the slope, with the contour wherever feasible.

Both permanent and rotation pastures are generally fair to good. In old pastures that receive no fertilizer, weeds, herbs, shrubs, and redcedar are encroaching, but bluegrass, redtop and wild white clover are abundant.

Brush, briers, and cedars soon cover most idle areas. The sods are generally fairly heavy on most idle land. The present forest includes redcedar, gray and white birches, some hard maple, and locust.

This complex is only fair for crops but good for pasture. Rotations should be long and consist predominantly of leguminous hay crops. Tillage should be done on the contour. Strip cropping, with diversion terraces at regular intervals, is needed, though shallow soil may prohibit diversion terraces in some areas.

**Pittsfield-Wassaic gravelly loams, stony and ledgy rolling phases (5–15% slopes) (Pk).**—This is a complex of two gravelly high-lime-content soils, one deep and the other shallow. It differs from Pittsfield-Wassaic gravelly loams, hilly phases, mainly in having many loose limestone fragments and boulders. The relief is undulating and rolling. Outcrops of the underlying limestone bedrock are

a little more numerous than on Pittsfield-Wassaic gravelly loams, undulating and rolling phases.

The soil profiles in pastured areas are similar to those of the Pittsfield-Wassaic gravelly loams, undulating and rolling phases, except large stones and boulders occur on the surface and throughout the various layers. The surface soils are slightly acid or neutral; the subsoils are alkaline. The soils have developed from glacial till parent material, the principal rock constituent of which is dolomitic limestone.

The soils vary in number of stones on the surface but are usually too stony for cultivation and mowing. In scattered areas stones have been removed to permit mowing hay between the larger boulders and outcrops of underlying rock.

*Use and management.*—Timothy is the principal hay crop on this complex. Pastures are generally poorer than on Pittsfield-Wassaic gravelly loams, undulating and rolling phases. They are somewhat neglected; varying quantities of sumac, hardhack, mullein, wild rose, goldenrod, and other weeds and brush are growing in them. Nevertheless, Canada and Kentucky bluegrasses, redbud, and wild white clover are usually fairly abundant in all pastures. Pasture could be greatly improved by removing stones and small boulders, applying phosphates, and cutting the brush and briars.

As they are now, the soils are poorly suited to cultivation. If loose stones were removed they would be fair to good. They need management similar to that required by Pittsfield-Wassaic gravelly loams, undulating and rolling phases.

**Pittsfield-Wassaic gravelly loams, stony and ledgy hilly phases** (15–30% slopes) (PH).—Both soils of this complex are too stony for cultivation. The Pittsfield soil is 8 or 10 feet deep, high in lime, and well-drained; the Wassaic soil is also high in lime and well-drained, but has bedrock at 20 or 30 inches and outcrops of bedrock in some places. Except for its steep slope, this complex is similar to Pittsfield-Wassaic gravelly loams, stony and ledgy rolling phases.

*Use and management.*—This complex is used mainly for pasture, which is usually of only fair quality and untreated. Bluegrass and wild white clover are present in all pastures. They would dominate in the stand if they were fertilized with phosphorus. If stones were removed, this complex would be suitable for long crop rotations dominated by hay. Strip cropping and contour cultivation would be necessary to reduce runoff.

**Pittstown gravelly silt loam, nearly level and gently sloping phases** (0–8% slopes) (PM).—These soils have developed from moderately deep or deep deposits of acid glacial till, which is composed chiefly of acid slate and shale materials but also contains some schist, quartzite, sandstone, and crystalline materials. The soils are moderately well-drained to imperfectly drained. The deep subsoil is moderately compact. Slow internal drainage causes poor aeration below 18 inches. The relief is normally gently sloping and uniform or smooth. Slopes are dominantly in the upper part of the 0 to 8 percent range.

These soils occur throughout the entire region of slate and shale in close association with Bernardston, Dutchess, and Nassau soils. Fre-

quently they occur between the well-drained more rolling upland soils and the more nearly level or depressed areas of poorly drained Stissing and Mansfield soils. The most extensive areas, 60 to 100 acres in size, are west and south of Millbrook.

The 9-inch surface soil in pastures is dark-brown or dark grayish-brown friable granular silt loam. Below 9 and continuing to 14 inches is firm yellowish-brown silt loam. From 14 to 20 inches the subsoil is yellowish-brown gritty silt loam, firm or slightly compact, and stained with gray, yellow, and rust brown. The subsoil from 20 down to 48 inches is grayish-brown gritty silt loam mottled with gray, yellow, and rust brown. This layer is very compact and becomes more strongly mottled with depth. Below 48 inches is compact olive-brown gritty silt loam, somewhat mottled in the upper few inches. This layer is less compact than the one above.

Roots are most abundant in the surface layer and penetrate the upper subsoil. Throughout the profile are many slate fragments and some shale, schist, and sandstone. The profile is acid throughout.

The soil varies in degree of mottling in the subsoil and in the amount of gravel in the surface soil. Many small soil areas that have only slightly stained subsoils are closely associated with areas that have strongly stained or mottled subsoils. A few small areas scattered throughout the region of slate and shale soils have almost no gravel.

*Use and management.*—Cultivated areas of these soils are used principally for corn, oats, and hay. Large acreages on beef farms are in hay and pasture. Alfalfa is poorly suited because of the imperfect internal drainage. The chief hay crops are timothy, redtop, alsike, and red clover.

From 8 to 10 tons of manure supplemented with superphosphate is used for corn. About 1 ton of lime and 200 pounds of 20-percent phosphate are applied for small grains used as a companion crop for a hay seeding. Hay is cut for 2 or 3 years and then grazed for 2 years or more, depending on the condition of the pasture. Rotations lasting 6 or 7 years are commonly used.

Several good to excellent permanent and rotation pastures have been established on the beef farms in the east-central part of the county. These require lime and phosphate and proper grazing. The better pastures contain wild white clover, Kentucky and Canada bluegrasses, timothy, and alsike clover. The sward is heavy. The condition of pastures varies throughout the county. Native pastures include redtop, poverty oatgrass, some wild white clover, Kentucky bluegrass, and many weeds and shrubs such as goldenrod, wild aster, yarro, sorrel, strawberry, dewberry, English plantain, and wild carrot.

Most idle areas are suitable for cultivation but are associated with poorer soils or on the private hunting reserves of larger estates. Some areas have been reforested. The forest vegetation includes hardwoods of the oak and the beech-maple-hemlock associations and some white pine.

The soils are suited to intensive rotations but should be manured heavily or planted to a sod-forming crop at least 2 out of 5 years. Two successive years of row crops can be grown without damage if tillage is done on the contour and winter cover is provided. Ladino clover appears to be the best long-lived legume to include in seeding

mixtures for pasture. The soils need lime and phosphorus. If heavily cropped, they may need potash in addition to that supplied in the manure. Runoff is only moderately rapid on most areas. Generally it can be controlled by proper selection of crops, fertilization to insure vigorous growth, and contour cultivation.

**Poultney loam** (0-3% slopes) (Pn).—Like Poultney silt loam, this is a level well-drained productive soil of the first bottoms. Unlike the silt loam, it is lighter textured throughout the profile. Areas 2 to 30 acres in size occur in the same parts of the county as Poultney silt loam. The soil developed mainly from alluvium washed from slate material.

The 15-inch surface soil is dark-brown friable crumb-structured loam. Next occurs a friable loam or light silt loam that grades to light brown with depth. The subsoil below 40 inches is generally grayish-brown light loam or very fine sandy loam. It grades into gravelly sandy loam at 45 or 50 inches.

A few areas are gravelly and are indicated on the map with the gravel symbol. Included also are a few areas having a fine sandy loam surface texture. Locally in the western part of the county there are small included areas of Ondawa loam, which was derived from granite, gneiss, and schist materials.

*Use and management.*—Cultivated areas of this soil are used mainly for corn, oats, and hay. The prevailing practices of tillage, crop rotation, and fertilization are similar to those followed on Poultney silt loam. Estimated crop yields are slightly lower than on the silt loam; pastures yield about the same.

**Poultney silt loam** (0-3% slopes) (Po).—This well-drained soil occurs on flood plains along streams. It consists of recently deposited silty material that washed from nearby uplands. This material comes mainly from shale and slate rocks. The soil is subject to overflow each spring and commonly receives a thin deposit of new materials carried in the floodwaters. The relief is nearly level. The soil is easy to work and not subject to serious washing. It is acid throughout the profile. Internal drainage is moderately rapid after floodwaters recede.

The soil occurs principally in the acid soil regions or along streams flowing from these areas. It is most abundant along the upland streams in the central, eastern, and southern parts of the county, but also occurs along streams flowing from the uplands into the Harlem Valley, Fishkill Creek and its tributary valleys, and in the valleys at Smithfield and Shekomeko. The soil is closely associated with alluvial soils of the Pawlet, Housatonic, and Saco series. This and other Poultney soils are derived from alluvium washed mainly from slate materials, but in the western part of the county they include a few small areas of Ondawa silt loam, a similar soil derived from granite, schist, and gneiss materials.

Under heavy sod the surface soil extending to 8 or 9 inches is dark-brown firm but friable silt loam of fine granular structure. From 8 down to 24 inches is dark-brown crumbly silt loam. The subsoil below 24 inches on down to 35 or 40 inches is distinctly lighter brown and is commonly of loam texture. With depth the subsoil grades into a lighter textured grayish-brown layer of fine sandy loam, gravel,

and sand that is loose and structureless. The soil below 40 inches is in many places stained with rust brown and yellow. Roots are most abundant in the surface layer but they penetrate the subsoil to the water table or to the level of the adjacent streams. Except in the lower part, little gravel occurs in the profile.

*Use and management.*—Poultney silt loam is highly productive of general farm crops. The cultivated areas are used for corn, oats, and hay, chiefly timothy. A few areas are limed and used for timothy and red clover or for red clover and alfalfa. In general, no regular rotation is followed. The soil is fairly fertile. Fertilizers are used more on the adjacent upland soils than on this and similar soils of the bottom lands. When available, manure is used for corn and occasionally as a top dressing for meadows. Pastures are generally fair to good.

The forest vegetation consists of willow, alder, soft and hard maples, elm, and black ash. Timothy, Canada and Kentucky bluegrasses, redtop, quackgrass, wild carrot, strawberry, goldenrod, and plantain are among the plants growing in old pastures.

The soil is suited to intensive use for clean-cultivated crops. Many farmers can well afford to concentrate row crops on it for several years in succession and thereby permit use of the more erodible soils of the uplands for hay. If the soil is used in this way, it should be manured each year. Where it is used for pasture, Ladino clover appears to be the most promising long-lived legume. The soil needs lime and phosphorus; where heavily cropped, it may need potash. Cover crops should follow row crops as protection against scouring during spring floods. Some areas need special practices to control stream-bank erosion.

**Red Hook silt loam (0-3% slopes) (RA).**—This poorly drained soil has developed on glacial stream terraces from stratified outwash consisting of silt, sand, and gravel deposited by glacial streams. The parent material is chiefly acid slate, shale, and sandstone rock materials, with which smaller quantities of calcareous sandstone, limestone, or crystalline rock have been mixed. The areas are on level or on slightly depressed parts of the terraces. The lower subsoil, usually very compact and impervious, makes internal drainage so poor that crops are frequently damaged by high water. The substratum beneath the compact lower subsoil, however, usually consists of loose stratified sands and gravel.

Red Hook silt loam is closely associated with the better drained acid terrace soils of the Hoosic and Braceville series. A few areas of it are associated with Copake and Palmyra soils, which are, respectively, neutral and calcareous in the deep subsoil. It is also closely associated with very poorly drained Atherton soils and small muck areas. The soil is most extensive on the terraces along the Hudson River and Fishkill Creek.

The surface soil is dark grayish-brown firm silt loam about 12 inches thick. The upper subsoil, to a depth of 19 inches, is pale-brown gritty silt loam mottled with yellow, gray, and rust brown. The subsoil, extending from 19 down to 25 inches, is pale-brown heavy gravelly loam strongly mottled with rust brown, gray, and yellow. From a depth of 25 to 36 inches the subsoil is very compact sandy loam strongly mottled with rust brown, yellow, and gray. The substratum is loose grayish-brown stratified gravelly sand, gravel, and fine sand. The

upper part of the substratum is stained yellow and rust brown. The soil is strongly acid throughout the profile. Roots are most abundant in the surface soil and upper subsoil layers; few occur in the lower subsoil.

The soil varies somewhat in surface texture, especially where it is closely associated with the sandy Hoosic soils. In the Fishkill Creek valley, areas occur on low terraces not flooded by the present streams but adjacent to soils of the bottom lands along the streams. The substratum in these low-terrace areas is often heavier in texture than that of the typical Red Hook silt loam.

*Use and management.*—The acreage of this soil under cultivation is used principally for hay, but to a small extent for corn, oats, and vegetables. Most areas are small, so they are normally worked with and managed like the adjacent soils. A few areas are artificially drained with tile or blind ditches. The yields vary greatly, depending somewhat upon the season. In wet seasons yields of corn and oats are usually low; in dry seasons they may be good. With artificial drainage and proper use of lime, manure, and fertilizer, fair yields can be obtained.

Pastures vary a great deal, depending considerably upon management practices followed. The better pastures, to which superphosphate and lime have been applied, support a fair to good stand of bluegrass, timothy, redbud, and wild white clover, in which grow a few weeds. In most pastures the proportion of hardhack, goldenrod, coarse sedges, reeds, and other weeds is greater than that of redbud and other desirable pasture grasses. The forest consists mostly of elm, ash, red maple, white oak, willow, tuliptree, and basswood.

**Rhinebeck silt loam** (0-5% slopes) (Rb).—This imperfectly drained heavy soil is associated with the well-drained Hudson soils. It has developed from glacial lake sediments, mainly silt and clay. It occurs on the nearly level glacial lake plain near the Hudson River. Relief is only slightly sloping in most places, and runoff is moderately slow. A few slopes exceed 8 percent but most of them are in the 0 to 5 percent range. Other characteristics are similar to those of the Hudson series, but this Rhinebeck soil is strongly mottled with yellow, rust brown, and gray below 8 or 10 inches. The mottling indicates a high water table and periodically poor aeration at that depth. The content of organic matter in the surface soil is medium in cultivated areas.

The surface soil in cultivated fields is light grayish-brown friable silt loam that breaks into small subangular almost granular fragments. It is about 8 inches thick and filled with roots. From 8 to a depth of 15 inches is light-brown silt loam of medium nut structure. This layer is generally mottled but is well penetrated by roots. It is moderately acid. From 15 to 32 inches the subsoil is brown heavy silty clay strongly mottled with gray, yellow, and rust brown. This silty clay breaks into large irregular fragments that are hard when dry and plastic when wet. It contains few roots. The layer extending from 32 to a depth of 41 inches is grayish-brown silty clay loam. It is mottled with light gray and yellow, is compact and slightly alkaline, and shows stratification. The substratum below 41 inches is laminated slightly pinkish-brown silty clay; the various strata are of varying color and strongly alkaline or calcareous.

The soil varies chiefly in depth of its surface layer, which ranges from 6 to 11 inches and averages 8 inches. The subsoil and substratum of this soil, as is true for most soils developed from glacial lake sediments, occasionally contain lenses or strata of fine sand. Included with this soil are one or two small areas that have lost most of their original surface soil.

*Use and management.*—Cultivated areas of this soil are used for corn, oats, wheat, timothy and clover, and, to a less extent, for fruit.

The rotation commonly used lasts 4 to 6 years. Corn is grown 1 year and followed by 1 year of oats or wheat and 2 or 3 years of hay. The hay meadows are frequently pastured 1 or 2 years before plowing. Alfalfa and red clover, though often seeded on this soil, do not hold well. The seedings are usually mixtures containing timothy, alsike, red clover, and alfalfa. Where available, 8 to 10 tons of manure supplemented with superphosphate is applied for corn. About 200 pounds of 20-percent phosphate is applied to fields prepared for grain and hay. At this time some operators use a ton of lime an acre.

If the slope is perceptible, the soil is subject to serious washing. Plant and cultivate row crops across the slope to retard runoff as much as possible. The use of winter cover crops after corn also reduces the loss of surface soil during fall and winter. Clean-cultivated crops should not be grown more often than 1 year in every 4. Ladino clover promises to be a better legume for seeding mixtures than alfalfa. The soil needs moderate applications of lime and phosphorus, but the content of potash is generally not deficient.

The forested areas support a mixed growth of elm, white pine, black locust, hard and soft maples, red and white oaks, and flowering dogwood. Native pastures have a fairly heavy growth of Kentucky bluegrass, timothy, and wild white clover, with some dock, chicory, goldenrod, and other weeds.

**Rhinebeck silty clay loam (2-5% slopes) (Rc).**—The principal areas of this imperfectly drained soil are in the northwestern part of the county near Rhinebeck, Madalin, and Upper Red Hook. The soil is similar to Rhinebeck silt loam but much heavier textured. It is closely associated with Hudson silty clay loam, gently sloping phase, and Madalin silty clay loam.

The surface soil is 8 inches of light grayish-brown plastic silty clay loam. A thin light-brown layer may remain below the plowed layer. The upper part of the subsoil, extending to a depth of 17 inches, is brown silty clay loam that breaks out into large irregular fragments resistant to crushing. The surface and upper subsoil layers are moderately acid and well penetrated by roots. The soil is mottled below the plowed layer. From 17 down to 38 inches the subsoil is light-brown to light grayish-brown silty clay loam, strongly mottled with gray, rust brown, and yellow. This layer breaks out into large blocks, but when left in place shows definite stratification in the lower part. It is penetrated by few roots and ranges from moderately acid in the upper part to neutral in the lower few inches. The substratum starts below 38 inches; it is laminated or stratified silty clay that varies from olive brown to faintly reddish brown. The substratum is neutral in the upper part but with depth it becomes strongly alkaline and calcareous.

The soil varies principally in depth of its surface layer and in texture of the subsoil and substratum. The surface soil varies from 5 to 10 inches in thickness, depending upon the extent of erosion. In most areas erosion is moderate and the surface soil is about 7 inches thick. Within the subsoil and substratum, lenses of silt and fine sandy loam are frequently found. Relief ranges from nearly level to gently sloping. One included area of about 40 acres has a steeper slope.

*Use and management.*—This soil is used in much the same way as Rhinebeck silt loam. The cultivated areas are almost entirely in corn, small grains, and hay crops. No apples are grown.

Tillage, rotation, and fertilization are similar to those on Rhinebeck silt loam, but the rotations are usually slightly longer. Tillage should be done across the slope to retard runoff. Under sod there is little evidence of active erosion, except in idle areas and poorly managed pastures.

**Rough stony land (Gloucester, Hollis, and Chatfield soil materials) (25–60% slopes) (Rd).**—This unit is composed of shallow areas of soil interspersed among large areas of bare rock. It includes the steep and very stony land associated with Chatfield, Gloucester, and Hollis soils. Areas of this land type on the Hudson highlands in the southern part of the county have rocks that give rise to Chatfield and Gloucester soils, chiefly granite or gneiss materials. Areas developed on the Taconic and Housatonic highlands and on Chestnut Ridge consist for the most part of very shallow soils, schist bed-rock outcrops, and a little loose rock material on the surface. Hollis soils are derived from this kind of material. Practically all areas are in forest, their best use.

**Saco silty clay loam (0–2% slopes) (SA).**—This is a very poorly drained alluvial soil derived from shale, slate, schist, or crystalline rock materials, with or without admixtures of other kinds of rock. It occurs along slowly flowing streams from or going through regions where the soils have developed chiefly from these materials. It is found on nearly level relief, often at the head of large streams. The soil is subject to frequent overflow and is saturated most of the year. The larger areas are in swamplike places cut by many small stream channels.

The surface soil in wooded areas is a black coarsely granular friable and strongly acid silty clay loam that extends to a depth of 8 inches. The apparent organic-matter content is high. From 8 down to 14 inches is black, massive and strongly acid, heavy silt loam mottled with rust brown and gray. The subsoil from 14 to 22 inches is heavy plastic bluish-gray silty clay loam, strongly mottled with yellow and rust brown. From 22 to 38 inches the soil is bluish-gray sandy loam to silt loam, strongly mottled with yellow and rust brown. Below 38 inches are stratified sands and pieces of gravel composed chiefly of schist, shale, slate, and crystalline rock materials.

The subsoil is moderately to strongly acid throughout. Plant roots occur almost entirely in the surface soil. There is almost no internal or surface drainage. The soil varies in texture of the lower subsoil, which ranges from gravelly sandy loam to silty clay loam. Although only one type is recognized, the texture of the surface soil ranges from silt loam to silty clay loam.

*Use and management.*—Much of Saco silty clay loam is in forest and a considerable acreage is pastured. The condition of the pasture varies. In the better pastures the vegetation is only fair; it includes meadow grass, redbtop, and lower percentages of reeds, rushes, cattails, and coarse grasses. Pastures require drainage for best results. Open ditches or properly plowed furrows are helpful in carrying off surface water, which is inclined to stand on low areas. Drainage seldom can be improved enough to make the soil well suited to crops.

The vegetation is mostly alder and willow, with some elm, hemlock, gray birch, black ash, and red maple. Reeds, rushes, sedges, and rebel weed are abundant in open areas.

**Staatsburg gravelly loam, ledgy undulating and rolling phases (3-15% slopes) (SB).**—These are very shallow soils with numerous outcrops of bedrock. They are well-drained and 18 or 20 inches thick. The outcrops, which generally do not stick up far above the surface, seriously interfere with but do not prevent cultivation. The general relief is billowy. These soils have developed from shallow deposits of glacial till composed almost entirely of calcareous sandstone materials. They are closely associated with Staatsburg gravelly loam, very ledgy rolling phase, and Cossayuna soils in the western part of the region occupied by soils derived from calcareous sandstone. They occur most extensively northeast of Poughkeepsie, where they occupy a narrow belt east of Hyde Park and Rhinebeck that continues as far north as Red Hook. Small areas are closely associated with cultivated Cossayuna soils and are worked with them.

In forested areas there is first a thin layer of litter, and then half an inch of very dark-brown humus. The surface soil beneath the humus is about 5 inches of dark-brown mellow loam of fine granular structure that is well penetrated by roots. From a depth of 5 down to 11 inches is soft friable light yellowish-brown silt loam. The sub-soil extending from 11 to 20 inches is light-brown firm but friable silt loam. The bedrock of calcareous sandstone commonly occurs at 20 inches.

The soil is moderately acid throughout; roots penetrate all layers. The soil is well drained and holds moisture fairly well, though the moisture-holding capacity is limited by the shallowness over bedrock. Surface water usually runs off barren areas rapidly. Throughout the profile and on the surface are shaly fragments and small flagstones from calcareous sandstone. Freshly broken surfaces of these fragments usually react with hydrochloric acid, which indicates the presence of lime. This lime content is apparently reflected in the relatively good stands of bluegrass.

The soils vary principally in depth. A very small percentage of the total acreage has been severely eroded; about 80 percent has been moderately eroded.

*Use and management.*—More and more of the cultivated areas of this soil are being abandoned. Those areas closely associated with the better agricultural soils or those that are in gardens around suburban developments continue in use. The acreage in pasture may increase, for a fair stand can be maintained with proper treatment and controlled grazing. Idle areas are rather soon overgrown with brush and then slowly revert to forest. Orchards do not yield well.

The forest vegetation consists mostly of oak, maple, hickory, ash, tuliptree, basswood, and dogwood. Some white pine, redcedar, hemlock, cherry, beech, and birch trees are also present.

**Staatsburg gravelly loam, very ledgy rolling phase (5-15% slopes) (S<sub>D</sub>).**—The outstanding feature of this soil is the numerous jagged ledges of calcareous sandstone that crop out in long lines in a northeast-southwest direction. The relief is billowy or undulating. The soil has developed from shallow deposits of glacial till over calcareous sandstone. Individual areas are generally large and often include 200 or 300 acres; they are closely associated with the ledgy undulating and rolling phases.

The soil profile is similar to that of Staatsburg gravelly loam, ledgy undulating and rolling phases, but many loose stones and boulders occur on and throughout the soil, and outcrops of underlying rocks are more numerous.

*Use and management.*—This soil seems well suited to grasses and it supports fair pasture (pl. 4, *B*), especially if phosphorus is supplied. Pastures are difficult to fertilize because of the outcrops. The forest growth is the same as that on the ledgy undulating and rolling phases.

**Staatsburg gravelly loam, very ledgy hilly phase (15-30% slopes) (S<sub>C</sub>).**—Outcrops of bedrock are so numerous on this very rocky and hilly soil that tillage is impossible in most places. The topography is uneven. The soil between the outcrops is like that of the very ledgy rolling phase. It is usually about 18 inches deep over bedrock.

Runoff is rapid from the hilly slopes, and the soil is too shallow to hold much water for plants. As a result, pastures produce well for only a few weeks early in spring. Rockiness and uneven hilly slopes make pasture improvement difficult. This phase is generally better suited to forest than to pasture. Most of it is in forest.

**Steep ledgy land (Nassau soil material) (30+ % slopes) (S<sub>E</sub>).**—Steep slopes and resulting high runoff, combined with shallowness and resulting low water-holding capacity, make this land type very droughty. The profile in the deeper areas is similar to that of Nassau slaty silt loam, ledgy undulating and rolling phases, but outcrops of slate and shale bedrock are more numerous and the soil as a whole is shallower. Like the Nassau soils, this land type is low in lime, phosphorus, potash, and nitrogen. Slopes are steep and uneven.

*Use and management.*—Cultivation of this land type with ordinary machinery is impossible in most places. Pastures are difficult to improve and produce little at their best. Forest is the best use for this land type.

**Steep ledgy land (Wassaic and Staatsburg soil materials) (30+ % slopes) (S<sub>F</sub>).**—Calcareous sandstone or limestone bedrock outcrops in numerous jagged ledges on the steep slopes of this mapping unit. The soil between the outcrops is seldom more than 2 feet thick over bedrock. The profiles between the outcrops are similar to those of Staatsburg gravelly loam, ledgy undulating and rolling phases, or those of Wassaic gravelly loam, rolling phases, but are usually more shallow. Slopes are steep.

*Use and management.*—Approximately three-fourths of this steep ledgy land type is in forest, its best use. The steep slopes and outcrops prevent fertilization of pasture by machinery. The shallow soil dries out early in summer, so even improved pastures produce little feed.

**Stissing gravelly silt loam (0-5% slopes) (Sg).**—Areas of this poorly drained soil occur in depressed or nearly level places on the lower slopes and at the heads of streams in the regions occupied by slate and shale soils. The soil has developed from moderately deep or deep glacial till parent material, which is composed chiefly of acid slate or shale but also contains some sandstone, schist, and crystalline materials. Relief is smooth and very gently sloping or level. The subsoil is mottled; internal drainage is very slow. The soil occurs between the Mansfield soils in the depressions and the better drained Pittstown, Dutchess, and Bernardston soils on the more sloping or rolling uplands.

In meadows the surface soil is about 10 inches of very dark-brown friable gravelly silt loam of coarse granular structure. In some areas the lower inch or two is lightly stained with yellow, gray, and rust brown. From 10 down to 15 inches is firm brownish-gray gravelly silt loam, slightly mottled with gray, yellow, and rust brown. The subsoil from 15 to 24 inches is firm or slightly compact olive-gray gritty silt loam, strongly mottled with gray, yellow, and rust brown. From 24 to 30 inches the subsoil is similar in color and mottling but slightly heavier textured and more compact. Below 30 and continuing to 48 inches is the deep subsoil, a very compact strongly mottled dark olive-brown heavy silt loam. The substratum starts below 48 inches. It is olive-brown silt loam that breaks out into large, hard, irregular pieces that contain many partly decomposed rusty-brown slate fragments. The depth to slate bedrock varies considerably, but the bedrock seldom crops out and is generally at least 4 feet below the surface. Roots are most abundant in the surface soil; few roots penetrate the compact subsoil. The soil is moderately to strongly acid in all layers.

*Use and management.*—Although Stissing gravelly silt loam is poorly drained, only small areas of it occurring within tracts of better drained soil are artificially drained.

No regular rotations are followed. The soil is used mostly for hay. The meadows are cut until the yields begin to fail. Timothy, redtop, and alsike clover, the principal plants used for hay, are frequently grown in mixture. Oats and buckwheat are the chief cultivated crops. Corn is sometimes grown, especially in the few artificially drained areas adjacent to better drained soils. Yields vary with the season. In exceptionally wet years corn, oats, and buckwheat may be a complete failure on the undrained areas. Artificial drainage would increase yields.

Pastures are generally poor and could be greatly improved with lime and phosphorus, and especially with drainage. Run-out meadows are pastured for a number of years before they are plowed and reseeded to hay. Native pastures include redtop, poverty oatgrass, wild strawberries, wild carrot, goldenrod, and many other weeds. Ash, elm, soft maple, and hemlock are the important trees in forested areas.

**Stockbridge gravelly loam, gently sloping and sloping phases** (0-15% slopes) (Sk).—These phases have developed from deep glacial till composed of a high percentage of slate and limestone and some sandstone and crystalline rock materials. They occur on long uniform mild slopes on drumlinlike hills. They have developed most extensively in the back valleys in the eastern half of the county. The areas are not contiguous; they are scattered and associated with Dutchess, Bernardston, Pittsfield, Dover, and Wassaic soils. The lower part of the subsoil is compact, but the structure is such that internal drainage is good. These phases are "stronger" than the associated Dutchess and Bernardston soils. Soil erosion is not a serious problem under present methods of management.

The 8- or 9-inch surface soil in cultivated fields is dark-brown mellow granular gravelly loam. The subsoil to a depth of 19 inches is brown friable heavy gravelly loam or light silt loam. From 19 down to 32 inches the subsoil is grayish-brown compact gravelly loam. These first two layers are acid; the third layer is about neutral. Below 32 inches the subsoil is dark gray-brown very compact gravelly loam. This layer is mostly neutral or alkaline, but with depth it frequently becomes calcareous.

These soils are gravelly throughout. They contain pieces of limestone, sandstone, and quartz and fragments of schist and slate. In places limestone boulders are present through the soil mass.

The soils vary considerably in the quantity of limestone present and in reaction. The surface soils are nearly always acid; the deep subsoils, neutral or alkaline. The depth to alkaline material varies. In areas where these soils grade into the Bernardston, the depth to alkaline material is 4 to 5 feet. The subsoils of these Stockbridge soils and the Bernardston soils are slightly acid. The deep substrata in exposures of the Stockbridge soils, however, are usually alkaline or calcareous.

*Use and management.*—Long rotations are generally followed on these phases. Corn is grown 1 or 2 years and followed by 1 year of oats and 3 years of hay. From 8 to 10 tons of manure supplemented with superphosphate is commonly applied for corn. About  $\frac{1}{2}$  to 1 ton of lime and 200 pounds of 20-percent phosphate are applied for oats sown as a companion crop for the hay seeding. In some areas, especially in the Harlem Valley, soil tests do not indicate that lime is needed for satisfactory growth of red clover. Though alfalfa is well suited to these soils, little is grown.

Most pastures are fair to good. Kentucky and Canada bluegrasses grow in nearly all pastures, and in the better ones wild white clover is also abundant. Wild grasses, weeds, and brushy cinquefoil are present in the poorer pastures. Rotation and permanent pasture range from fair to excellent.

The soils are well suited to a wide variety of crops. Clean-tilled crops can be grown safely once in 4 years. The soils should be manured heavily or have a hay or pasture crop on them 2 out of 4 years. Alfalfa is the best long-lived legume. The soils need lime and phosphorus and may need potash. Strip cropping is required on long slopes, and all tillage operations should be across the slope. Where cultivation and planting are done up and down or diagonally

across the slope, runoff is rapid and erosion is noticeable. In pastures and meadows the sods are heavy, so little erosion occurs.

A high percentage of these important agricultural soils is idle, principally because of kind of ownership. These areas are potentially suitable for cultivation. Several small areas of 2 to 4 acres that occur in fields associated with larger areas of shallow Wassaic or poorly drained Lyons soils have been abandoned. As the trend in the county is toward more intensive use of the better soils, it is doubtful that large areas of these soils will remain idle long.

**Stockbridge gravelly loam, moderately steep phase (15-30% slopes) (SL).**—Slopes of this phase are uniform but steeper than those of Stockbridge gravelly loam, gently sloping and sloping phases. Soil characteristics, however, are similar to those of the gently sloping areas, and the soil is no more extensively used. Other phases of Stockbridge gravelly loam are closely associated with this soil.

The soil profile is similar to that of the gently sloping and sloping phases, but most cleared areas have been moderately eroded and therefore have a surface soil an inch or two shallower. About 150 acres with stones enough to interfere seriously with cultivation are included with this soil. These stony areas are shown on the map by stone symbol.

*Use and management.*—Cultivated areas of this soil are used principally for timothy-and-clover hay, corn, and oats. Rotations vary, but the soils are generally kept in sod the greater part of the rotation. Corn is grown only 1 year in the rotation; it is followed by oats for 1 year and hay for 3 or 4 years. Meadows are generally pastured after the third or fourth year of mowing. Fertilizer and lime treatments are similar to those used for the gently sloping and sloping phases, but the longer rotations make applications less frequent.

Contour cultivation and planting usually retard runoff enough to prevent serious erosion. Where the slopes are long, strip cropping of these and the adjacent areas is needed. Cover crops should be used on areas left fallow during fall and winter. The soil needs long rotations that are made up largely of leguminous crops such as alfalfa. It also needs lime and phosphorus. Potash in addition to that supplied in manure may also be required.

Idle areas are potentially suitable for cultivation. Most of them are temporarily abandoned because of absentee ownership. The forests are second-growth stands consisting mostly of red, white, and black oaks, shagbark hickory, basswood, hard maple, beech, and some white pine and redcedar.

**Stockbridge gravelly loam, eroded moderately steep phase (15-30% slopes) (SE).**—This soil differs from Stockbridge gravelly loam, moderately steep phase, in being eroded to such extent that the original subsoil now makes up most of the plowed layer. Runoff is rapid; relief is usually uniform. The areas average 12 acres in size. The soil most frequently occurs as long narrow strips in association with gently undulating areas, and because of this receives methods of management suitable for the more gentle slopes. The result has been severe sheet erosion of this soil. Shallow gullies crossable with farm equipment have developed in a few areas.

*Use and management.*—Despite the loss of its surface soil, this phase is fairly intensively used. The cultivated areas are used in much the same way as those of Stockbridge gravelly loam, gently sloping and sloping phases. Similar rotations and fertilizer practices are followed. As a result, erosion is active on most areas used for corn and small grains and yields are lower than on the gently sloping and sloping phases.

Maintenance of a heavy sod, either for hay or pasture, is perhaps the best way of controlling erosion and rebuilding a high level of fertility for this soil. Where corn and small grains are grown, the soil needs contour cultivation and strip cropping. Heavy applications of manure are especially beneficial. Like the other Stockbridge soils, this one needs lime and phosphorus. It is more likely to need potash than other Stockbridge soils. Cover crops should follow corn in fall, as erosion is usually most serious when the soil remains fallow in winter.

Most pastures are poor. They usually contain bluegrass, red-top, sweet vernal, and some wild white clover. With applications of lime and phosphate, they could be greatly improved without reseeding.

**Stockbridge stony loam, sloping phase (5-15% slopes) (SM).**—This soil occurs mainly in the Harlem Valley where it is associated with other Stockbridge soils. The relief is uniform. The areas are on drumloid hills and lower slopes fronting the foothills. Stones on and in the soil interfere with cultivation, but much of the soil is farmed.

Except for huge boulders and stones, the profile of this soil is similar to that of the gently sloping and sloping phases of Stockbridge gravelly loam. The stones and boulders are mainly limestone and quartzite. The principal rock constituents of the parent materials are slate and limestone, with some marble, schist, and quartzite admixed. Erosion is only slight or moderate. Drainage is good.

*Use and management.*—Many of the smaller stones have been removed from the surface of about a fourth of this soil. These cleared areas are cultivated or used for hay.

No regular rotations are followed. Grassland is not plowed and seeded at regular intervals. Meadows are usually pastured when the hay yield begins to fail. Corn and oats are sometimes grown when hay and pasture yields become low. From 8 to 10 tons of manure and some superphosphate are applied for corn. Where tests show the need of lime for the successful growth of red clover,  $\frac{1}{2}$  to 1 ton of lime is applied for oats and the hay seeding. The hay seeding generally consists of timothy and red clover. Hay meadows are sometimes top-dressed with manure when the yield begins to drop.

Most pasture could be improved by adding superphosphate and, in some areas, lime. Nearly all pastures have Canada and Kentucky bluegrasses and some wild white clover. Many pastures are neglected and contain many weeds, hardhack, brush, and briars.

If the stones were removed, this soil could be used for the same crops as Stockbridge gravelly loam, gently sloping and sloping phases. It would require about the same management.

**Tidal marsh, fresh-water phase (0-1% slopes) (T<sub>A</sub>).**—Mapped in this separation are marsh areas occurring along the tidal flats of the Hudson River. They consist of mud covered by a rank growth of cattails, coarse grasses, and some wild rice. The tides of the Hudson River rise and fall over these muddy marshes. They are not used and have little value.

**Troy gravelly loam, gently sloping phase (3-8% slopes) (T<sub>C</sub>).**—This soil has smoother relief but is otherwise like the sloping phase. It commonly occupies the gently sloping or undulating crests of drumlins. The profile is essentially the same as that of the sloping phase—deep, well-drained, moderately fertile, and medium to strongly acid at the surface but alkaline at depths of 5 to 6 feet.

*Use and management.*—Use and management of this soil are much the same as for the sloping phase. The soil occurs as long narrow areas surrounded by the sloping phase. In fields the two are worked as a unit. Crop yields are usually slightly higher in this soil, principally because more water soaks in and is held for crops. More intensive rotations can be used on this phase than on the sloping phase. Clean-cultivated crops can be grown safely 2 years in succession in a rotation that contains 2 years of hay. Cultivation should be on the contour, and strip cropping is desirable. Both lime and phosphorus are needed; potash may be deficient in heavily cropped areas.

**Troy gravelly loam, sloping phase (8-15% slopes) (T<sub>E</sub>).**—This soil occupies moderately sloping sides of the fairly high, crowned knolls or drumloid hills prominent in the western part of the country. Areas occur on drumlins or hills scattered throughout the entire region occupied by calcareous sandstone soils. Comparatively few of them occur in the northern part, but from Schultzs ville south the number increases. Areas are most numerous east of Poughkeepsie, that is from Rochdale south toward Overlook School, to Diddell, and then southwest to Beacon.

The soil has developed from deep glacial till composed mainly of calcareous sandstone with which acid slate and shale, limestone, and igneous erratics are mixed. The relief is sloping. The subsoil is slightly compact and becomes more so with depth, though its structure is such that internal drainage is good. This phase is dominantly a loam, although areas of silt loam are included.

Moderately well-drained Albia soils are closely associated with this soil. Surrounding and adjacent to it are intervening areas of other soil developed from calcareous sandstone materials—soils of the Cossayuna, Staatsburg, Boynton, or Mansfield series.

In meadows the surface soils are 10 inches of finely granulated friable brown gravelly loam or silt loam. It is medium to strongly acid unless limed, filled with roots, and well-aerated. It contains gravel but not enough to interfere seriously with cultivation. The subsoil extending from 10 to 16 inches is friable yellowish-brown gravelly silt loam of weak fine blocky structure; it is acid; well penetrated by roots, and permeable to air and moisture. From 16 down to 23 inches the subsoil is firm or slightly compact yellowish-brown silt loam, which breaks into large medium hard irregular blocks that can be crushed under moderate pressure. The subsoil extending from 23 to 30 inches is grayish yellow-brown gravelly loam; it is acid, compact,

and breaks into large firm irregular blocks. Roots penetrate this lower subsoil layer by following the cleavage planes between fragments, so they do not penetrate so well as in layers above. This lower subsoil is extremely compact but has many porelike holes through which roots, air, and moisture penetrate.

Below 30 inches and on down to 68 inches is a layer of very compact olive-brown gravelly loam that breaks into large hard angular fragments. The reaction of this layer varies from place to place but becomes alkaline with depth. A few roots penetrate by following the cleavage planes between fragments. The deep grayish-brown gravelly loam substratum starts below 68 inches and continues to a depth of 18 feet or more. It is strongly calcareous, very compact or almost brittle, and breaks into irregular angular hard aggregates of nut size.

Throughout the profile are many pieces of gravel, stones, and a few boulders. Calcareous sandstone fragments predominate, though fairly large quantities of shale and slate and a few limestone fragments are found. Table 6 gives mechanical analyses and pH determinations for this soil.

TABLE 6.—*Mechanical analysis of Troy gravelly loam, sloping phase*

Sample No.	Depth	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay	pH determinations
	<i>In.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	<i>Pct.</i>	
1654120	0 to 10---	5.5	6.4	5.7	10.0	8.7	48.0	15.7	5.4
1654121	10 to 16---	5.3	7.4	5.8	10.3	8.2	45.8	17.2	5.5
1654122	16 to 23---	4.0	7.4	5.6	11.0	8.6	42.9	20.5	5.2
1654123	23 to 30---	4.8	8.0	6.3	11.2	9.0	41.1	19.6	5.2
1654124	30 to 68---	5.5	8.7	6.5	11.9	8.9	42.4	16.1	7.4
1654125	68 to 144..	7.9	8.1	6.4	11.8	8.8	42.1	14.9	8.5

The quantity of gravel in the surface soil varies from almost none to as much as 40 percent. Soil loss caused by erosion varies from a very little to as much as 75 percent of the original surface layer. Mapped with this soil are a few small areas together totaling about 1 percent of the total acreage that have lost most, or all, of the original surface soil.

*Use and management.*—More than nine-tenths of Troy gravelly loam, sloping phase, has at some time been cleared and farmed. Approximately half is now cultivated. The forested areas support good stands of hardwoods, mostly oak, maple, and dogwood with some ash and hickory. Of the cultivated land, about 30 percent is in fruit, 6 percent in vegetables, and the rest principally in crops needed on dairy farms.

Corn, oats, and hay are the crops usually grown on the dairy farms. Alfalfa, timothy, and clover are the principal hay crops. Tomatoes, sweet corn, cabbage, and beans are the most common vegetables, and apples the most common fruit.

A 4- to 6-year rotation is generally followed on the dairy farms. Corn is planted 1 or 2 years and followed by oats that are seeded

with a hay mixture. The hay is cut for 3 or 4 years. In the truck-crop areas, 1 or 2 years of the rotation may be used for vegetables.

From 10 to 12 tons of manure supplemented with superphosphate are usually applied for corn; a ton of lime is commonly applied for the seeding of small grains and hay. Where less phosphate is used on the corn, more is applied to the oats at the time of seeding. About 400 pounds of 20-percent superphosphate is used in the rotation. Little effort is made to control runoff and erosion, nor are cover crops often planted after harvesting row crops in fall. Apple yields vary according to variety and management.

The soil is well suited to a 4-year rotation consisting of a clean-cultivated crop, a small grain, and 2 years of hay. An alfalfa-grass mixture is the most productive hay crop, provided it is adequately limed and fertilized. Some evidence of potash deficiency was found in fields intensively cropped.

Runoff is moderately rapid and should be retarded to control erosion and to conserve water for crops. The good crop growth that can be obtained by liming and fertilization does much to control runoff, but if the rotation includes a clean-cultivated crop, all tillage should be done on the contour and the long slopes should be strip-cropped.

**Troy gravelly loam, moderately steep phase (15-30% slopes) (Tb).**—This soil is only fair for crops because of its moderately steep slopes. It is closely associated with the other phases of Troy gravelly loam. The soil is well-drained but good in water-holding capacity, moderately fertile, and not seriously eroded. The slope makes it hard to work and causes rapid runoff.

The profile characteristics are similar to those of the sloping phase. The surface soil is 1 or 2 inches thinner than that of the gravelly Troy soil on less steep slopes. The surface soil is medium to strongly acid; the subsoil is only slightly acid or neutral. In most places free lime occurs at depths of 5 to 6 feet.

*Use and management.*—The cultivated acreage of this soil is used for orchards and the crops needed on dairy farms. Orchards are generally maintained in sod, and erosion is somewhat stabilized. In general, plowing and cultivation are done near the contour. The soil is used for clean-cultivated crops only 1 year in a 6- or 7-year rotation. On dairy farms meadows are generally top-dressed with manure or fertilized after the second or third year of cutting and then used 1 or 2 years for pasture. Fertilization practices are similar to those used on the sloping phase. Yields are generally lower.

The soil needs a long rotation, including 4 years or more of leguminous hay or pasture and not more than 1 year of intertilled crops. Alfalfa is well suited to such a rotation. The soil needs lime and phosphorus; it may need potash in addition to that supplied in manure. Wherever feasible on the long slopes, strip cropping in narrow strips is desirable to retard runoff. Few slopes are sufficiently long to require diversion terraces. The use of a winter cover crop after row crops, a practice seldom followed except on areas used for truck crops, would prevent soil loss. For permanent pastures, management should include liming, fertilizing, mowing, and controlled grazing. Much of the idle acreage is made up of many small areas (1 or 2 acres)

that lie adjacent to idle steep soils. A few areas temporarily idle are adjacent to real estate developments.

**Troy gravelly loam, eroded moderately steep phase (15-30% slopes) (T<sub>B</sub>).**—Strong slopes and eroded condition detract from the value of this soil. The small areas occur mainly in association with other phases of Troy gravelly loam. The profile is similar to that of the sloping phase, though most of the original surface soil has been lost and the subsoil is turned up in plowing. Supplies of organic matter and nitrogen are very low.

*Use and management.*—This soil was once cleared of forest and intensively cultivated or pastured, but at the time of mapping about four-tenths was in crops. Many severely eroded and gullied areas have been abandoned.

Special management is needed to prevent further erosion and for rebuilding fertility. It may be necessary to apply these more intensive methods not only to areas of this soil but also to the adjacent phases. Methods that may be required are strip cropping and diversion terraces on long slopes, plus use of a long rotation that keeps the soil under sod-forming crops most of the time. Row crops should be eliminated from the rotation if possible. A year of small grain followed by a number of years of hay or pasture is a more desirable rotation. Lime and fertilizer needs must be met if rotations are to be effective. Orchards should be cultivated as little as possible. New orchards should be planted on the contour. Necessary tillage should be done across the slope. Alternate middles should be left in grass, or grass should be maintained in the tree rows.

Fair pastures have been and can be established on the more severely eroded and gullied areas. Management that includes liming, fertilizing, mowing if possible, and controlled grazing can control further erosion. Reforestation of areas too mutilated for other use may be desirable.

**Troy gravelly loam, steep phase (30-45% slopes) (T<sub>F</sub>).**—This soil is too steep to permit use of most farm machinery. It occurs mainly in long narrow strips adjacent to the sloping phase, and approximately 40 percent of the acreage has been severely eroded. The strips are frequently too narrow to work separately and are therefore used with adjacent areas of the sloping phase. Management for the sloping phase is followed and it is unsuitable for this steep phase.

Under forest, or in virgin condition, the profile of this steep soil is similar to that of the sloping phase but generally the various layers of the surface soil and subsoil are not so thick. The surface layer averages about 8 inches thick in uneroded forested areas.

*Use and management.*—This soil is too steep for intensive cultivation. Good pasture sods have been obtained by applying lime and fertilizer, and with controlled grazing they can be maintained. Re-seeding, liming, and fertilization of some of the pastures are necessary. Because areas of this phase are so narrow, it is usually necessary to include adjacent areas of other soils in a pasture. Reforestation of the more severely eroded and gullied areas may be necessary to prevent further damage to adjacent soils.

The forest is composed of red, white, chestnut, yellow, and black oaks, shagbark and pignut hickories, tuliptree, sassafras, basswood, mountain ash, and flowering dogwood.

**Urban land, undifferentiated (U<sub>A</sub>).**—Areas in cities and around industrial establishments and railroad yards that could not be classified by soil type were mapped as Urban land, undifferentiated. In most cases the unit consists of soils so mutilated by excavations and fills that they no longer can be classified.

**Wassaic gravelly loam, rolling phase (5–15% slopes) (W<sub>D</sub>).**—This soil has developed from shallow deposits of glacial till, mainly limestone material, overlying limestone bedrock. Other rock materials—sandstone, slate, schist, quartz, and gneiss—are present in smaller quantity. The relief is irregular. Outcrops of the underlying bedrock exist but do not prevent cultivation. Surface and internal drainage are good. Areas of this soil occur on the low hills and knolls in most of the principal valleys where limestone bedrock outcrops. The most important ones are in the northern part of the Harlem Valley, in the Fishkill, Clove, Wappinger, and Little Wappinger Creek Valleys, near Shekomeko and Smithfield, and in other scattered small areas throughout the eastern part of the county. This phase is most closely associated with the hilly phase. It is also associated with Pittsfield soils and the Pittsfield-Wassaic complex.

The surface soil in old pastures is faintly reddish-brown mellow finely granular gravelly loam. It is slightly acid or neutral and extends to a depth of about 10 inches. The subsoil extending from 10 to 16 inches is lighter brown gravelly silt loam that is friable and slightly alkaline. Starting below 16 inches and continuing to bedrock, which occurs at an average depth of 24 inches, the subsoil is mellow strongly alkaline or calcareous light reddish-brown silt loam. In most areas there is a ½- to 2-inch layer of brown gritty loam immediately above the bedrock. This thin layer is composed of disintegrated bedrock.

The surface soil varies from slightly acid to slightly alkaline within short distances. The amount of gravel in the surface soil also varies, but in no place is there enough to interfere seriously with cultivation. The soil has been slightly to moderately eroded in most areas; about 50 acres have been severely eroded. About 50 to 60 acres are included that have a fine sandy loam texture.

*Use and management.*—Cultivated areas of this soil are used to some extent for corn and oats, but principally for timothy, red clover, and alfalfa hay. The rotations vary in length and in crops included. Hay is commonly maintained until the yields are low and is sometimes pastured before it is plowed. Some manure is usually applied for corn, and 200 to 400 pounds of 20-percent phosphate is used in the rotation for corn or oats. Some farmers top dress meadows with manure when hay yields begin to fail. Yields vary. They are low in dry years but fair in average ones.

The rotation pastures and better-cared-for permanent pastures support Canada and Kentucky bluegrasses, redbud, wild white clover, timothy, and red clover. Some farmers top dress with manure and superphosphate, but many pastures are neglected and contain various undesirable weeds. Brush and trees are encroaching on the poorest pastures. The soil holds little water. Pasture plants are damaged in dry months but quickly recuperate when rain comes.

Redcedar, white pine, red, white, and yellow oaks, hickory, ash, hard maple, black locust, and gray, black, and yellow birches are the principal trees in forested areas.

The shallow soil should be managed so as to retain much of the water that falls on it. It is better suited to hay or pasture than to intertilled crops and small grains. Alfalfa does well and can be maintained for 4 years or more if enough phosphorus is supplied. Crops should be worked on the contour if feasible; the uneven relief commonly prevents strip cropping.

**Wassaic gravelly loam, hilly phase (15-30% slopes) (W<sub>A</sub>).**—The water-holding capacity of this shallow soil is seriously lowered by rapid runoff from its strong slopes. The relief is generally irregular. The areas occur on hills and knolls in valleys and are closely associated with or contiguous to areas of the rolling phase. A few outcrops of underlying limestone rock are noticeable in all areas.

The soil profile is similar to that of the rolling phase, but because of erosion the surface layer varies in thickness in the same field. The surface soil also varies from loam or gravelly loam to fine sandy loam in texture and from slightly acid to slightly alkaline in reaction.

*Use and management.*—Approximately three-fifths of Wassaic gravelly loam, hilly phase, is forested. The old forest includes mostly second-growth red, white, yellow, and black oaks, hard maple, shag-bark and pignut hickories, ash, black locust, beech, birch, white pine, and redcedar.

The soil is poorly suited to cultivation because it is irregular in relief and shallow. Crop yields are generally low, and the cropland erodes easily.

The well-managed pastures are usually good. They contain abundant Canada and Kentucky bluegrasses, redtop, and wild white clover. The sod is usually heavy on all except the shallowest areas lying adjacent to rock outcrops. The poorer pastures contain many weeds such as plantain, wild carrot, goldenrod, and devils-paint brush, as well as brush and redcedar. These poorer pastures could be greatly improved by removing brush and top dressing with superphosphate. If fertility is kept up and desirable grasses are present in sufficient quantity, reseeding is not necessary in most pastures. Under such conditions the good pasture grasses will crowd out the weeds. Erosion is active in the poorer pastures and idle areas.

**Wassaic gravelly loam, ledgy rolling phase (5-15% slopes) (W<sub>C</sub>).**—Outcrops and loose stones and boulders are usually so numerous on this shallow soil that cultivation is impossible. The soil has developed from the shallow glacial till in which the principal rock constituent is limestone. Relief is irregular. The profile between outcrops is similar to that of Wassaic gravelly loam, rolling phase. The subsoil is usually neutral in reaction.

*Use and management.*—Pastures on this soil are generally neglected and contain many undesirable weeds and brush. Neither manure nor phosphate is commonly applied, although most pastures would greatly benefit if they were. All pastures contain fair percentages of Canada and Kentucky bluegrass, redtop, and wild white clover. Erosion is active in the poorer pastures. All of the pastures produce little during dry periods but recuperate quickly after rains. They are frequently overgrazed during critical dry periods and undergrazed during spring and fall when the growth is best.

The forested areas have a growth of red, white, and black oaks, ash, black locust, hard maple, redcedar, hickory, black and yellow birches,

beech, and white pine. Probably 60 percent of the forest area is in farm wood lots that have been cut over several times; the rest is mostly young forest growing on abandoned areas.

**Wassaic gravelly loam, ledgy hilly phase** (15–30% slopes) (W<sub>B</sub>).—Steeper slopes differentiate this phase from the ledgy rolling phase. Outcrops of the underlying limestone bedrock are very numerous; the soil between outcrops is generally less than 24 inches thick.

*Use and management.*—This soil has a high content of lime; consequently, bluegrass and wild white clover are usually present in pastures but do not dominate unless phosphorus is applied. If fertilized, pasture is productive in spring and late fall but produces little during midsummer when moisture is limited. If better soils are available for pasture, this phase should be used for forest.

**Wayland silt loam** (0–2% slopes) (W<sub>E</sub>).—This poorly drained soil occurs on flood plains where the soil materials are alkaline. It is flooded periodically, and the receding waters leave sand, silt, and clay derived mainly from calcareous till. The soil lies along streams flowing from or in regions where upland soils have developed chiefly from high-lime glacial till. Relief is level or nearly level, so both surface and internal drainage are slow. The few small areas that are tilled or ditched occur between areas of better drained soils.

The surface soil in pastures is about 7 inches of dark grayish-brown granular friable slightly acid silt loam. Extending from 7 to 13 inches is a layer of brownish-gray silt loam mottled with rust brown, gray, and yellow. This layer is friable and slightly acid; it breaks into small soft subangular fragments. The subsoil continuing from 13 down to 31 inches is firm silt loam strongly mottled with gray, yellow, and rust brown. It is slightly alkaline. From 31 down to 44 inches the subsoil is light-gray silty clay, strongly mottled with rust brown and yellow. It is massive, plastic, and alkaline. Below 44 inches lies stratified gravel and sand.

Roots are most abundant in the upper 13 inches of the subsoil, but a few occur farther down. The soil varies chiefly in reaction of surface soil and upper subsoil. In the Harlem Valley the surface soil is usually neutral, but occasionally weakly alkaline. In all areas the subsoil is alkaline. The surface soil in a few areas is light silt loam, especially where it is closely associated with better drained soils of the fine sandy loam texture. In all areas Wayland silt loam is poorly drained and mottled to within 7 to 9 inches of the surface. A small acreage of permanently wet soil having an almost black highly organic surface soil is included.

*Use and management.*—Wayland silt loam, where properly managed, supports a good to excellent cover consisting of Kentucky bluegrass and some timothy and redtop. The pastures vary but most of them are fair to good. Nearly all of them contain some sedges and reeds, buttercup, plantain, dandelion, thistle, and other weeds. A few very poor pastures support mostly willow, alder, and weeds.

The cultivated areas are used principally for hay. Timothy, or timothy mixed with alsike and redtop, is the important hay crop. The soil is poorly suited to red clover and alfalfa. Corn and oats are sometimes grown with indifferent success. In unusually wet seasons crop yields are poor. Areas give best yields when protected from

overflow and drained. No regular rotations are followed. Hay seedings, once established, are usually maintained for an indefinite period, or until yields are low. Old meadows are usually pastured for a number of years before plowing and reseeding.

The natural forest cover includes red maple, elm, white and black ash, willow, alder, sycamore, hard maple, birch, and cherry.

**Whitman stony silt loam** (0-3% slopes) (Wf).—This very poorly drained soil of the uplands occurs in the region influenced by crystalline rocks. It has developed from deep glacial till, which is composed mainly of gneiss or granite mixed with some slate, schist, and quartzite. The till is similar to that giving rise to the well-drained Charlton and Gloucester soils.

This Whitman soil occurs on flats and in depressions. Water stands on it much of the year unless artificial drainage is provided. Most areas have a characteristic dark organic surface and are naturally stony. Large stones and boulders have been removed from a considerable acreage used for hay. Areas that still have many large stones and boulders on the surface are indicated on the soil map by boulder symbol. The largest areas are near Chestnut Ridge and Quaker Hill.

The 7-inch surface soil is very dark-brown or almost black silt loam stained with rust brown and gray. From 6 to 15 inches the subsoil is gray gritty silt loam strongly mottled with yellow, brown, and rust brown and slightly plastic. Below 15 inches and downward to 30 inches the subsoil is compact grayish olive-brown gravelly silt loam, strongly mottled with yellow and rust brown. Mottling decreases with depth. The substratum, beginning below 30 inches, is very compact faintly olive-gray gravelly loam stained with yellow and gray.

The soil is strongly acid throughout. Surface and internal drainage are poor. Few roots penetrate the compact subsoil beginning at a depth of 15 inches.

*Use and management.*—The cultivated areas of this soil are used principally for timothy and redtop hay. Oats and buckwheat are sometimes grown but they fail in very wet seasons. The areas used for crops have been cleared of stone.

Besides coarse water-loving grasses, pastures contain rushes, sedges, and many weeds. Pastures are generally poor, and alders, willow, and other brush are encroaching on many of them. Forested areas are pastured. The principal trees are elm, white oak, ash, hemlock, spruce, and willow.

If adequate drainage were provided, this soil would be well suited to Ladino clover. It would need heavy applications of lime and phosphorus, but experience in other areas indicates that the Whitman soils, when drained and fertilized, produce more hay and better pasture throughout the season than the associated well-drained soils that are usually less well supplied with plant nutrients.

**Woodbridge silt loam** (0-5% slopes) (SN).—This moderately well to imperfectly drained soil is one of the better ones in the Charlton soil areas (fig. 3). It has developed from moderately deep or deep deposits of glacial till, the principal rock constituents of which are schist and gneiss, with some slate, granite, and quartzite. The soil occurs in small areas (2 to 10 acres, sometimes 10 to 90) on slight

slopes and nearly level places. Both surface and internal drainage are moderately slow.

This soil is closely associated with members of the Charlton, Paxton, and Hollis series in the regions occupied by schist soils, and with the Chatfield and Gloucester soils in the regions occupied by gneissic and granitic soils.

The surface soil in meadows is dark-brown finely granular silt loam—mellow, friable, and strongly acid, and about 10 inches thick. The subsoil extending from a depth of 10 inches down to 17 inches is light-brown friable silt loam. From 17 down to 23 inches is firm but friable light-brown silt loam, slightly mottled with yellow and rust brown. Below 23 inches lies the compact grayish-brown subsoil, which is strongly mottled with yellow, rust brown, and gray. The substratum starts below 28 inches; it is very compact heavy silt loam.

Many schist fragments and pieces of gneiss and granite occur throughout the soil. Roots penetrate all layers above the compact subsoil; few occur in the compact strongly mottled part of the subsoil. The soil is strongly acid in all parts.

This soil varies chiefly in the number of gneiss or schist fragments in the profile and in the depth of the mottling. On nearly level areas the subsoil is frequently more highly mottled and is stained yellow and rust brown in the upper part. A few areas are stony enough to interfere with cultivation and are indicated on the map by stone symbol.

*Use and management.*—The smaller areas of this soil are generally worked with the associated soils. Larger cultivated areas are in corn, oats, and hay. The rotations vary greatly in length. Corn is generally grown 1 or 2 years, and followed by 1 year of oats, with which the hay is seeded. Hay crops are kept for long periods, or until the yields fail and native grasses and weeds predominate. When the ground has been prepared too late for seeding oats, buckwheat is sometimes grown in the rotation after corn.

From 8 to 10 tons of manure supplemented with superphosphate is applied for corn. From 1 to 1½ tons of lime and 150 to 200 pounds of superphosphate are applied for the oats-and-hay seeding. After the second or third season, meadows are sometimes top-dressed with manure.

This soil has better moisture conditions in midsummer than the well-drained soils with which it is associated. It is also less deficient in plant nutrients. In areas outside this county, it has proved itself well suited to Ladino clover-grass mixtures to be used for either hay or pasture.

Pastures vary from poor to fair or good. They contain mostly bentgrass. Some Kentucky bluegrass and wild white clover grow in the better ones. Pastures treated with lime and superphosphate have the best sod and contain the bluegrass and wild white clover. Plantain, sheep sorrel, creeping cinquefoil, wild carrot, buttercup, and goldenrod occur to some extent in nearly all pastures. The poorest pastures consist of brush and briars and very low percentages of desirable grasses.

The forests occur mostly on the stony areas that have never been cleared. The stands consist mainly of second-growth hemlock, soft maple, elm, ash, willow, and hickory.

## SOIL USE, MANAGEMENT, AND PRODUCTIVITY

By Marlin G. Cline, professor of soil science, Cornell University

This section shows the differences and similarities in suitability for use, needs for management, and productivity among soils of the county. The first part deals with the general quality of the soils, their suitability for use, and their management needs. The second part gives estimated average yields under such use and management. Those interested in only a few soils are referred to the section on The Soils of Dutchess County.

### SOIL QUALITY AND MANAGEMENT

In table 7 the soils of the county are grouped into six broad classes according to their relative suitability for crops, pasture, and forest. Group 1 includes the best soils of the county; group 5 the poorest for general agricultural use; and group 6 those unsuited to any agricultural use. In placing the soils in these six groups, the general productivity of each for the crops most commonly grown, the difficulty and cost of management practices required to obtain and maintain good production, and the ease of performing tillage were considered.

The first three groups are generally suited to crops, the fourth is poor for crops but at least fair for pasture, the fifth is poor for both crops and pasture but can be used for forest, and the sixth is unsuited to crops, pasture, or forest. This grouping can be used to evaluate the relative quality of each soil in the county. It can also be used as a basis for making maps of the entire county, or of smaller areas, to show where the good, fair, or poor soils are located and how they are associated. Uncolored soil maps can be obtained for the county, or tracings can be made, and each soil area can then be colored one of six different colors, each representing one of the six different groups of soils. Such maps are especially useful to men interested in general land values, the relation of land values to soil quality, and the general suitability of soils for crops, pasture, and forest.

For farmers, extension workers, and others interested in suitability of soils for specific crops, each soil is classified as good, fair, poor, or very poor for silage corn, oats, alfalfa, Ladino clover, and apples. Maps showing where soils of different suitability for each of these crops are located can be prepared from table 7 by first selecting a different color for each class of soils for a given crop and then coloring individual soil areas. Such maps are useful for guiding extension programs in local areas, for teaching, and for farm or community planning. Similar groupings and maps can be prepared for other crops.

Each of the first five groups designating agricultural suitability contains soils that need greatly different kinds of management and that are suited to different kinds of crops. Each group was subdivided, therefore, into subgroups within which the soils are relatively similar and need similar general kinds of management. Management groups 1A and 1B, for example, both consist of very good soils but those in 1A need different management than those in 1B. There are 17 such subgroups of soils suited to crops, 5 better suited to pasture, and 3 better suited to forest. Land types of group 6 have not been subdivided.

The general management needed for establishing and maintaining a high level of productivity are indicated for each soil in table 7.

General rotations suited to each group are given. The first rotation in the list is, in general, the most intensive rotation of general farm crops that should be used for soils of each management group. The rotations suggested are, in decreasing order of intensity and soil-depleting effects:

- Row crops continuously.
- Row crops 2 years, small grain, hay.
- Row crops, small grain, hay.
- Row crops 2 years, small grain, hay 2 or 3 years.
- Row crops, small grain, hay 2 or 3 years.
- Row crops, small grain 2 years, hay 2 or 3 years.
- Row crops, small grain, hay 4 years or more.
- Small grain, hay 1 year or more.
- Small grain, hay 2 years or more.
- Small grain, hay 4 years or more.

Row crops generally cause greater destruction of organic matter and expose the soil more to washing than do small grains or hay. Hay adds more organic matter and protects the soil more than small grains. The best choice of specific crops for the rotation depends upon needs of the farm as a unit as well as upon the needs of the soil. Several alternative crops commonly may be suited to the same place in a rotation, each having its own advantages and disadvantages. If the preceding crop can be harvested early enough to permit seeding before September 15, winter wheat usually produces more feed an acre under similar management than oats. Wheat can be used equally well as a companion crop for hay seedings. Hay seedings also can be made with, or after, such early harvested crops as peas. By doing this, small grain is eliminated from the rotation. On some farms new hay seedings may be made successfully in crops of oats or Sudan grass used for supplemental pasture, but the seeding should be made by June 1, and Sudan grass should be grazed when 12 or 15 inches tall for good results.

The best choice of legume for meadows depends on how the meadow is to be used, the soil, and the management to be practiced. On soils to which it is adapted, alfalfa generally produces more hay than other legumes. If a seeding is to be left down for only 1 year, however, red clover may be more economical than alfalfa. If the seeding is to be used for pasture, Ladino clover should be considered. For soils that are imperfectly or poorly drained, Ladino clover is the best long-lived legume for medium-length stands of pasture. Birdsfoot trefoil is better adapted to droughty soils of low fertility that are to be kept in sod for long periods. The trefoil usually establishes itself slowly; it should not be used in short rotations, but on poor soils it is more persistent than alfalfa or Ladino clover for long-term hay.

Indicated in table 7 are the amounts of lime, nitrogen, phosphorus, and potash the soils usually need for rotations of general farm crops, such a rotation of corn, small grain, and hay. These requirements, termed as "low," "medium," and "high," apply to the rotations commonly used on dairy farms and are based on limited information. Vegetables should be fertilized more heavily in accordance with vegetable-crop fertilizer recommendations. As more information becomes available, the needs of some soils may be found to be greater.



GROUP 2.—FAIR TO GOOD SOILS FOR CROPS; GOOD TO EXCELLENT SOILS FOR PASTURE OR FOREST

2A. Neutral to strongly acid moderately well to imperfectly drained soils of first bottoms:	{ R continuously... R-R-G-H 1 year or more. R-G-H 1 year or more.	Eel and Lobdell silt loams, undifferentiated.	Low	Low	Medium	Low	Low	Fair	Poor	Poor	Good	Very poor.	
		Pawlet silt loam	High	Medium	do	Medium	do	do	do	do	do	do	Do.
2B. Neutral to slightly acid well-drained moderately deep to deep rolling and sloping soils of uplands:	{ R-R-G-H 2 years or more. R-G-G-H 2 years or more. G-H 2 years or more.	Pittsfield gravelly loam, sloping phase.	Low	do	do	do	Medium	do	Good	Good	do	Good.	
		Pittsfield-Wassaic gravelly loams, undulating and rolling phases.	do	do	do	do	do	do	do	do	do	do	Fair.
		Dover fine sandy loam, rolling phase.	do	do	do	do	do	do	Fair	do	do	do	Do.
2C. Medium to strongly acid well-drained moderately deep to deep rolling and sloping soils of uplands and terraces:	{ R-R-G-H 2 years or more. R-G-G-H 2 years or more. G-H 2 years or more.	Copake gravelly loam, rolling phase.	Medium	do	do	do	do	do	do	do	Fair	Good.	
		Hudson fine sandy loam, gently sloping phase.	do	do	do	do	do	do	do	do	do	Good	Do.
		Stockbridge gravelly loam, gently sloping and sloping phases.	do	do	do	do	do	do	do	Good	do	do	Do.
		Troy gravelly loam, sloping phase.	do	do	do	do	do	do	do	do	do	do	Do.
		Cossayuna gravelly loam, undulating and rolling phases.	do	do	do	do	do	do	do	do	do	do	Do.
		Cossayuna fine sandy loam, undulating and rolling phases.	do	do	do	do	do	do	do	Fair	do	do	Do.
		Albia gravelly silt loam, sloping phase.	do	do	do	do	do	do	do	do	Fair	do	Poor.
		Colonie fine sandy loam, rolling phase.	High	do	do	High	do	do	do	do	do	Fair	Good.
		Hoosic gravelly loam, rolling phase.	do	do	do	do	do	do	do	do	Good	do	Do.
		Bernardston gravelly silt loam, sloping phase.	do	do	do	do	do	do	do	Good	do	Good	Do.
Dutchess gravelly silt loam, undulating and rolling phases.	do	do	do	do	do	do	do	do	Fair	do	Do.		

See footnotes at end of table.

TABLE 7.—Quality, management needs, and suitability of selected crops for the soils of Dutchess County, N. Y.—Continued

## GROUP 2.—FAIR TO GOOD SOILS FOR CROPS; GOOD TO EXCELLENT SOILS FOR PASTURE OR FOREST—Continued

Management group and soil	Rotations <sup>1</sup>	Lime re- quirement <sup>2</sup>	Nitrogen require- ment <sup>3</sup>	Phosphorus require- ment <sup>4</sup>	Potassium require- ment <sup>5</sup>	Erodibil- ity <sup>6</sup>	Suitability <sup>7</sup> for—				
							Silage corn	Oats	Alfalfa	Ladino clover	Apples
<b>2D. Very strongly acid well- drained moderately deep to deep rolling and sloping soils of uplands:</b>											
Paxton gravelly loam, gently sloping and sloping phases.	R-G-H 2 years or more. R-G-G-H 2 years or more. G-H 2 years or more.	High	Medium	Medium	High	Medium	Fair	Fair	Poor	Fair	Poor.
Charlton gravelly loam, un- dulating and sloping phases.		do	High	do	do	do	do	do	do	do	Do.
Gloucester gravelly loam, rolling phase.		do	do	do	do	do	Low	do	do	do	do
<b>2E. Neutral to strongly acid, moderately well to imperfectly drained level to sloping soils of uplands and terraces:</b>											
Amenia silt loam	R-R-G-H 2 years or more.	Low	Medium	do	Medium	do	do	do	Fair	Good	Do.
Albia gravelly silt loam, gently sloping phase.		Medium	do	do	do	do	do	do	do	do	Do.
Claverack gravelly loam	R-G-H 2 years or more.	do	do	do	do	do	do	do	do	do	Do.
Elmwood fine sandy loam		High	do	do	High	do	do	do	do	do	Do.
Braceville, Hero, and Phelps silt loams, undifferentiated.	G-H 2 years or more.	do	do	do	do	do	do	do	do	do	Do.
Pittstown gravelly silt loam, nearly level and gently sloping phases.		do	do	do	do	do	do	do	do	do	Do.
Woodbridge silt loam		do	do	do	do	do	do	do	Poor	do	Do.
<b>2F. Heavy-textured well-drained medium acid level to gently sloping soils:</b>											
Hudson silt loam, gently sloping phase.	R-G-H 2 years or more. R-G-G-H 2 years or more.	Medium	do	do	Low	Medium	do	Good	Good	do	Fair.
Hudson silty clay loam, gently sloping phase.		G-H 2 years or more.	do	do	do	do	do	do	Fair	do	do



TABLE 7.—*Quality, management needs, and suitability of selected crops for the soils of Dutchess County, N. Y.—Continued*  
 GROUP 3.—POOR TO FAIR SOILS FOR CROPS; POOR TO GOOD SOILS FOR PASTURE; FAIR TO GOOD SOILS FOR FOREST—Continued

Management group and soil	Rotations <sup>1</sup>	Lime re- quirement <sup>2</sup>	Nitrogen re- quirement <sup>3</sup>	Phosphorus re- quirement <sup>4</sup>	Potassium re- quirement <sup>5</sup>	Erodibil- ity <sup>6</sup>	Suitability <sup>7</sup> for—				
							Silage corn	Oats	Alfalfa	Ladino clover	Apples
<b>3C. Medium to strongly acid well-drained deep to moderately deep moderately to strongly eroded hilly soils of uplands:</b>											
Stockbridge gravelly loam, eroded moderately steep phase.	G-H 4 years or more.	Medium...	High.....	Medium...	Medium...	Very high	Poor.....	Fair.....	Fair.....	Fair.....	Good.
Troy gravelly loam, eroded moderately steep phase.		do.....	do.....	do.....	do.....	do.....	do.....	do.....	do.....	do.....	Do.
Cossayuna gravelly loam, eroded hilly phase.		do.....	do.....	do.....	do.....	do.....	do.....	do.....	do.....	do.....	Do.
Bernardston gravelly silt loam, eroded moderately steep phase.		High.....	do.....	do.....	High.....	do.....	do.....	do.....	do.....	do.....	Do.
Dutchess gravelly silt loam, eroded hilly phase.		do.....	do.....	do.....	do.....	do.....	do.....	do.....	do.....	do.....	Do.
Nassau-Cossayuna gravelly loams, eroded hilly phases.		do.....	do.....	do.....	do.....	do.....	do.....	do.....	do.....	do.....	Fair.
<b>3D. Very strongly acid well-drained deep to moderately deep hilly soils of uplands:</b>											
Paxton gravelly loam, moderately steep phase.	R-G-H 4 years or more.	do.....	Medium...	do.....	do.....	High.....	do.....	do.....	Poor.....	do.....	Poor.
Charlton gravelly loam, moderately steep phase.	G-H 4 years or more.	do.....	High.....	do.....	do.....	do.....	do.....	do.....	do.....	Poor.....	Do.
Gloucester gravelly loam, hilly phase.	G-H 4 years or more.	do.....	do.....	do.....	do.....	Medium...	do.....	do.....	do.....	do.....	Do.

<b>3E. Eroded moderately deep and uneroded shallow rolling and sloping soils of uplands:</b> Cossayuna gravelly loam, eroded undulating and rolling phases. Dutchess gravelly silt loam, eroded undulating and rolling phases. Wassaic gravelly loam, rolling phase. Nassau-Cossayuna gravelly loams: Undulating and rolling phases. Eroded undulating and rolling phases. Hollis channery loam, rolling phase.	R-G-H 4 years or more. G-H 4 years or more.	Medium	do	do	Medium	High	Fair	do	Good	Fair	Fair.	
		High	do	do	High	do	do	do	Fair	do	Do.	
		Low	Medium	do	Medium	do	do	do	do	do	Do.	
		High	do	do	High	do	do	do	do	do	Do.	
		do	High	do	do	do	do	do	do	do	Do.	
<b>3F. Droughty strongly to very strongly acid nearly level soils of terraces:</b> Hoosic gravelly sandy loam, nearly level and undulating phases. Merrimac gravelly fine sandy loam, nearly level and undulating phases.	R-Green manure-winter clover. R-G-H 1 year or more.	do	do	do	do	Low	Poor	do	Fair	do	Good.	
		do	do	do	do	do	do	do	do	do	do	Do.
		do	do	do	do	do	do	do	do	do	do	Do.
<b>3G. Heavy-textured well-drained rolling and hilly soils:</b> Hudson silt loam, rolling phase. Hudson silty clay loam: Eroded rolling phase. Hilly phase. Hudson silt loam, hilly phase.	G-H 4 years or more.	Medium	Medium	do	Low	High	do	Fair	Good	Fair	Fair.	
		do	High	do	do	Very high	do	do	do	do	do	Poor.
		do	Medium	do	do	do	do	do	do	do	do	Do.
		do	do	do	do	do	do	do	do	do	do	Do.
<b>3H. Poorly drained soils:</b> Kendaia silt loam. Boynton gravelly silt loam. Stissing gravelly silt loam. Red Hook silt loam. Housatonic silt loam. Madalin silt loam. Madalin silty clay loam.	Hay for as long as good stand persists.	Low	Low	do	do	Low	do	Poor	Very poor	do	Very poor.	
		Medium	do	do	Medium	do	do	do	do	do	do	Do.
		High	do	do	do	do	do	do	do	do	do	Do.
		do	do	do	do	do	do	do	do	do	do	Do.
		do	do	do	do	do	do	do	do	do	do	Do.
		Medium	do	do	Low	do	do	do	do	do	do	Do.
do	do	do	do	do	do	do	do	do	do	Do.		

See footnotes at end of table.

TABLE 7.—Quality, management needs, and suitability of selected crops for the soils of Dutchess County, N. Y.—Continued

GROUP 4.—VERY POOR SOILS FOR CROPS; FAIR TO GOOD SOILS FOR PASTURE; FAIR TO GOOD SOILS FOR FOREST

Management group and soil	Rotations <sup>1</sup>	Lime re- quirement <sup>2</sup>	Nitrogen require- ment <sup>3</sup>	Phosphorus require- ment <sup>4</sup>	Potassium require- ment <sup>5</sup>	Erodibil- ity <sup>6</sup>	Suitability <sup>7</sup> for—						
							Silage corn	Oats	Alfalfa	Ladino clover	Apples		
<b>4A. Stony but deep soils with moderate to strong slopes:</b>													
Pittsfield-Wassaic gravelly loams:	If cleared of stones, same as group—												
Stony and ledgy rolling phases.	2B	Low	Medium	Medium	Medium	Medium	Generally too stony for cultivation but potential cropland if loose stones are removed. Management for crops or pasture should be similar to that for the soils of the group indicated in the column headed rotations.						
Stony and ledgy hilly phases.	3A	do	do	do	do	High							
Stockbridge stony loam, sloping phase.	2C	Medium	do	do	do	Medium							
Cossayuna stony silt loam: Rolling phase.	2C	do	do	do	do	do							
Hilly phase.	3B	do	do	do	do	High							
Charlton stony loam, moderately steep phase.	3D	High	High	do	High	do							
Gloucester stony loam: Rolling phase.	2D	do	do	do	do	Medium							
Hilly phase.	3D	do	do	do	do	do							
<b>4B. Steep nonstony soils with fair water-holding capacity:</b>													
Palmyra gravelly loam, steep phase.	None	Low	Medium	do	Medium	High		If used for crops, should be kept in sod as much as possible.					
Copake gravelly loam, steep phase.		Medium	do	do	do	do							
Hudson silty clay loam, steep phase.		do	do	do	do	Low	Very high						
Troy gravelly loam, steep phase.		do	do	do	do	Medium	do						
Hoosic gravelly loam, steep phase.		High	do	do	do	High	High						
Charlton gravelly loam, steep phase.		do	High	do	do	do	Very high						

**4C. Shallow soils with occasional outcrops:**

- Wassaic gravelly loam, hilly phase.
- Nassau slaty silt loam: Eroded undulating and rolling phases.
- Undulating and rolling phases.
- Hollis channery loam: Eroded rolling phase.
- Eroded hilly phase.

None

Low	Medium	do	Medium	High
High	High	do	High	do
do	do	do	do	do
do	do	do	do	do
do	do	do	do	Very high

Shallow droughty soils of low productivity; if used for crops should be managed like soils of group 3E.

**4D. Very shallow soils with numerous outcrops:**

- Wassaic gravelly loam: Ledgy rolling phase.
- Ledgy hilly phase.
- Dover fine sandy loam: Ledgy rolling phase.
- Ledgy hilly phase.
- Staatsburg gravelly loam, ledgy undulating and rolling phases.
- Nassau slaty silt loam, ledgy undulating and rolling phases.

None

Low	Medium	do	Medium	High
do	do	do	do	Very high
do	do	do	do	High
do	do	do	do	Very high
Medium	do	do	do	High
High	High	do	High	do

Generally frequent outcrops prohibit cultivation; very shallow and droughty; pasture production low after July 1.

**4E. Very poorly drained soils:**

- Lyons silt loam.
- Wayland silt loam.
- Livingston silty clay loam.
- Atherton silt loam.
- Mansfield silt loam.
- Saco silty clay loam.
- Alluvial soils, undifferentiated.
- Whitman stony silt loam.

None

Low	Low	do	Low	Low
do	do	do	do	do
do	do	do	do	do
High	do	do	Medium	do
Medium	do	do	do	do
High	do	do	do	do
Medium	Medium	do	do	do
High	Low	do	do	do

Water stands on these soils much of the year unless drainage is provided; well suited to Ladino clover if adequately drained; usually more fertile than associated better drained soils.

See footnotes at end of table.

TABLE 7.—*Quality, management needs, and suitability of selected crops for the soils of Dutchess County, N. Y.—Continued*

## GROUP 5.—VERY POOR SOILS FOR CROPS OR PASTURE; POOR TO GOOD SOILS FOR FOREST

Management group and soil	Rotations <sup>1</sup>	Lime re- quirement <sup>2</sup>	Nitrogen re- quirement <sup>3</sup>	Phosphorus re- quirement <sup>4</sup>	Potassium re- quirement <sup>5</sup>	Erodibil- ity <sup>6</sup>	Suitability <sup>7</sup> for—					
							Silage corn	Oats	Alfalfa	Ladino clover	Apples	
<b>5A. Deep steep soils of low fertility:</b>	None-----	High-----	High-----	Medium---	High-----	Very high.	} Very droughty soils, steep and low in fertility.					
Colonie fine sandy loam, hilly and steep phases.		do-----	do-----	do-----	do-----	Medium---						
Merrimac gravelly sandy loam, hilly phase.		do-----	do-----	do-----	do-----	High-----						
Gloucester gravelly loam, steep phase. Gloucester stony loam, steep phase.		do-----	do-----	do-----	do-----	do-----						
<b>5B. Very shallow soils with numerous outcrops:</b>	None-----	Low-----	Medium---	do-----	Medium---	Very high.	} Pastures produce very poorly; forest generally a better use.					
Dover fine sandy loam, ledgy steep phase.		Medium---	do-----	do-----	do-----	do-----						
Staatsburg gravelly loam: Very ledgy hilly phase.		do-----	do-----	do-----	do-----	High-----						
Very ledgy rolling phase.		do-----	do-----	do-----	do-----	Very high.						
Steep ledgy land (Wassaic and Staatsburg soil materials).		Very high.	High-----	do-----	High-----	do-----						
Nassau slaty silt loam, ledgy hilly phase.		do-----	do-----	do-----	do-----	do-----						
Steep ledgy land (Nassau soil material).		do-----	do-----	do-----	do-----	do-----						
Hollis channery loam, ledgy hilly phase.		do-----	do-----	do-----	do-----	do-----						
Chatfield stony loam: Ledgy rolling phase.		do-----	do-----	do-----	do-----	High-----						
Ledgy hilly phase.		do-----	do-----	do-----	do-----	Very high.						
Rough stony land (Gloucester, Hollis, and Chatfield soil materials).	do-----	do-----	do-----	do-----	do-----							
<b>5C. Organic soils:</b>	None-----	Low-----	Medium---	do-----	do-----	Low-----	} Potentially good to excellent for vegetables and potatoes if drained.					
Carlisle muck-----		High-----	do-----	do-----	do-----	do-----						
Muck: Acid deep phase----- Acid shallow phase-----		do-----	do-----	do-----	do-----	do-----						

GROUP 6.—LAND TYPES UNSUITED TO CROPS, PASTURE, OR FOREST

Made land							} Usually unsuited to any agricultural or forest use.
Tidal marsh, fresh-water phase							
Urban land, undifferentiated							

<sup>1</sup> R=row or intertilled crops; G=small grains; H=Hay or rotation pasture. Rotations listed under each soil management group apply to all soils of that group.

<sup>2</sup> Lime requirement: Low=none; medium=½ to 1 ton of ground limestone every 4 or 5 years; high=1 to 2 tons of ground limestone every 4 or 5 years for the rotations used on a general farm after correction of acidity.

<sup>3</sup> Nitrogen requirement is given in relative descriptive terms and indicates lack of adequate reserves in organic matter.

<sup>4</sup> Phosphorus requirement: A general need of the equivalent of 150 pounds of 20-percent phosphate an acre a year for the rotations used on general and dairy farms is indicated. No attempt has been made to indicate deviations from this general need, because experimental evidence is lacking. Analyses show that total phosphorus is low in the Dutchess and associated soils (6).

<sup>5</sup> Potassium requirement: Low=0 to 25 pounds of potash (K<sub>2</sub>O) in manure or commercial fertilizer an acre a year; medium=25 to 50; high=50 to 100, for leguminous hay crops. About 25 pounds of potash are contained in 2½ to 4 tons of manure, 50 pounds of muriate of potash, or 500 pounds of 5-10-5 fertilizer.

<sup>6</sup> Erodibility in general descriptive terms, see p. 148.

<sup>7</sup> Relative suitability of the soil for the crop when good management is practiced. "Good" indicates that high yields may be expected under moderately intensive management; "fair" that only fair yields may be expected or that intensive management practices are required; "poor" that the crop may be grown but is subject to occasional failure or to low yields or that very intensive management is required; and "very poor" that the crop cannot or should not be grown under ordinary conditions. All soils of groups 4 and 5 are very poor for the crops listed; group 6 is unsuitable for agricultural or forest use.

Fertilizer needs indicated are for maintenance; soils seriously depleted by heavy cropping or erosion will need larger applications for reestablishment of fertility.

In table 7 the relative susceptibility of each soil to erosion is indicated in general terms. Erodibility is influenced by the rotation used. "Low" erodibility usually indicates that no special engineering measures are needed to control sheet erosion for any of the rotations listed. "Medium" erodibility indicates a need for contour strip cropping—with or without diversion terraces at regular intervals, depending on the length and steepness of slopes—for the most intensive rotation listed. Less intensive cropping practices require correspondingly less intensive control measures. "High" erodibility indicates a consistent need for (1) regularly spaced diversion terraces and contour cropping in narrow strips for the most intensive rotation that includes row crops, or (2) maintenance in long-term sod-forming crops. "Very high" erodibility indicates a need for as nearly continuous maintenance in sod-forming or forest crops as possible.

Use of barnyard manure has not been indicated in table 7, but its importance cannot be overemphasized (5). Almost all crops grown in the county respond to manure, and it is especially valuable for vegetable crops, corn, and grass meadows. Greatest returns are obtained on most farms by applying 6 to 10 tons an acre. It is more profitable to spread an application of 6 to 10 tons an acre over a large acreage than it is to make heavier applications to a smaller acreage. Effects of manure last for several years. On most dairy farms it is possible to build up and maintain a high state of fertility largely by the use of leguminous crops and manure, which are supplemented with lime and phosphorus fertilizer. Each ton of manure applied during the rotation will decrease by 7 to 10 pounds the amount of both nitrogen and potash fertilizer needed for the entire rotation.

Native pasture on all soils of the county need phosphorus at approximately the rates indicated in table 7. Pasture needs lime in quantities comparable to but generally slightly lower than the quantities required by cropland (4, 6). Except on the soils with good moisture relations, pastures improved by fertilization yield little good feed for dairy cows during mid-summer. About 1 acre of unplowed permanent pasture should be improved (6) for each livestock unit on the farm so as to provide good quality feed during the flush spring pasture season.

On dairy farms it is generally a good practice to put plowable permanent pasture into a long rotation consisting mainly of meadow, to fertilize and lime according to soil and crop needs, and to use more of the hayland on the farm for summer pasture after a first cutting of hay. The increased acreage of hay thus provided will, on many farms, yield enough hay at the first cutting to supply the needs for winter. A stand consisting of an adapted legume mixed with grass is more productive of hay and pasture than a pure stand of the legume.

#### GROUP 1.—GOOD TO EXCELLENT SOILS FOR CROPS, PASTURE, OR FOREST

The soils of management group 1 are the best in the county for general farming, though they differ in suitability for individual crops. All are deep, well-drained, and at least moderately fertile. They have mild slopes and are adapted to all types of machinery. None is seri-

ously susceptible to erosion. All are easily kept in good tilth, and none is excessively droughty. They are suited to intensive use for a wide variety of crops and with few special management practices produce good yields of adapted crops under moderate fertilization.

## GROUP 1A

The soils of management group 1A (see table 7) are nearly level. They occur along the larger streams and are among the most fertile in the county. They are commonly flooded in spring, but floodwaters recede first from them. Their drainage is good during the cropping season. New sediments deposited during floods keep them at a high state of fertility. They are easy to work and to keep in good tilth.

These soils can be used very intensively and are especially well suited to corn, vegetables, and alfalfa or Ladino clover sown with grass in hay mixtures. The high fertility often causes lodging of small grains, and rust is more common than on poorer soils. Occasionally prolonged flooding makes the planting of orchards hazardous. Vegetable crops respond markedly to heavy applications of complete fertilizer. Alfalfa is generally the most productive legume for hay mixtures, but Ladino clover may be preferred if the aftermath is to be used intensively for pasture.

Few special practices are required. Such winter cover crops as rye should be sown after row crops to prevent scouring during floods. In places special practices are also needed to prevent stream-bank gouging. In general, dairy farmers can afford to concentrate inter-tilled crops on these soils and manure and fertilize them intensively. By so doing, the more sloping and erodible soils can be left in hay for longer periods.

## GROUP 1B

In management group 1B are the best soils of the terraces and uplands (see table 7). They are nearly level to gently sloping and are above the level of spring floods. All are well drained without being droughty. They are well suited to a wide variety of crops, including small grains, corn, alfalfa, clover, most vegetables, and fruits. The soils with fine sandy loam and loam textures are especially well suited to early vegetables for market. Gentle slopes make this group easy to work, suitable for use of heavy farm machinery, and not seriously susceptible to erosion. Although they are among the more fertile soils of the county, their good physical condition makes them highly responsive to fertilization and good management.

All of the rotations listed in table 7 are well suited to these soils. Except for high lime and potash requirements on Hoosic and Colonie soils, the fertilizer needs are moderate for ordinary rotations. Vegetable crops respond greatly to heavy fertilization. Alfalfa is generally the most productive legume for hay mixtures, though both Ladino and red clovers produce well. Manuring and the use of sod-forming crops are needed to maintain supplies of organic matter and nitrogen, which decrease rapidly under intensive cultivation. Special practices such as strip cropping and terracing are not needed. It is good farm management to use these soils for the more intensive rotations listed in table 7, and to leave the less responsive and more erodible

soils in hay or pasture for longer periods than would be possible otherwise.

**GROUP 2.—FAIR TO GOOD SOILS FOR CROPS; GOOD TO EXCELLENT SOILS FOR PASTURE OR FOREST**

The soils of management group 2 are among the better ones in the county, but some features such as slope, moderately low fertility, imperfect drainage, or heavy texture make each one inferior to soils of group 1. All are potential cropland, and some produce yields of certain crops as high as those obtained on soils of group 1. Generally, however, needs for management are greater and yields are lower under comparable management.

**GROUP 2A**

The moderately well to imperfectly drained soils of management group 2A (see table 7) occur in association with the well-drained soils of group 1A on first bottoms along streams. They are nearly level, easy to work, fertile, and not subject to serious erosion, but slow internal drainage and slow recession of floodwaters after spring floods limit crop adaptability. Usually the difficulty of obtaining satisfactory outlets limits their improvement by artificial drainage.

These soils are adapted to intensive rotations, and their fertilizer requirements are low. Vegetable crops produce well in favorable seasons but are damaged occasionally by unusually high water. Corn is subject to the same limitations, though both corn and vegetables are grown successfully by many farmers. Small grains are subject to lodging and rust and, because of prolonged high water in spring, sometimes must be planted too late for good results. Wherever feasible, hay seedings should be made after an early harvested row crop or in a crop that is pastured or used for hay, not with oats for grain. Ladino clover is exceptionally well suited as the dominant legume in grass-legume mixtures for hay and pasture. Alfalfa, though it often winterkills, persists well enough to be used as a minor plant in such mixtures with fair results. Cover crops such as rye should be seeded after clean-tilled crops to prevent scouring during floods. Protection against stream-bank gouging is also needed.

**GROUP 2B**

In management group 2B (see table 7) are well-drained high-lime soils of the uplands that have slopes falling less than 15 feet in 100 feet of distance. Some areas of nearly level soil are included, and on these the rotations for group 1B may be used. All of the soils of group 2B can be cultivated with little difficulty and are easily kept in good tilth. They are well drained without being excessively droughty. If row crops are grown regularly, slopes are sufficiently steep in most places to require use of strip cropping and occasional diversion terraces to control runoff and reduce erosion. All tillage should be done on the contour if possible. Where rolling topography prevents contour tillage and strip cropping, the soils should be worked across the slope and rotations should consist of close-growing crops, such as small grains and hay, for as long a time as weed control and normal farm operations permit.

Alfalfa is the outstanding legume for hay mixtures and requires no lime. Hay mixtures are easily established in small grains. Generally potash can be maintained by 7- or 8-ton applications of manure every 2 or 3 years. Possible exceptions to this are the Dover soils. All the soils require phosphorus for good yields of general farm crops. Vegetable crops respond well to complete fertilizer applied in recommended quantities. If more nearly level soils of equal quality are available, the soils of group 2B should then be used for longer crop rotations dominated by hay, and the row crops concentrated on the more level soils. Soils of group 2B can be safely used for a row crop once every 4 years.

#### GROUP 2C

In group 2C (see table 7) are well-drained medium to strongly acid soils of the uplands and terraces that have slopes of less than 15 percent. They differ from soils of group 2B mainly in being more acid and generally lower in fertility. They are suited to similar rotations but for general farm crops require 1 to 1½ tons of ground limestone every 4 or 5 years for maintenance after correction of initial acidity. The Colonie, Hoosic, Bernardston, and Dutchess soils need potash in addition to that contained in the manure available on dairy farms.

Alfalfa would generally be the most productive legume in hay mixtures if the soils were adequately limed and fertilized. If the aftermath is to be used intensively for pasture, however, Ladino clover may be better suited. Both corn and small grain are well suited. Where these soils occur near the Hudson River or in other places with good air drainage, they are also among those best suited to orchards. Organic matter and nitrogen decrease rapidly when the soils are cropped intensively, so supplies of these should be maintained by using farm manure and sod-forming crops.

Cultivation should be across the slope if possible, and the soils should be strip-cropped if they are used in a rotation that includes row crops as often as once in 4 or 5 years. Occasional diversion terraces are needed on long slopes to intercept runoff. Where uneven topography prevents strip cropping and contour cultivation, rotations should be lengthened to include more hay. Some nearly level areas are included on which rotations of group 1B can be used without special practices to control runoff.

#### GROUP 2D

In management group 2D (see table 7) are very strongly acid and moderately droughty soils that have slopes of less than 15 percent. Like soils of groups 2B and 2C, they are suited to rotations that include 2 years or more of hay and a row crop not more often than once every 4 or 5 years. They require much more fertilizer and lime than soils of group 2B and 2C. They are well drained, and crops respond readily to heavy fertilization.

Corn for silage produces fair to good yields if a high fertility level is maintained, but corn for grain is often damaged by early frost. Oats planted early produce well where fertility is high. Alfalfa commonly disappears from the stand after 1 or 2 years. Ladino clover is generally a more persistent legume for hay mixtures. A grass-clover

mixture produces a good first crop of hay, but, especially on the somewhat droughty Gloucester soils, the aftermath period for hay or pasture is usually short. For meadows that are to be used for 4 years or more, birdsfoot trefoil should be tried on a small area to determine its adaptation.

The soils have good physical conditions for fruit but are commonly located where fruit is damaged by frost. The keys to good production are heavy fertilization and maintenance of organic matter by using manure, sod-forming crops, and crop residues.

If intertilled crops are used once in a 4- or 5-year rotation, the Woodbridge and Charlton soils need strip cropping, and occasional diversion ditches on long slopes. The less erodible Gloucester soil requires less intensive practices, as contour cultivation, for control of runoff.

#### GROUP 2E

The moderately well to imperfectly drained soils of management group 2E (see table 7) are associated with the well-drained soils of groups 2B, 2C, and 2D. They are generally more fertile than these well-drained soils, but slow internal drainage limits the choice of crops and reduces yields in wet seasons. They are sufficiently well drained to be considered fair as cropland, however, and for adapted crops frequently outyield the associated well-drained soils.

They are well suited to intensive rotations; that is, those having 2 years of intertilled crops in a 5-year rotation. They are productive of midseason and late vegetables when heavily fertilized but are usually too wet and too cold in spring for early vegetables. Corn for silage yields well. Planting of spring grains is often delayed too long for high yields. In some years small grains make a rank growth and are subject to lodging and rust. If the season has normal or less than normal rainfall, small grains may produce better than on the associated well-drained soils.

Ladino clover or birdsfoot trefoil should be the dominant long-lived legume in pasture and hay mixtures. On all soils of the group except Woodbridge silt loam, alfalfa tolerates the moderate to imperfect drainage well enough to be included at a rate of 4 pounds of seed an acre in mixtures dominated by Ladino clover and grass. These soils are highly productive of hay and pasture. Generally they are nearly level and need little more than cross-slope cultivation to retard runoff. Open ditches can improve drainage in many places.

#### GROUP 2F

In management group 2F (see table 7) are heavy-textured level to gently sloping well-drained soils occurring near the Hudson River. They are hard to work and difficult to keep in good physical condition. Their fertility level is moderately high, but because of their heavy texture they respond slowly to management practices.

Hay and small grains are usually better suited than corn or vegetables. Although slopes are mild, the soils absorb water slowly and are subject to abnormally high runoff. They are therefore erodible.

In general, longer rotations including more hay and small-grain crops are preferable for this group. Alfalfa is well suited and should be the dominant legume in most mixtures for hay, but Ladino clover

adds to the value of hay mixtures to be used for pasturing. Although there is abundant lime in the subsoils, light applications are needed to establish legumes. If the slope is perceptible, all operations should be on the contour and strip cropping should be practiced.

#### GROUP 2G

The same general rotations and supporting practices are needed for soils of group 2G (see table 7) as are used for the associated soils of group 2F, but alfalfa is poorly suited and should be replaced by Ladino clover or birdsfoot trefoil as a long-lived legume. The soils are generally nearly level and can be improved by open ditches to remove excess water as rapidly as possible. Several farmers have had good success with ridging the soil in narrow lands, or by relying on the intervening dead furrows to remove water. These are very poor soils for apples; pears are grown with fair success.

#### GROUP 3.—POOR TO FAIR SOILS FOR CROPS; POOR TO GOOD SOILS FOR PASTURE; FAIR TO GOOD SOILS FOR FOREST

Hilly relief, poor drainage, severe erosion, droughtiness, or shallowness makes each soil of this group inferior to soils of group 2 for crops. All are potential cropland, but each has a very limited number of adapted crops or requires intensive management for maintenance of productivity. All are at least fair pasture land, and some are highly productive.

#### GROUP 3A

Management group 3A (see table 7) consists of high-lime well-drained or droughty hilly soils on steep relief. Their fertilizer and lime requirements are low, but they are susceptible to serious erosion and difficult to work with farm machinery. The strong slopes fall between 15 and 30 feet in 100 feet distance, so runoff is rapid. The rapid runoff creates an erosion hazard, prevents adequate absorption of water by the soil, and leads to droughtiness in midsummer. The Palmyra soil is especially droughty.

In general, these soils are poor for intertilled crops and should be kept in hay or pasture as much of the time as feasible. If row crops are grown, they should not be used more often than once in 6 years, and the rotation should be supported by using strip crops and diversion ditches spaced at regular intervals on long slopes. All operations should be on the contour. Alfalfa is superior to Ladino clover because it has deep roots and is able to withstand droughty conditions, but for very long-term hay and pasture, birdsfoot trefoil is more persistent. These soils are good for orchards but poor for vegetables.

#### GROUP 3B

The soils of management group 3B (see table 7) are hilly and well drained like those of group 3A, but need lime and have a generally lower fertility level. Rapid runoff creates a serious problem in erosion control and prevents adequate absorption of water. The Copake and Hoosic soils are especially droughty. Heavy machinery is difficult to use.

Crop rotations should include as few row crops and as much hay or pasture as possible. If row crops must be used, they should be supported by application of manure and use of strip crops and diversion terraces at regular intervals on long slopes to retard runoff. All operations should be on the contour. Alfalfa is a productive legume for hay mixtures, but for long-term hay, birdsfoot trefoil is more persistent. Both require  $\frac{1}{2}$  to  $1\frac{1}{2}$  tons of ground limestone every 4 or 5 years in the rotation for good results. Potash, in addition to that contained in the manure normally applied on dairy farms, is needed by Hoosic, Bernardston, and Dutchess soils. Soils of this group are poor for vegetable crops but are well suited to orchards where climate is favorable.

#### GROUP 3C

Moderate to strong erosion is the characteristic distinguishing the soils of management group 3C (see table 7) from those of group 3B. Loss of most of the original plowed layer has reduced the fertility level, particularly of nitrogen, and has made these soils unusually susceptible to erosion. For this reason, row crops should not be used if use of other crops is feasible. The land should be kept in grass-legume mixtures for hay and pasture until the stand becomes poor. Then hay should be reseeded with a small-grain nurse crop. If row crops must be grown occasionally, the rotations and supporting practices suggested for group 3B should be used, and heavy applications of barnyard manure applied. The basic problem is to build up the fertility level and organic-matter supply while runoff is controlled. If lime and fertilizer needs are met, alfalfa in mixtures with grasses is well suited to the soils. Birdsfoot trefoil is more persistent for long-term meadows that are adequately limed and periodically fertilized.

#### GROUP 3D

The soils of management group 3D (see table 7) are very acid, well-drained, hilly, and low in fertility. They are hard to cultivate and subject to moderate to serious erosion. They are similar to soils of groups 3A and 3B, but their crop adaptation is more limited and yields of adapted crops are generally lower because of lower fertility. Hay and pasture are best suited and should be grown as much of the time as possible. If row crops must be used, a rotation consisting of a row crop, a small grain, and 4 years or more of hay or pasture is suitable. The erosion control this rotation affords should be supplemented by using strip crops and diversion ditches spaced at regular intervals. Alfalfa stands do not persist long; the more tolerant birdsfoot trefoil is better suited as the long-lived legume in hay mixtures. Heavy fertilization and liming are required for success with hay or pasture seedings. The soils are well suited to orchards but commonly occur in areas where climate is not favorable.

#### GROUP 3E

The soils of management group 3E (see table 7) are either shallow over bedrock or moderately shallow and eroded. Fertility is generally low. Shallowness makes these soils droughty and sub-

ject to more severe erosion than the deep well-drained soils on similar slope. Slopes are less than 15 percent. Ordinary farm machinery is not difficult to use except where there are occasional outcrops of bed-rock. The greatest problems of management are those of building up and maintaining fertility and of controlling runoff so as to make maximum use of available water. Even under the best management, however, crop yields are generally limited.

If possible, these soils should be used for long-term hay meadows or pastures, which should be reseeded, when necessary, with a pasture mixture in a nurse crop of small grain. If row crops must be grown, they should not be used more than once in 6 years and, except on the more gently sloping areas, such rotations should be supported by strip cropping. Alfalfa can be used successfully in mixtures with grasses on all soils except those of the Nassau and Hollis series; birdsfoot trefoil is adapted to all. A fair first crop of hay can be expected from grass-legume mixtures if lime and fertilizer are applied in adequate quantities, but the aftermath is commonly short unless the season is abnormally wet.

#### GROUP 3F

The light-textured very droughty soils of management group 3F (see table 7) are almost level. Excessive runoff is not a problem but maintenance of fertility is. The soils are poorly suited to general farm crops because they have a low water-holding capacity. They are well suited to early vegetables. They are ready for cultivation early in spring, and crops respond greatly to heavy fertilization before the heat and dry weather of midsummer. Tree fruits of all kinds are well-adapted. If these soils are used for hay, alfalfa is probably one of the best legumes because it is deep-rooting; birdsfoot trefoil may prove to be superior, however, because it apparently tolerates low fertility levels. Heavy liming and fertilization are necessary for success with any crop. Green or barnyard manure helps to maintain the supply of organic matter, which is normally deficient.

#### GROUP 3G

In management group 3G are heavy-textured rolling and hilly soils (see table 7). They absorb water slowly, though they are well-drained, and control of runoff is a major problem. Fertility is generally high except on the eroded soil of the group. Intertilled crops should be avoided if possible because of poor yields and the danger of erosion. One of the best uses is hay or pasture for as long as the stand will persist; after the stand runs out, hay or pasture mixtures should be reseeded in a small-grain crop. Alfalfa is well suited and generally outyields clovers in hay mixtures.

#### GROUP 3H

The soils of management group 3H (see table 7) are so poorly drained that they are seldom used for crops other than hay or pasture unless artificial drainage is provided. If they are not drained, corn, small grains, and vegetable crops are frequently drowned during periods of temporary flooding. Alfalfa is seldom a success, but Ladino clover is very productive if open-ditch drainage is provided. With

natural drainage or open-ditch drainage, these soils should be used for long term Ladino clover-grass mixtures. If they are adequately drained with tile, all except the Madalin soils are highly productive of midseason and late vegetables.

**GROUP 4.—VERY POOR SOILS FOR CROPS; FAIR TO GOOD SOILS FOR PASTURE;  
FAIR TO GOOD SOILS FOR FOREST**

Some characteristic as stoniness, steep slope, shallow soil, very poor drainage, or low fertility makes each soil of group 4 either totally unsuited to or very poor for crops that require tillage. None is so infertile or droughty, however, that it will not produce at least fair pasture. The group is divided into five subgroups; the soils of each subgroup have somewhat similar problems of management.

**GROUP 4A**

Soils of group 4A (see table 7) are usually too stony for cultivation. If loose stones were removed, they would be suitable for cultivation and would require management like the soils of the groups indicated in the column headed "Rotations" in table 7. They are good soils for pasture in their present condition; fertilizer and lime needs are indicated in the table.

**GROUP 4B**

Soils of group 4B (see table 7) are generally too steep for cultivation. If cultivation is necessary, they should be kept in hay for as long as possible. For all except Charlton gravelly loam, steep phase, alfalfa is suitable as the dominant legume in the hay mixtures. Hudson, Troy and Charlton soils are fair for Ladino clover. Birdsfoot trefoil shows considerable promise for meadows that are used more than 4 years. All except the Palmyra soils require lime for legumes. Improved pastures require the quantities of lime and phosphorus fertilizer indicated in table 7 and should be kept free of brush. Mowing and fertilizing are very difficult because of the steep slopes. Where better land is available for pasture, it may be advisable to return these soils to forest. The Palmyra, Copake, and Hoosic soils, especially, are droughty and in normal years produce little pasture after July 1.

**GROUP 4C**

Soils of management group 4C (see table 7) can be used for crops, but as a result of shallowness are so droughty and low in plant-nutrient reserves that they are generally better used for pasture. They produce fair to good pasture during May and June if they are adequately limed and fertilized but in most years produce little after July 15. Management for crops or pasture should be similar to that suggested for soils of group 3E.

**GROUP 4D**

Soils of management group 4D (see table 7) contain so many outcrops that cultivation of most areas is impossible. All except Nassau slaty silt loam, ledgy undulating and rolling phases, contain considerable lime and are generally high enough in fertility to provide fair pasture during the spring months when moisture is available and temperatures are not high. All need phosphorus fertilizer. Nassau

slaty silt loam, ledgy undulating and rolling phases, requires 1 to 2 tons of ground limestone every 4 or 5 years, in addition to phosphorus, if it is to produce fair pasture.

#### GROUP 4E

The soils of management group 4E (see table 7) are so poorly drained that water stands on them late in spring and periodically after rains during summer. The water table is generally near the surface. When open ditches are provided to remove excess waters rapidly, good stands of white clover and bluegrass become established if lime and fertilizer requirements are met. In many cases such drainage is good enough to permit plowing and establishment of good Ladino clover-grass meadows for hay or pasture. Areas of Lyons, Wayland, Atherton, Mansfield, Saco, and Whitman soils for which good outlets for tile drainage can be provided are potentially good for the crops suited to the better drained soils of group 3H.

#### GROUP 5.—VERY POOR SOILS FOR CROPS OR PASTURE; POOR TO GOOD SOILS FOR FOREST

The soils of group 5 are so droughty and low in fertility, so shallow, or so poorly drained that they are best suited to forest in their natural condition.

#### GROUP 5A

Soils of management group 5A (see table 7) are deep but very droughty, low in fertility, and steep. They are difficult to improve for permanent pasture and are not responsive to fertilization. They support good forests.

#### GROUP 5B

The soils of management group 5B (see table 7) are both shallow and hilly or steep. Outcrops make the use of machinery for fertilizing and mowing almost impossible. Pastures are fair for only a short period in spring, even when they are improved. Wassaic, Dover, and Staatsburg soils can be used profitably for spring pasture without improvement on some farms, but without fertilization and liming the other soils of the group produce little forage of value for dairy cows. The shallowness of the soils and their lack of moisture also limit timber production.

#### GROUP 5C

In management group 5C are the mucks, which in their natural undrained condition are too wet for either pasture or crops. Carlisle muck and Muck, acid deep phase, are potentially good cropland for vegetable crops and potatoes. They require a good outlet and a complete system of open ditches or tile for adequate drainage. When drained they are among the most valuable soils in the county. Some areas are now drained and under cultivation, but the greater part is in forest. Muck, acid shallow phase, associated with Carlisle muck and Muck, acid deep phase, is potentially fair land for cultivation.

**GROUP 6.—LAND TYPES UNSUITED TO CROPS, PASTURE, OR FOREST**

In group 6 are Tidal marsh, fresh water phase; and Urban land, undifferentiated. These have no potential value for crops, pasture, or forest in their present condition. Some areas of Made land could be reforested and some could be cropped in small parcels. Most of the areas are dumps or excavations that would require reclamation before they could be used.

**ESTIMATED YIELDS**

Estimated average acre yields of principal crops under two kinds of management are given for each soil in table 8. Yields in columns A for each crop are those to be expected under the kind of soil management most commonly practiced at the time the area was surveyed. These management practices are described for each soil in the section on The Soils of Dutchess County. Estimates are based on information supplied by farmers and the county agricultural agent, observations of soil surveyors, and average yields from crop reporters and the United States census. Soils on which reported yields approach average yields for the county were selected and used for a basis of comparison. Yields of other soils for which no data on yields were available were estimated by comparison with these soils, considering not only differences in soil characteristics that affect yields but also known general differences in management practices used. It should be recognized that yields of column A are mostly estimates, and that actual yields may vary according to soil management and the weather.

Estimated yields in columns B for each soil are those to be expected under the systems of management described for soil groups in the section on Soil Quality and Management. These management systems are designed to give long-time average crop yields and to maintain soil productivity. They represent sound management for soil conservation and sustained production. Experience in this or other areas has shown them to be practical farming procedures. The column at the extreme right of the table gives the management subgroup under which these systems of management are described in the section on Soil Quality and Management. As in column A, yields are based on actual ones obtained under comparable management on a small number of soils, either on farms or on experimental fields. Estimates for other soils were made by considering their relative productivity and response to management practices as indicated by differences of soil characteristics that affect yields.

**SOIL ASSOCIATIONS**

For persons interested in the kind and quality of soil resources in areas large enough to contain several farms, soil-association areas are outlined in figure 3. This figure and the interpretive material in this section can be used to evaluate the general quality of soils in a community. Such an evaluation can be used in land classification, land-use planning, extension programs, and teaching. It can be used to get a general picture of the soil resources in the county.

Each soil association consists of several kinds of soils that occur in a constantly repeated pattern of distribution. The general quality of the soil association for agriculture is affected not only by the quality of

the soils but also by the size of the areas and the way in which good and poor soils are associated. In table 9 the soil associations are grouped into classes according to general quality for agriculture, and estimated percentages of good, fair, poor, and very poor soils are given.

#### ASSOCIATIONS DOMINATED BY GOOD CROPLAND

Soil associations listed in table 9 as dominantly good for cropland consist in largest part of soils good to excellent for the crops that require tillage. The soils occur in areas sufficiently large to provide good cropland proportionate to the total acreage of the farm. Few farms on these associations are limited by too small a proportionate acreage of good cropland.

These associations include the best agricultural areas in the county, and in most places on them the agriculture is prosperous. Among the soil associations, the management needs of soils range widely both in kind and intensity, but these needs generally can be met by employing the farm methods commonly used in the county. Each association has problems characteristic of the combination of soils included.

In the Pittsfield association (P), large uniform areas of Pittsfield gravelly loam, sloping phase, are available for cropland. This fertile high-lime soil is excellent for crops or pasture and constitutes 80 to 90 percent of the area. Small areas of the hilly Pittsfield soils are interspersed with the large moderately sloping areas and are commonly used for pasture. The use of legumes (of which alfalfa is best adapted), manure, and phosphorus is the principal means for maintaining productivity; strip cropping and contour tillage are needed to control runoff in some areas.

The Stockbridge association (S) is also dominated by large areas of good cropland. The Stockbridge soils form the principal acreage for crops, or 60 to 90 percent of the total area occupied by the association. Small percentages of the deep fertile Copake and Pittsfield and the shallow Wassaic and Dover soils, all of which are high in lime, are included in some areas. Near Millerton, a few areas of the shallow acid Nassau soils are included. Relief is generally undulating to sloping. Abundant good cropland is available in large areas. The needs of this association differ from those of the Pittsfield association mainly in the added moderate requirement for lime.

The Palmyra-Genesee association (PG) consists mainly of medium to large areas of high-lime Palmyra gravelly loam, nearly level and undulating phases, which make up 40 to 70 percent of the total area. Between areas of the Palmyra phases are moderately narrow crooked areas of fertile, level, high-lime Genesee and Eel soils of the first bottoms along streams. These alluvial soils generally make up 20 to 30 percent of the association, though in places poorly drained Wayland silt loam makes up 10 to 25 percent. Abundant cropland is available in most parts of this association. The soils need phosphorus but not lime; use of alfalfa for hay and the application of available manure are the principal management needs. Few or no special practices for water control are needed.

The Copake-Chagrin association (CC) occupies nearly level terraces and first bottoms as does the Palmyra-Genesee association. The well-drained Copake soils of the terraces make up 40 to 70 percent

TABLE 8.—*Estimated acre yields of principal crops under common and good management practices on the soils of Dutchess County, N. Y.*

[Yields in columns A are obtained by management practices most commonly used; those in columns B by management practices defined in the section on Soil Quality and Management. Blank spaces indicate that the crop is unsuited to the soil under the management specified.]

Soil	Corn silage		Oats		Alfalfa-grass hay <sup>1</sup>		Red clover-timothy hay <sup>2</sup>		Apples		Permanent pasture <sup>3</sup>		Soil group and sub-group
	A	B	A	B	A	B	A	B	A	B	A	B	
Albia gravelly silt loam:													
Gently sloping phase	8.4	10.2	35	43	<sup>1</sup> 1.6	2.0	1.6	2.2	80	120	80	100	2E
Sloping phase	7.8	10.2	35	40	<sup>1</sup> 1.6	1.8	1.5	1.9	100	150	80	100	2C
Alluvial soils, undifferentiated											40	60	4E
Amenia silt loam	9.0	10.8	35	43	<sup>1</sup> 2.0	2.2	2.0	2.2		120	100	110	2E
Atherton silt loam												<sup>1</sup> 75	4E
Bernardston gravelly silt loam:													
Eroded moderately steep phase	6.0	9.0	25	38	1.2	2.0	1.2	1.7		170	35	70	3C
Moderately steep phase	7.2	9.0	33	40	1.6	2.0	1.3	1.7		180	50	70	3B
Sloping phase	8.4	10.8	38	48	2.0	2.4	1.5	2.0		200	70	90	2C
Boynton gravelly silt loam		<sup>1</sup> 9.6		<sup>1</sup> 40							70	<sup>1</sup> 100	3H
Braceville, Hero, and Phelps silt loams, undifferentiated	8.4	10.2	30	38	( <sup>1</sup> )	1.2	1.5	2.0			75	95	2E
Carlisle muck													5C
Chagrin gravelly loam, alluvial fan phase	12.0	13.2	35	40	2.2	2.6	1.6	2.0			100	110	1A
Chagrin silt loam	12.6	13.8	35	40	2.8	3.0	2.0	2.4			110	120	1A
Charlton gravelly loam:													
Moderately steep phase	6.0	8.4	25	35	( <sup>1</sup> )	1.4	1.0	1.5		140	30	55	3D
Steep phase					( <sup>1</sup> )	1.0	.6	1.0			15	25	4B
Undulating and sloping phases	7.2	9.6	33	45	( <sup>1</sup> )	1.6	1.2	1.6	100	150	40	70	2D
Charlton stony loam, moderately steep phase											30	50	4A
Chatfield stony loam:													
Ledgy hilly phase											15	20	5B
Ledgy rolling phase											20	25	5B
Claverack gravelly loam	7.2	9.0	30	38	( <sup>1</sup> )	1.2	1.4	2.0			70	90	2E
Colonie fine sandy loam:													
Hilly and steep phases											10	20	5A
Nearly level phase	9.0	10.4	38	48	1.8	2.2	1.4	2.0	160	190	40	60	1B
Rolling phase	6.6	8.4	28	35	1.4	1.8	1.2	1.6	150	170	35	50	2C
Copake fine sandy loam, nearly level and undulating phases	9.0	11.6	38	48	2.0	2.4	1.6	2.0	170	190	60	80	1B
Copake gravelly loam:													
Hilly phase	5.4	7.2	25	30	1.2	1.6	1.0	1.2		160	40	50	3B
Nearly level and undulating phases	9.6	12.0	40	50	2.2	2.6	1.6	2.0	200	200	70	90	1B
Rolling phase	8.4	10.8	35	43	2.0	2.4	1.5	1.9	200	200	60	70	2C
Steep phase					1.0	1.2	.5	1.0			20	35	4B
Cossayuna fine sandy loam, undulating and rolling phases	7.8	10.2	33	43	2.0	2.4	1.5	1.9	200	200	60	75	2C

Cossayuna gravelly loam:													
Eroded hilly phase	6.0	9.0	25	38	1.2	2.0	1.2	1.7	130	170	35	70	3C
Eroded undulating and rolling phases	6.6	9.6	30	43	2.0	2.6	1.4	1.9	150	180	50	85	3E
Hilly phase	7.2	9.0	33	40	1.6	2.0	1.4	1.7	170	180	50	70	3B
Undulating and rolling phases	8.4	10.8	38	48	2.2	2.6	1.6	2.0	200	200	70	90	2C
Cossayuna stony silt loam:													
Hilly phase											45	65	4A
Rolling phase											65	85	4A
Dover fine sandy loam:													
Hilly phase	7.8	10.0	30	40	1.8	2.0	1.2	1.4			50	70	3A
Ledgy hilly phase											25	35	4D
Ledgy rolling phase											35	45	4D
Ledgy steep phase											15	20	5B
Rolling phase	9.0	10.8	35	43	2.0	2.2	1.4	1.6		100	70	80	2B
Dutchess gravelly silt loam:													
Eroded hilly phase	5.4	8.4	23	35	1.0	2.0	1.1	1.6		150	30	65	3C
Eroded undulating and rolling phases	6.6	9.6	30	43	1.4	2.2	1.2	1.8	150	180	40	75	3E
Hilly phase	6.6	8.4	33	40	1.2	2.0	1.2	1.6	170	180	40	65	3B
Undulating and rolling phases	7.8	10.2	38	48	1.8	2.2	1.4	1.9	170	190	60	80	2C
Eel and Loddell silt loams, undifferentiated	9.6	10.8	28	33	1.8	2.0	2.2	2.4			120	120	2A
Elmwood fine sandy loam	6.6	8.4	30	38	( <sup>5</sup> )	.8	1.4	2.0			60	75	2E
Genesee fine sandy loam	13.2	14.4	35	40	3.0	3.0	2.2	2.4			120	120	1A
Gloucester gravelly loam:													
Hilly phase	4.8	7.8	20	30	( <sup>5</sup> )	1.0	.8	1.3		140	20	40	3D
Rolling phase	6.0	9.0	28	38	( <sup>5</sup> )	1.2	1.0	1.5		150	30	50	2D
Steep phase											10	20	5A
Gloucester stony loam:													
Hilly phase											20	40	4A
Rolling phase											30	50	4A
Steep phase											10	20	5A
Hollis channery loam:													
Eroded hilly phase	3.6	4.8	13	18			.6	1.0			20	30	4C
Eroded rolling phase	3.6	5.4	13	20			.6	1.0			15	35	4C
Ledgy hilly phase											15	20	5B
Rolling phase	4.2	6.0	15	23			.8	1.2			25	40	3E
Hoosic fine sandy loam, nearly level and undulating phases	9.0	12.0	38	48	1.8	2.2	1.2	1.6	170	190	50	70	1B
Hoosic gravelly loam:													
Hilly phase	4.8	6.6	20	25	1.0	1.4	1.0	1.2		150	35	45	3B
Nearly level and undulating phases	9.0	12.0	38	48	2.0	2.4	1.4	1.9	200	200	60	80	1B
Rolling phase	7.2	9.0	33	40	1.8	2.2	1.3	1.7	200	200	55	70	2C
Steep phase					.8	1.0	.5	.8			15	25	4B
Hoosic gravelly sandy loam, nearly level and undulating phases	4.8	7.2	20	28		1.6	1.0	1.3		170	30	50	3F
Hoosic loam, nearly level and undulating phases	9.6	12.0	40	50	2.0	2.4	1.4	1.9	200	200	70	90	1B
Housatonic silt loam											70	100	3H
Hudson fine sandy loam, gently sloping phase	7.8	10.2	33	40	2.0	2.4	1.4	1.8		170	60	80	2C
Hudson silt loam:													
Gently sloping phase	8.4	10.2	35	45	2.4	2.6	1.6	1.9	130	150	85	100	2F
Hilly phase	6.0	7.2	30	40	2.0	2.2	1.5	1.8			70	80	3G
Rolling phase	7.2	9.0	33	43	2.2	2.4	1.6	1.9		150	80	95	3G

See footnotes at end of table.

TABLE 8.—Estimated acre yields of principal crops under common and good management practices on the soils of Dutchess County, N. Y.—  
Continued

Soil	Corn silage		Oats		Alfalfa-grass hay <sup>1</sup>		Red clover-timothy hay <sup>2</sup>		Apples		Permanent pasture <sup>3</sup>		Soil group and sub-group
	A	B	A	B	A	B	A	B	A	B	A	B	
Hudson silty clay loam:													
Eroded rolling phase	Tons 4.8	Tons 7.2	Bushels 20	Bushels 35	Tons 1.8	Tons 2.2	Tons 1.4	Tons 1.8			Cow-acres 70	Cow-acres 90	3G
Gently sloping phase	6.0	8.4	30	40	2.4	2.6	1.5	1.8			85	100	2F
Hilly phase	4.2	6.0	20	33	1.8	2.0	1.4	1.7			70	85	3G
Steep phase											35	45	4B
Kendaia silt loam		6 10.2		6 40				6 2.0			80	6 110	3H
Livingston silty clay loam											30	6 80	4E
Lyons silt loam											30	6 100	4E
Madalin silt loam		6 6.0		6 25				6 1.8			80	6 100	3H
Madalin silty clay loam		6 5.4		6 23				6 1.8			75	6 95	3H
Made land													6
Mansfield silt loam									120	150	20	6 80	4E
Merrimac gravelly fine sandy loam, nearly level and undulating phases	4.2	6.6	20	28	(5)	1.2	1.0	1.3		170	30	50	3F
Merrimac gravelly sandy loam, hilly phase											10	20	5A
Muck:													
Acid deep phase													5C
Acid shallow phase													5C
Nassau-Cossayuna gravelly loams:													
Eroded hilly phases	6.0	8.4	23	35	1.2	1.6	1.2	1.6		100	40	65	3C
Eroded undulating and rolling phases	6.0	8.4	25	40	1.4	2.0	1.2	1.7		130	40	70	3E
Undulating and rolling phases	7.2	9.0	33	43	1.6	2.0	1.4	1.8		140	60	80	3E
Nassau slaty silt loam:													
Eroded undulating and rolling phases	3.6	5.4	13	20			6	1.0			15	35	4C
Ledgy hilly phase											15	20	5B
Ledgy undulating and rolling phases											15	25	4D
Undulating and rolling phases	4.8	6.0	18	23			8	1.2			25	40	4C
Ondawa gravelly loam, alluvial fan phase	10.8	12.0	35	40	2.0	2.4	1.8	2.2			90	100	1A
Palmyra gravelly loam:													
Hilly phase	6.0	7.8	25	30	1.6	1.8	1.3	1.5		160	45	50	3A
Nearly level and undulating phases	9.6	12.0	40	50	2.6	2.8	1.8	2.0		200	80	90	1B
Steep phase					1.0	1.2	6	1.0			25	35	4B
Pawlet silt loam	8.4	10.2	25	30	(5)	1.6	1.8	2.2			100	120	2A
Paxton gravelly loam:													
Gently sloping and sloping phases	7.2	9.6	33	45	(5)	1.6	1.3	1.8		100	60	80	2D
Moderately steep phase	6.0	8.4	25	35	(5)	1.4	1.1	1.6		80	40	65	3D
Pittsfield gravelly loam:													
Moderately steep phase	7.8	9.6	35	43	2.4	2.6	1.5	1.8		170	65	75	3A
Sloping phase	9.6	12.0	40	50	2.8	3.0	2.0	2.2		200	90	100	2B

Pittsfield-Wassaic gravelly loams:														
Hilly phases.....	7.2	9.0	33	40	2.0	2.2	1.4	1.7		150	55	70	3A	
Stony and ledgy hilly phases.....											50	65	4A	
Stony and ledgy rolling phases.....											75	85	4A	
Undulating and rolling phases.....	9.0	11.4	38	48	2.6	2.8	1.8	2.0		100	80	90	2B	
Pittstown gravelly silt loam, nearly level and gently sloping phases.....	7.8	9.6	30	40	(5)	1.6	1.4	2.0			75	95	2E	
Poultney loam.....	11.4	12.6	35	40	2.4	2.8	1.8	2.2			90	110	1A	
Poultney silt loam.....	12.0	13.2	35	40	2.4	2.8	1.8	2.2			100	120	1A	
Red Hook silt loam.....		<sup>6</sup> 8.4		<sup>6</sup> 35				<sup>6</sup> 1.8				65	<sup>6</sup> 95	3H
Rhinebeck silt loam.....	7.2	9.0	28	35				1.5				90	100	2G
Rhinebeck silty clay loam.....	6.6	8.4	23	30				1.4				90	100	2G
Rough stony land (Gloucester, Hollis, and Chatfield soil materials).....														5B
Saco silty clay loam.....											20	<sup>6</sup> 80	4E	
Staatsburg gravelly loam:														
Ledgy undulating and rolling phases.....	4.8	6.0	20	23	1.0	1.2	1.0	1.2			45	65	4D	
Very ledgy hilly phase.....											20	30	5B	
Very ledgy rolling phase.....											30	40	5B	
Steep ledgy land:														
Nassau soil material.....												10	15	5B
Wassaic and Staatsburg soil materials.....												15	20	5B
Stissing gravelly silt loam.....		<sup>6</sup> 9.0		<sup>6</sup> 38				<sup>6</sup> 1.8				65	<sup>6</sup> 95	3H
Stockbridge gravelly loam:														
Eroded moderately steep phase.....	6.0	9.0	25	38	1.2	2.0	1.2	1.7		170		40	70	3C
Gently sloping and sloping phases.....	9.0	11.4	40	50	2.2	2.6	1.6	2.0		200		70	90	2C
Moderately steep phase.....	7.2	9.0	33	40	1.6	2.0	1.4	1.7		180		50	70	3B
Stockbridge stony loam, sloping phase.....	8.0	10.8	35	45		2.4	1.4	1.8				65	85	4A
Tidal marsh, fresh-water phase.....														6
Troy gravelly loam:														
Eroded moderately steep phase.....	6.0	9.0	25	38	1.2	2.0	1.2	1.7		170		35	70	3C
Gently sloping phase.....	9.0	12.0	40	50	2.2	2.6	1.6	2.0		200	200	70	90	1B
Moderately steep phase.....	7.2	9.0	33	40	1.6	2.0	1.4	1.7		170	180	50	70	3B
Sloping phase.....	8.4	10.8	38	48	2.2	2.6	1.6	2.0		200	200	70	90	2C
Steep phase.....					1.2	1.6	1.7	1.2				30	45	4B
Urban land, undifferentiated.....														6
Wassaic gravelly loam:														
Hilly phase.....	4.8	6.6	28	35	1.4	1.6	1.0	1.2			45	55	4C	
Ledgy hilly phase.....											25	35	4D	
Ledgy rolling phase.....											35	45	4D	
Rolling phase.....	6.6	8.4	30	38	1.6	1.8	1.2	1.4			50	65	3E	
Wayland silt loam.....											30	<sup>6</sup> 100	4E	
Whitman stony silt loam.....											20	<sup>6</sup> 80	4E	
Woodbridge silt loam.....	7.2	9.0	30	40			1.4	2.0			70	95	2E	

<sup>1</sup> Two cuttings of hay from legume-grass mixtures in which alfalfa is the dominant legume.  
<sup>2</sup> First-year red clover-timothy hay.  
<sup>3</sup> Permanent pastures that have not been plowed for 10 years or more.

<sup>4</sup> Cow-acre-days is the product of the number of animal units carried per acre and the number of days of grazing obtained without injury to the pasture. For example, a soil that can supply 50 days of full feed for one cow on one acre rates 50, but a soil that can supply 50 days of full feed for one cow on 2 acres rates only 25.  
<sup>5</sup> Alfalfa seldom persists in the stand for more than 2 years.  
<sup>6</sup> With artificial drainage adequate for the crop specified.

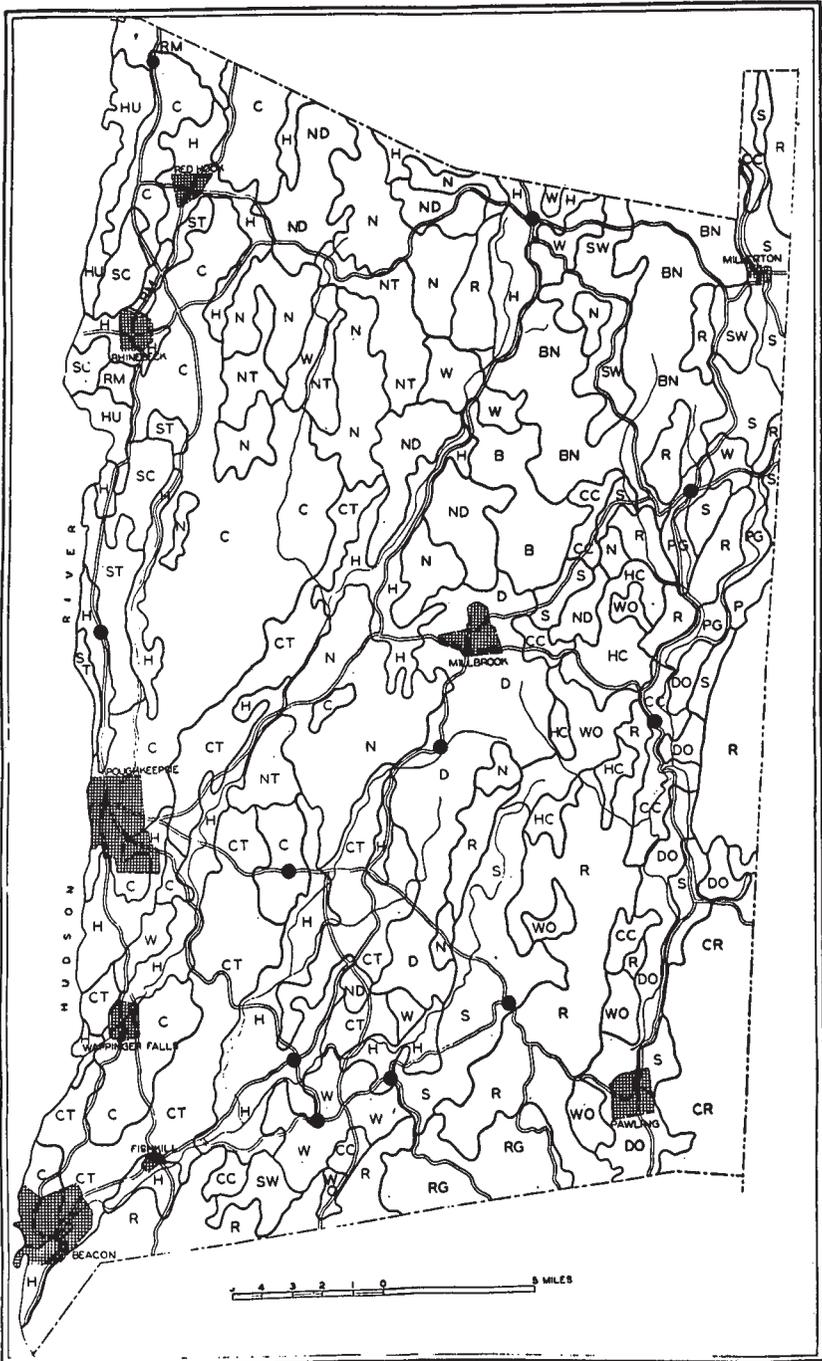


FIGURE 3.

TABLE 9.—*General quality of soil associations and relative percentages of soils of different quality in each*

Soil association	Sym- bol <sup>1</sup>	Soil quality			
		Good	Fair	Poor	Very poor
<b>Dominantly good cropland:</b>		<i>Percent</i>	<i>Percent</i>	<i>Percent</i>	<i>Percent</i>
Pittsfield.....	P	80-90	5-15	5-10	0-10
Stockbridge.....	S	60-90	5-30	5-15	0-5
Palmyra-Genesee.....	PG	70-90	0-20	5-20	0-10
Copake-Chagrin.....	CC	50-80	0-20	10-30	0-30
Hoosic-Poultney.....	H	60-85	0-20	10-40	0-20
Cossayuna-Troy-Albia.....	CT	50-70	20-40	5-20	0-10
Dutchess-Pittstown.....	D	50-80	5-30	5-20	0-5
Bernardston-Stissing.....	B	50-70	5-20	10-20	0-5
Paxton-Woodbridge.....	WO	40-80	10-30	5-30	0-10
Stockbridge-Wassaic.....	SW	40-60	20-40	20-40	0-10
Cossayuna-Albia.....	C	40-60	20-40	10-30	0-20
Bernardston-Nassau.....	BN	40-70	20-40	20-40	0-10
<b>Dominantly fair cropland and land better suited to pasture than to crops:</b>					
Wassaic-Pittsfield.....	W	30-50	30-50	20-40	0-5
Rhinebeck-Madalin.....	RM	20-40	30-60	15-25	0-5
Hudson.....	HU	20-40	20-40	30-50	0-5
Nassau-Troy (Cossayuna).....	NT	20-40	20-35	35-55	0-10
Nassau-Dutchess (Bernardston).....	ND	25-40	15-30	30-50	0-10
Charlton-Rough stony land-Hollis.....	CR	20-40	15-35	25-40	15-35
<b>Dominantly land better suited to pasture than to crops:</b>					
Stony Cossayuna-Staatsburg.....	SC	10-30	10-30	60-80	0-10
Staatsburg.....	ST	0-10	0-25	60-80	0-10
Dover.....	DO	10-30	5-10	50-70	0-20
<b>Dominantly land best suited to forest:</b>					
Hollis-Charlton (Paxton).....	HC	0-15	10-30	30-50	30-60
Nassau.....	N	0-10	10-40	10-30	40-70
Rough stony land-Gloucester-Chatfield.....	RG	0-10	10-20	10-30	50-80
Rough stony land.....	R	0-5	0-10	0-25	70-100

<sup>1</sup> See figure 3, p. 164.

## EXPLANATION OF FIGURE 3

## Soil associations of Dutchess County, N. Y.

B, Bernardston-Stissing	NT, Nassau-Troy (Cossayuna)
BN, Bernardston-Nassau	P, Pittsfield
C, Cossayuna-Albia	PG, Palmyra-Genesee
CC, Copake-Chagrin	R, Rough stony land
CR, Charlton-Rough stony land-Hollis	RG, Rough stony land-Gloucester-Chatfield
CT, Cossayuna-Troy-Albia	RM, Rhinebeck-Madalin
D, Dutchess-Pittstown	S, Stockbridge
DO, Dover	SC, Stony Cossayuna-Staatsburg
H, Hoosic-Poultney	ST, Staatsburg
HC, Hollis-Charlton (Paxton)	SW, Stockbridge-Wassaic
HU, Hudson	W, Wassaic-Pittsfield
N, Nassau	WO, Paxton-Woodbridge
ND, Nassau-Dutchess (Bernardston)	

of the areas; Chagrin and Eel soils of the first bottom, 20 to 30 percent. Small areas of upland soils and poorly drained soils of the first bottoms are included. In addition to the management needs described for the Palmyra-Genesee association, moderate applications of lime are commonly required.

The Hoosic-Poultney association (H), like the Copake-Chagrin, is an association on terraces and first bottoms. Unlike the Copake-Chagrin, it consists of strongly acid soils. The Hoosic soils of the terraces make up 60 to 90 percent of the area; the Poultney and Pawlet soils of the first bottoms, 10 to 30 percent. Small areas of associated soils of the uplands and poorly drained soils of the terraces and first bottoms are included. Usually the areas of this association on terraces (Hoosic) are larger and those on the first bottoms (Poultney) are narrower than areas of corresponding position in the Copake-Chagrin association. Abundant good cropland is available, but it needs lime, phosphorus, and potash for high productivity. It is highly responsive to good management. The association includes some of the best land in the county.

The Cossayuna-Troy-Albia association (CT) is characterized by long narrow hills of Troy soils interspersed with lower undulating areas of Cossayuna soils, there being nearly equal percentages of each. Together these soils make up 60 to 90 percent of the area. Their moderately well to imperfectly drained equivalent, Albia gravelly silt loam, gently sloping phase, makes up most of the rest, though small areas of poorly drained and shallow soils are also included. Much of the area is good cropland, though not the best in the county. Moderate quantities of lime are needed in most areas, as well as phosphorus. Most Troy soils need strip cropping or contour tillage. These practices, use of a legume such as alfalfa in the rotation, and the application of manure are the keys to good management on dairy and general farms.

The Dutchess-Pittstown association (D) is characterized by low undulating to rolling relief. From 70 to 90 percent consists of Dutchess soils, or of the moderately well to imperfectly drained equivalent, Pittstown soils. Small areas of Bernardston, Nassau, Mansfield, and alluvial soils are included. All of these soils are strongly acid and also need phosphorus. Potash is usually limited, and nitrogen and organic matter decline rapidly unless they are maintained by using manure and legumes such as alfalfa or Ladino clover. In many places the rolling topography is not well suited to strip cropping, and runoff should be controlled by cropping systems. Abundant good cropland is available. The association supports prosperous general and dairy farms when well managed.

The Bernardston-Stissing association (B) is also an association of deep acid dominantly well-drained soils, but it is characterized by moderately large areas of uniformly sloping Bernardston soils within a network of narrow areas of poorly drained Stissing and Mansfield soils. Some areas of Dutchess soils are included. The well-drained Bernardston (and Dutchess) make up 50 to 70 percent of the area and are the principal soils well suited to crops. Heavy liming, the use of phosphorus, applications of barnyard manure, and the use of alfalfa, Ladino clover, or other legumes in the rotation are keys to good management on most farms. In addition, areas of good cropland are

generally well suited to strip cropping and contour cultivation for control of runoff.

The Paxton-Woodbridge association (WO) consists of 70 to 90 percent of the uniformly sloping Paxton soil, which occurs in large areas, and 5 to 20 percent of its moderately well to imperfectly drained equivalent, the Woodbridge soil. The rest is mainly the poorly drained Whitman or the shallow Hollis soil. The association is much like the Bernardston-Stissing, but its soils are from crystalline rock materials instead of slate and shale and are generally somewhat lower in fertility, especially in potash. Alfalfa has not been so successful, but in similar areas in New England, Ladino clover has done well when properly managed. Abundant cropland of moderately good quality is available on most farms. Good management on general farms consists of heavy liming, fertilization with phosphorus and potash, use of manure, inclusion of legumes in the rotation, and practicing strip cropping and contour tillage on the uniform slopes.

The Stockbridge-Wassaic association (SW) is 40 to 60 percent deep medium-lime Stockbridge soils, occurring in large areas, interspersed with slightly smaller acreages of the moderately shallow high-lime Wassaic soils or the Pittsfield-Wassaic complex. In most areas a high percentage of the Wassaic soils is ledgy or hilly. Most of the good cropland is on the Stockbridge soils, but 20 to 40 percent of the area is fair cropland on the Wassaic soils. In some places Copake and Eel soils are included and make up as much as 20 percent of the areas. Generally enough cropland is available on the Stockbridge soils or the Pittsfield-Wassaic complex to satisfy the needs of most general or dairy farms. The shallow, ledgy, stony, or hilly soils are used for pasture. Nevertheless, on many farms there is little excess of good cropland. Farmers should take full advantage of the potentially high productivity of the good cropland through moderate liming, use of phosphorus, and application of available manure in a rotation that includes a legume such as alfalfa. Strip cropping and contour cultivation are easily adapted to the dominantly uniform slopes.

The Cossayuna-Albia association (C) is characterized by the uneven low relief of the dominant Cossayuna soils, which make up 75 percent of the area. About 10 to 20 percent is Albia soils in small areas. Long crooked areas of poorly drained alluvial soils, Muck, acid shallow phase, or wet Mansfield soils occur as a network that divides the well-drained Cossayuna soils into moderate-sized areas. Scattered moderate-size areas of deep Troy soils and shallow Nassau or Staatsburg soils are included.

The association is capable of supporting a prosperous agriculture. Sufficient cropland is available to satisfy the needs of most general farms, although in some places it is cut up into small fields by poorly drained areas.

The soils need moderate quantities of lime, and phosphorus is deficient. Most areas are well suited to alfalfa. Plant nutrients can usually be supplied by the use of available manure in rotations that contain legumes such as alfalfa. Generally the relief is uneven, so runoff must be controlled by cropping systems rather than by special practices such as strip cropping.

The Bernardston-Nassau association (BN) is characterized by large areas of the uniformly sloping deep well-drained acid Bernardston

soils (with some Dutchess), which commonly make up about one-half of the area, intermingled with equally large hilly areas of the shallow acid Nassau soils. In this association farms are located on the Bernardston soils and depend on them for cropland. Adjacent areas of Nassau soils are used for pasture with some of the Bernardston, but the central parts of the areas of Nassau soils are generally forested. Farms that have been located almost entirely in areas of Nassau soils are rapidly being abandoned. The association therefore supports fewer farms per square mile and has more nonfarm land than most others of this group. Nevertheless, the farms on it are usually good units. On general farms good soil management should center on use of legumes in the rotation, heavy liming, application of phosphorus fertilizer, full use of available manure, and the use of strip cropping and contour tillage.

#### ASSOCIATIONS DOMINATED BY FAIR CROPLAND AND LAND BETTER SUITED TO PASTURE THAN TO CROPS

These associations generally have little cropland in excess of needs of the farm unit, and a large percentage is not of the high quality that dominates the first group (see table 9).

The Wassaic-Pittsfield association (W) is dominated by large areas of the Pittsfield-Wassaic complex and the shallow Wassaic soils. Large areas of both are hilly or stony and ledgy. The pattern is such that some farms have abundant cropland of good quality, but many must depend on the shallower soils of fair quality for crops. Fair to good land for pasture is plentiful. The soils require little lime, but phosphorus is needed, as well as manure and a rotation centered about legumes. Fair to good general and dairy farms dominate the areas.

The Rhinebeck-Madalin association (RM) is characterized by its nearly level relief. The heavy-textured imperfectly drained Rhinebeck soils make up 30 to 50 percent of the area, and the equally heavy and poorly drained Madalin soils about 10 to 30 percent. Both large and small areas of Hudson, Elmwood, Livingston, and Cossayuna soils are included with the long narrow areas of wet alluvial soils. Very little high quality cropland is available, but more than 75 percent is at least fair for crops. The association is best suited to a type of farming built around production of hay and pasture. Ladino clover is the outstanding legume for most areas. The soils generally need little lime or potash but are deficient in phosphorus. The nearly level topography in most places makes strip cropping unnecessary. Open-ditch drainage is needed in many areas.

The Hudson association (HU) is made up mainly of Hudson soils (70 to 90 percent of the total). Level or gently sloping Hudson soils are in the eastern part, into which long fingerlike areas of hilly and steep Hudson soils extend along drainageways from the nearby Hudson River. The rest of the association is mainly Colonie, Rhinebeck, and Hoosic soils in widely scattered areas. The soils are dominantly heavy-textured and highly susceptible to erosion. From 30 to 50 percent of the area is poor for crops but at least fair for pasture. Little high quality cropland is available. The way in which smooth steep Hudson soils are distributed within farm units largely deter-

mines the potential prosperity of the farms. Fruit is moderately well suited to the smoother areas, but farming systems built around grass are usually best suited to farms that include both major constituents. On these farms, alfalfa is generally the most productive legume. The soils need moderate quantities of lime and heavy phosphorus fertilization, but require little potash in addition to that in the available manure. Wherever feasible, cropland with perceptible slopes should be strip-cropped.

About 40 to 60 percent of the Nassau-Troy (Cossayuna) association (NT) consists of shallow Nassau soils, which occur in large areas. One-half to three-fourths of the Nassau areas are hilly and poorly suited to crops. The deep Troy (and Cossayuna) soils make up 20 to 30 percent of the association and occur as both large and small areas surrounded by larger areas of Nassau soils. A few farms have sufficient good cropland available to support a good farm business, but most farms must depend partly on the poorer undulating and rolling Nassau soils for crops. Almost all farms depend on the relatively poor Nassau soils for pasture. Many of the hilly areas of Nassau soils are in forest.

This association supports relatively few farms per square mile, and these are usually only fair. One of the principal problems is to obtain sufficient good cropland. The soils need lime, phosphorus, and commonly potash. Dairy herds are generally small, so little manure is available. In most places legumes used in the crop rotation must be depended on to maintain nitrogen and organic matter.

The Nassau-Dutchess (Bernardston) association (ND) is much like the Nassau-Troy (Cossayuna) association except that the good cropland available (Dutchess and Bernardston) is more strongly acid and generally lower in fertility. Nassau soils make up 40 to 80 percent of the area, and within these areas are distributed small to large isolated areas of Dutchess or Bernardston soils. The Dutchess and Bernardston soils make up 30 to 40 percent of the association. The management problems are essentially the same as those on the Nassau-Troy (Cossayuna) association.

The Charlton-Rough stony land-Hollis association (CR) includes the highlands surrounding Quaker Hill above the Harlem Valley. The large areas on precipitous slopes rising from the valley are rough stony lands, which make up about one-third of the association. The smoother areas at higher elevations and adjacent to these steep slopes are mainly the shallow Hollis soils that compose 15 to 20 percent of the area. At elevations of 900 to 1,200 feet, usually above the rough stony land, are large areas of the Charlton soils, which comprise 40 to 50 percent of the total area and are the main support of farms in the association. Thus, the farms are concentrated on the Charlton soils but depend to some extent on Hollis soils where good land is limited. The rough stony land is in forest, and so is a part of the Hollis soils. The farmed soils are low in fertility and need heavy liming, applications of phosphorus, potash, and manure, and use of legumes in the crop rotation. Alfalfa has not been successful in most trials on these soils; red clover, Ladino clover, and birdsfoot trefoil should receive the greatest attention.

### ASSOCIATIONS DOMINATED BY LAND BETTER SUITED TO PASTURE THAN TO CROPS

The three associations in this group contain very little soil that can be used for crops; most of the land is so stony or filled with outcrops of bedrock that cultivation is impossible. All contain large percentages of land at least fair for permanent pasture, though production is commonly low in midsummer as a result of poor moisture relations. These associations are generally used for farming only where they can be used for pasture in conjunction with nearby areas containing good cropland.

The Stony Cossayuna-Staatsburg association (SC) is dominated by Cossayuna stony silt loam, rolling phase, which contains sufficient large stones and boulders to be generally unsuited to cultivation. About 15 to 25 percent consists of the shallow Staatsburg soils. Inclusions of nonstony Cossayuna soil and soils of the terraces may total as much as 25 percent in some places and provide small fields suitable for cultivation. The land is mainly idle or forested.

The Staatsburg association (ST) is 70 to 90 percent very shallow Staatsburg soils, with minor inclusions of Cossayuna, Hoosic, and poorly drained soils in small areas. Not more than one-fourth can be cultivated. The area is mainly idle or forested, except where it adjoins other associations containing good cropland.

The Dover association (DO) is 70 to 90 percent Dover fine sandy loam, ledgy rolling phase, which is unsuited to cultivation, with inclusions of Dover fine sandy loam, rolling phase, Stockbridge soils, alluvial soils, and muck. Much of the area is idle, but parts adjacent to other associations of the Harlem Valley are used for pasture.

### ASSOCIATIONS DOMINATED BY LAND BEST SUITED TO FOREST

These associations contain little soil suitable for either crops or pasture. Isolated areas contain some land fair for cropland and pasture and support a few poor farm units.

The Hollis-Charlton (Paxton) association (HC) is 70 to 80 percent shallow acid droughty Hollis soils and 20 to 30 percent Charlton or Paxton soils. More than one-third, and in most places nearer one-half, of the area is very poor for either crops or pasture. About 40 percent is poor for pasture. Not more than one-third is fair land for crops. The association is mostly idle or in forest. A few farms are operating where Charlton or Paxton soils provide a small acreage of cropland that can be supplemented by the best areas of Hollis soils.

The Nassau association (N) is 75 to 90 percent shallow droughty acid Nassau soils and 10 to 25 percent inclusions of Dutchess, Cossayuna, or alluvial soils. Most of the area is idle or forested; the association has been the site of widespread abandonment of farms. A few poor farms are still operating on the better areas of Nassau soils or where small areas of Cossayuna or Dutchess soils occur.

The Rough stony land-Gloucester-Chatfield association (RG) is characterized by large areas of rough stony land, which makes up 60 to 80 percent of the area. Intermingled are smaller areas of Gloucester or shallow Chatfield soils, comprising as much as one-third of the area, on which some operating farms are located. Usually lack

of adequate cropland and poor quality of land available for either crops or pasture limit farming.

The Rough stony land association (R) is in most places more than 80 or 90 percent Rough stony land (Gloucester, Hollis, and Chatfield soil materials). A few areas are dominated by Steep ledgy land (Nassau soil material). In all areas very little or no land is suitable for either crops or pasture. The association is almost entirely forested.

## MORPHOLOGY AND GENESIS OF SOILS

By Marlin G. Cline, professor of soil science, Cornell University

Soil is the product of soil-forming processes acting on materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief or lay of the land, and (5) the length of time the forces of development have acted on the material (8).

Climate and vegetation are the active factors of soil genesis. They exert their influences on the parent material and change it from a heterogeneous mass of inert material to a body that has a definite genetic morphology and that is filled with living things. The effects of climate and vegetation are guided, or limited, to varying degrees by the modifying influence of relief as it affects such conditions as exposure, drainage, the quantity of water that percolates through the soil, the rate of natural erosion, and the kinds and amounts of plant and animal life on and in the soil. The nature of the parent material itself also guides the course of action that results from the forces of climate and vegetation. It is important in determining internal soil climate and the kinds of life that exist in the soil. The degree to which it resists the forces of climate and vegetation is of major importance. Finally, time is involved for changes to take place, and age becomes a factor of soil formation. Age is reflected in the degree to which the soil has developed into a body that is in equilibrium with its environment. The degree of such development depends not only on time but also on the rate of action of the forces of climate and vegetation as that rate is guided by the factors of relief and parent material.

Within the boundaries of Dutchess County, climate varies within relatively narrow limits. The average annual precipitation at seven stations over a period of years ranged from 38 to 50 inches; that of the growing season, from 17 to 22 inches. The mean annual temperature ranges from 47 to 50° F.; that of the growing season, from 65 to 67°. The highlands of the south and east have the highest rainfall and the lowest temperature. The average length of the growing season is about 160 days.

The well-drained sites were originally heavily forested with hardwoods, which return relatively large quantities of plant nutrients to the surface. The trees thus counteracted the tendency of percolating waters to remove nutrients, particularly bases, from the soil profile.

The cool climate is not conducive to extremely rapid weathering

of minerals. The parent material is mainly of glacial origin and has been exposed to soil-forming processes for a relatively short time; consequently, materials that tend to resist the forces prevalent have been changed relatively little in the soils of Dutchess County, compared to soils derived from older materials of similar kind in many other parts of the United States.

Nevertheless, certain common characteristics have developed on soils of well-drained sites even though the materials they developed from were originally greatly different. All have a dark-colored horizon at the surface in which organic matter has accumulated. In virgin areas this is generally only a little mixed with mineral soil; but in the soils high in lime, a well-defined  $A_1$  horizon occurs under present forests. The upper part of the solum is yellowish brown and is distinguishable from the lower part mainly on the basis of its fine crumb structure, which contrasts with the weak fine blocky structure at depths below 8 or 10 inches. There is little textural profile within the solum except in special cases that will be noted. On the soils from acid materials, a thin gray layer less than one-fourth inch thick occurs immediately under the humus layer in undisturbed forests. The C horizon is characteristically more gray in color and slightly lighter in texture than the solum. These characteristics point to more rapid formation of clay in the solum than in the parent material and to little translocation of clay within the solum.

Total amounts of various elements in profiles of Stockbridge gravelly loam, gently sloping and sloping phases; Troy gravelly loam, sloping phase; Wassaic gravelly loam, rolling phase; and Merrimac gravelly sandy loam, hilly phase (or Merrimac gravelly fine sandy loam, nearly level and undulating phases) in Dutchess County have been determined by Bizzell (2).<sup>4</sup> These data show that nitrogen, phosphorus, and sulfur decrease from the surface downward. Calcium content is higher in the topmost layer and in the parent material than in the lower part of the solum of soils that originally contained much lime. Calcium content also decreases from the surface downward in soils derived from strongly acid materials. Potassium and magnesium supplies, however, increase with depth and are higher than the calcium content throughout the profiles examined. Thus the effects of leaching of the end products of weathering are apparent in the data for potassium and magnesium, whereas the counteracting effects of vegetation in returning to the surface litter that is high in certain plant nutrients is apparent in the data for the other elements.

Comparatively weak textural profiles in which bases have been moderately leached from the solum, with consequent development of acidity, are characteristic of the normal soils of the area. These general characteristics may be considered the effects of the relatively constant climatic conditions and general type of vegetation within the area. They are the common characteristics of the zonal soil series listed in table 10.

Among the zonal soils (8), however, striking differences exist and can be related to the kinds of rock materials from which the soils are derived. Observations of this kind, limited to a small area like

---

<sup>4</sup> Designated as Gloucester, Dutchess, Dover, and Merrimac soils, respectively, in the soil survey of 1907 and in Bizzell's bulletin (2).

Dutchess County, may lead to the inference that the kind of geological material is the dominant soil-forming factor. This is true to the extent that it largely determines differences among soils, provided climate, vegetation, relief, and age are reasonably constant. Thus, in Dutchess County, differences among the zonal soil series may be attributed mainly to differences of thickness and kind of parent material, as indicated in table 10.

The most striking differences among soils of the county, however, are found among those soils derived from similar parent materials. Within an area covered by one kind of glacial till, for example, the soils vary from the general type of profile described for the zonal soils to a soil with a thick, black highly organic layer at the surface and a gray highly mottled subsoil. These differences are associated with differences in relief and internal and external drainage. The soil climate is modified by relief and drainage. In the black highly organic soil mentioned above, waterlogging of the entire soil persists most of the year, and as a result there is deficiency of oxygen, dominance of water-tolerant vegetation, a small amount of leaching, and the accumulation of plant remains under conditions for decomposition entirely different from those in well-drained soils. These waterlogged soils and intergrades to the well-drained soils are intrazonal soils, or soils within a zonal region (8).

Sediments washed from soils or soil materials of the county are deposited periodically on the flood plains of present streams. These materials have been in place for very short periods, and new materials are added at the surface almost every year. Even though the forces of climate and vegetation may be similar to those acting on the adjacent uplands, they have not acted long enough to produce the effects noted for the zonal soils of the region. Such young soils are called azonal (8).

It should not be inferred that the effects of soil-forming processes are entirely lacking in these flood-plain soils. There is generally evidence of accumulation of organic matter in the surface layers, and where local conditions in relief or height of water table of nearby streams have caused excessively moist soil conditions, many of the characteristics of the hydromorphic intrazonal soils of the uplands are apparent. These characteristics are exceptionally high organic-matter content in the surface layer, light-gray color of underlying horizons, and mottling of soils subjected to a fluctuating water table.

In table 10 the soil series of the county have been grouped in general types of profiles that represent great soil groups and orders. Reference to this table, which includes a general description of the parent material, will indicate to what degree the soil-forming forces mentioned above have apparently operated (1) to form greatly different soils from the same parent material and (2) remarkably similar soils from different parent materials.

Some doubt exists as to the great soil group to which the zonal soils (table 10) belong; the exact classification of many must await further physical and chemical studies. The zonal soils derived from strongly acid materials are undoubtedly Brown Podzolic soils. They have a 2- to 4-inch layer of matted mor (organic matter) on the surface and a thin light-gray incipient A<sub>2</sub> horizon, commonly less than

TABLE 10.—Catenas and natural classification of soil series in Dutchess County, N. Y.

Parent material	Zonal soils			Intrazonal soils		Azonal soils	
	Brown and Gray-Brown Podzolic and Brown Forest soils <sup>1</sup>			Low-Humic Gley	Humic Gley	Alluvial	
	Lithosolic	Typical	Weakly hydro-morphic	Typical	Typical	Typical	Weakly hydro-morphic
Soils dominantly from granite and gneiss:							
Recent acid alluvium.....				Housatonic.....	Saco.....	Ondawa.....	Pawlet.
Glacial till, strongly acid, shallow to deep..	Chatfield (B).....	Gloucester (B).....			Whitman.....		
Glacial outwash, strongly acid.....		Merrimac (B).....					
Soils dominantly from schist:							
Recent acid alluvium.....				Housatonic.....	Saco.....	Ondawa.....	Pawlet.
Glacial till, strongly acid:							
Shallow to deep.....	Hollis (B).....	Charlton (B).....	Woodbridge (B).....		Whitman.....		
Deep, compact.....		Paxton (B).....	Woodbridge (B).....		Whitman.....		
Soils dominantly from acid slate:							
Recent acid alluvium.....				Housatonic.....	Saco.....	Poultney.....	Pawlet.
Glacial till, strongly acid:							
Shallow to deep.....	Nassau (B).....	Dutchess (B).....	Pittstown (B).....	Stissing.....	Mansfield.....		
Very deep.....		Bernardston (B).....	Pittstown (B).....	Stissing.....	Mansfield.....		
Glacial outwash, strongly acid.....		Hoosic (B).....	Braceville (B).....	Red Hook.....	Atherton.....		
Soils dominantly from calcareous sandstone and slate:							
Recent alluvium, neutral or alkaline.....				Wayland <sup>2</sup> .....	Wayland.....	Chagrin.....	Lobdell.
Glacial till, weakly calcareous:							
Shallow to deep.....	Staatsburg (GB).....	Cossayuna (GB).....	Albia (GB).....	Boynton.....	Mansfield.....		
Very deep.....		Troy (GB).....	Albia (GB).....	Boynton.....	Mansfield.....		
Soils dominantly from limestone, slate, and crystalline rocks:							
Recent alluvium, neutral or alkaline.....				Wayland <sup>2</sup> .....	Wayland.....	Chagrin.....	Lobdell.
Glacial till, moderately calcareous, very deep.							
Glacial outwash, moderately calcareous.....		Stockbridge (B).....					
Soils dominantly from crystalline limestone:							
Recent alluvium.....		Copake (B).....	Hero (B).....				
Glacial till, highly calcareous, shallow to deep.	Dover (BF) <sup>3</sup> .....	Dover (BF).....	Amenia (BF).....	Kendaia.....	Lyons.....	Genesee.....	Eel.

Soils dominantly from noncrystalline limestone:							
Recent alluvium, neutral or alkaline.....	Wassaic (BF).....	Pittsfield (BF).....	Amenia (BF).....	Kendala.....	Lyons.....	Genesee.....	Eel.
Glacial till, highly calcareous, shallow to deep.							
Glacial outwash, highly calcareous.....		Palmyra (GB).....	Phelps (GB).....				
Soils from lacustrine sediments:							
Silts and clays, calcareous.....		Hudson (GB).....	Rhinebeck (GB).....	Madalin.....	Livingston.....		
Sands, strongly acid:							
Deep over clay.....		Colonie (B).....					
Shallow over clay.....			Elmwood (B).....				
Sand and gravel, medium acid, shallow over clay.			Claverack (B).....				

<sup>1</sup> B = Brown Podzolic; GB = Gray-Brown Podzolic; BF = Brown Forest.

<sup>2</sup> Wayland soils, as mapped in this county, include some Humic-Gley areas.

<sup>3</sup> Ledy phases of Dover fine sandy loam.

one-fourth inch thick. In many places a miniature Podzol profile, complete with gray  $A_2$ , moderately organic  $B_1$ , and weak thin rusty-brown  $B_2$ , is present immediately under the humus layer, all within a thickness of 2 inches. A moderate yellowish-brown B horizon extends to a depth between 12 and 20 inches, with little apparent change except a gradation from a medium crumb structure to a weak fine blocky structure with depth in the loam and silt loam soils. The B is underlain by lighter colored and commonly lighter textured material of the C horizon.

At the other extreme, the Pittsfield, Dover, and Wassaic soils, which are derived from highly calcareous materials, generally have a distinct  $A_1$  horizon under present wood lots, which have all been disturbed by cutting and some grazing. No gray  $A_2$  horizon is apparent, but the horizon under the  $A_1$  looks like the B horizon of the Brown Podzolic soils. There is little evidence of a distinct accumulation of clay in the B at the expense of an A horizon, though there is some structural change with depth. These neutral brown soils are considered Brown Forest soils.

The Palmyra and Hudson soils show considerable textural profile, and remnants of a thin pale-brown  $A_2$  horizon can be found under the plowed layer in some areas. Probably these soils are Gray-Brown Podzolic. The area is in a transition zone from the Gray-Brown to Brown Podzolic regions, and several soils, as the Troy, Cossayuna, Stockbridge, and Copake, have some characteristics of both great soil groups.

Associated with the typical zonal soils are areas in which bedrock is near the surface. These soils have profiles that are essentially similar to the typical zonal profiles in kind and arrangement of horizons, but the soils are thin, and in many places the horizons also. Commonly a very thin horizon of decomposing bedrock underlies a thin B horizon. These profiles have been designated as Lithosolic in table 10, inasmuch as they appear to be transitions to the Lithosols of the azonal order.

A third type of profile that falls within the range of Brown Forest, Gray-Brown Podzolic, or Brown Podzolic soils has been designated as weakly hydromorphic in table 10. The soils are commonly described as moderately well to imperfectly drained. To a depth of 12 or 15 inches, the profile is essentially similar to that of the associated well-drained soils. From 12 or 15 to 18 or 24 inches, however, the B horizon is mottled and streaked with strong brown and dusky yellow, probably indicating alternating oxidizing and reducing conditions as a result of periodic waterlogging. Below 18 or 24 inches the soil material is generally very compact and often semicemented. This compact layer appears to be merely compact till in some soils; in others it may be a genetic panlike horizon. Its net effect, whatever its nature, is to retard the downward movement of water and to contribute to temporary waterlogging of the layer immediately above it.

The Low-Humic Gley soils (table 10) in forests have a 4- to 6-inch  $A_1$  horizon at the surface. It gives way to a pale-brown or light brownish-gray (commonly called gray) gleylike A horizon about 4 to 8 inches thick. This is underlain by a light yellowish-brown B horizon of medium blocky structure that is profusely mottled and

streaked with strong brown and dusky yellow. A very compact semi-cemented layer almost impermeable to water occurs in some soils at 15 or 20 inches. This "hardpan" is highly mottled but somewhat lighter in color than the layer above. This "pan" usually grades into compact parent material that is less strongly cemented, but it may overlie an unconforming stratum of silt or clay. The soils do not have well-defined textural profiles; the "hardpan" is very compact, and when dry is seemingly cemented. It is not indurated, however, and crumbles suddenly under hard pressure. After long periods of wet weather, the cementation is less apparent. The effect of this highly compact layer is to waterlog the entire soil for prolonged periods. It is probable that the gray color of the second horizon may be the result of very high microbiological activity on the relatively large quantity of organic matter of the surface layer and competition for oxygen with resulting reduction of iron compounds.

The Humic Gley soil series of Dutchess County have a mucklike layer high in organic material at the surface that is 6 to as much as 10 or 12 inches thick. It is underlain by medium-gray to light brownish-gray material only slightly mottled with yellow and brown. This material may continue to considerable depth with increasing mottling or may grade into light yellowish-brown strongly mottled material below 6 or 8 inches. The soil is saturated throughout the year under normal conditions, and organic matter accumulates on the surface in large quantities.

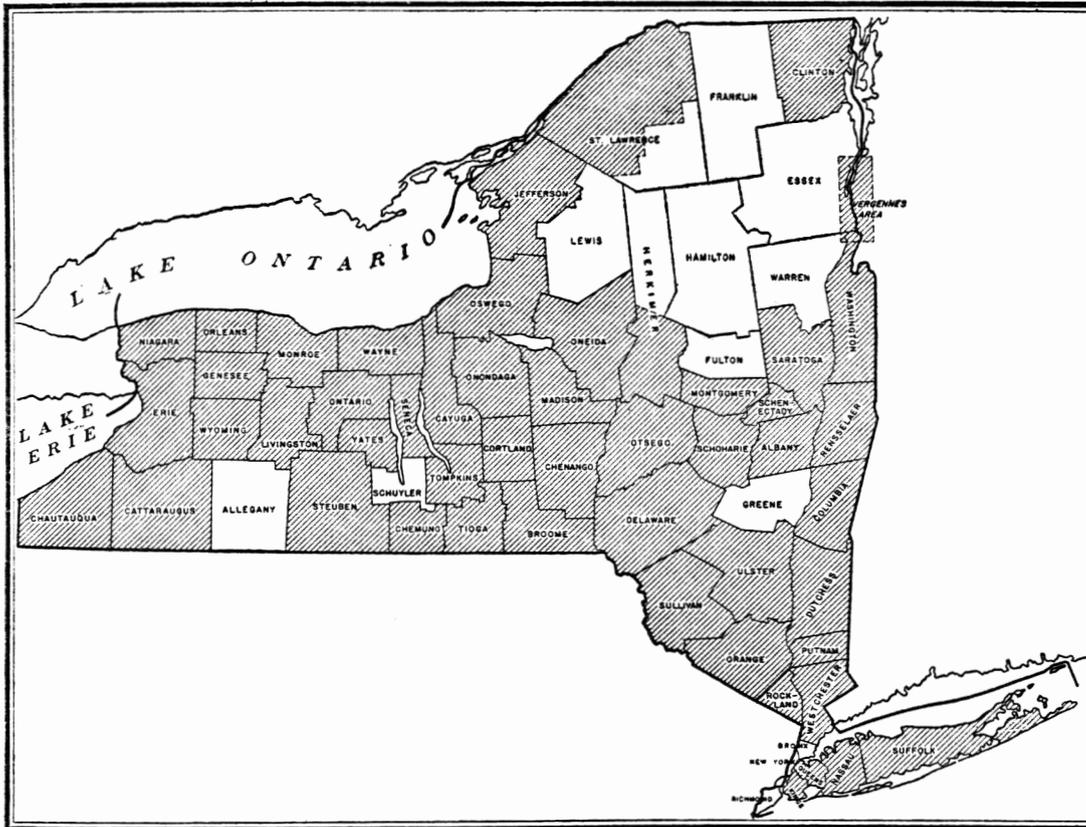
The Alluvial soils have been subdivided into four general types of profiles. In the typical alluvial soil profile, a weak A<sub>1</sub> horizon, darker in color than the underlying horizons, is generally present, but recognizable horizons below it are apparently caused mainly by accidents of deposition and not by genetic development through soil-forming processes. Some evidence of removal of bases from the upper parts of the profile can be found. The pH commonly increases slightly with depth.

Where the water table is high for relatively short periods of time, the soil material below 15 or 18 inches is mottled and streaked with rusty brown and yellow—weakly Hydromorphic profiles. Where the high water table is maintained for longer periods, the A horizon is brownish gray to dusky brown and mottling occurs from the surface downward—moderately hydromorphic profiles. Where the water table is permanently at or near the surface, a dark-gray to black mucklike horizon up to 8 inches thick occurs at the surface and the underlying mineral soil is medium gray or light brownish gray streaked with dusky yellow and dark yellowish brown—strongly hydromorphic profiles. In Dutchess County, the Wayland soil series includes both strongly and moderately hydromorphic profiles.

## LITERATURE CITED

- (1) BAYNE, M. C.  
1937. COUNTY AT LARGE. 194 pp., illus. Vassar College, Poughkeepsie, N. Y.
- (2) BIZZELL, J. A.  
1930. THE CHEMICAL COMPOSITION OF NEW YORK SOILS. N. Y. (Cornell) Agr. Expt. Sta. Bul. 513, 25 pp. illus.
- (3) FENNEMAN, N. M.  
1938. PHYSIOGRAPHY OF EASTERN UNITED STATES. 714 pp., illus. New York and London.
- (4) GUSTAFSON, A. F.  
1940. SOIL AND FIELD-CROP MANAGEMENT FOR SOUTHEASTERN NEW YORK. N. Y. (Cornell) Agr. Expt. Sta. Bul. 746, 31 pp., illus.
- (5) ———  
1944. FARM MANURE, ITS PRODUCTION, MANAGEMENT, AND USE. N. Y. Agr. Col. (Cornell) Ext. Bul. 642, 32 pp., illus.
- (6) JOHNSTON-WALLACE, D. B.  
1938. PASTURE IMPROVEMENT AND MANAGEMENT. N. Y. Agr. Col. (Cornell) Ext. Bul. 393. 42 pp., illus.
- (7) ROBERTS, E. A. and REYNOLDS, H. W.  
1938. THE ROLE OF PLANT LIFE IN THE HISTORY OF DUTCHESS COUNTY. 44 pp., illus. Poughkeepsie, N. Y.
- (8) UNITED STATES DEPARTMENT OF AGRICULTURE  
1938. SOILS AND MEN. U. S. Dept. Agr. Yearbook 1938, 1232 pp., illus.





Areas surveyed in New York shown by shading.

# 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](http://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](mailto: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](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](mailto:program.intake@usda.gov).

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