Issued September 5, 1914.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE NEW YORK STATE COLLEGE OF AGRICULTURE, CORNELL UNIVERSITY, L. H. BAILEY, DIRECTOR; E. O. FIPPIN, IN CHARGE OF SOIL SURVEY.

SOIL SURVEY OF ORANGE COUNTY, NEW YORK.

BY

G. A. CRABB, OF THE U. S. DEPARTMENT OF AGRICULTURE,
AND T. M. MORRISON, OF THE NEW YORK STATE
COLLEGE OF AGRICULTURE.

J. E. LAPHAM, INSPECTOR NORTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1912.]

WASHINGTON:
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1914.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Soils,
Washington, D. C., February 4, 1914.

Sir: In continuance of the work in New York, which is being carried on in cooperation with the State, a survey of Orange County was undertaken during the field season of 1912. The selection of this area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this area, and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1912, as provided by law.

Respectfully,

Milton Whitney,
Chief of Bureau.

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

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SOIL SURVEY OF ORANGE COUNTY, NEW YORK.

By G. A. CRABB, of the U. S. Department of Agriculture, and T. M. MORRISON, of the New York State College of Agriculture.

DESCRIPTION OF THE AREA.

Orange County is located in the southeastern corner of New York State. It is irregular in outline, and comprises 834 square miles, or

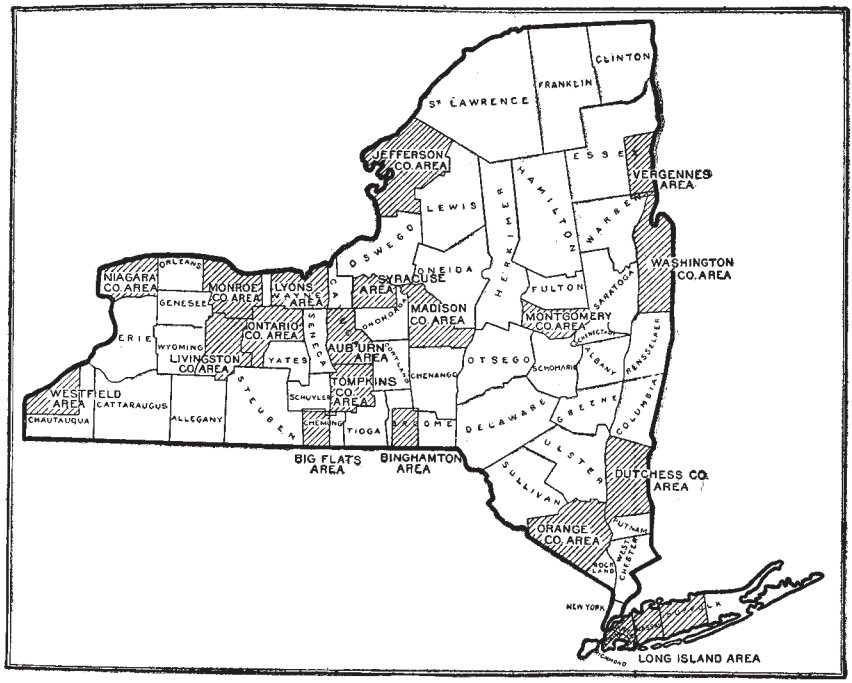

FIG. 1.—Sketch map showing areas surveyed in New York.

533,760 acres. It is bounded on the east by Dutchess, Putnam, and Westchester Counties, from which it is separated by the Hudson River, and on the southeast by Rockland County. The southwestern boundary is formed by the New Jersey and Pennsylvania State lines, the latter formed by the Delaware River, separating Orange County from Passaic and Sussex Counties, N. J., and Pike County, Pa. It is bounded on the west and north by Sullivan

and Ulster Counties, N. Y. On the extreme western boundary Mongaup River marks the division between Orange and Sullivan Counties, while on the northwest these counties are separated by the Shawangunk Kill.

The surface features of Orange County are diversified. They vary from the level "drowned lands" of the Wallkill River to the rugged peaks and ridges of the Highlands. The greater part of the county is included in a country of hills and ridges and of broader valleys with more even topography. The elevation ranges from sea level on the Hudson, which has tidal flow, to 1,680 feet on Schunemunk Mountain. In general average elevations vary from 800 to 1,200 feet in the mountainous sections to 300 to 500 feet in the Wallkill-Newburgh Valley.

The surface of the entire county has been modified by glacial action. The region most influenced by glaciation is that west of Newburgh, where the glacial drift has a depth of 500 feet or more. The section least affected is in the Highlands along the Hudson River, about the Schunemunk and other mountains in the southeastern part of the county, the Shawangunk Mountains in the west-central part, and the Catskill Plateau west of the Neversink River.

Broadly, Orange County comprises four physiographic divisions, the large, broad valley extending from northeast to southwest through the central part of the county, bordered by hills and ridges, with small streams between, the mountains of the Highlands on the southeast, the Shawangunk Mountains on the northwest, and west of the Shawangunk range the Catskill Plateau, which is separated from the mountains on the east by the Neversink River Valley.

The southeastern part of the county, including the Highlands, is the most extensive mountainous section. The Highlands consist of a number of separate ranges which rise abruptly from the Hudson River on the east. The principal mountain ranges are the Stockbridge, Goshen, Letterrock, Bellvale, and Warwick Mountains. Storm King is one of the principal peaks. The ranges also include Bear Mountain, Stevens Mountain, Black Mountain, Rascal Mountain, and Black Rock Hill. The elevations range from about 1,200 feet to 1,500 feet above sea level. This Highlands region is broken by the Ramapo River and Greenwood Lake valleys and by numerous small streams. On the New Jersey line near the Wallkill are the Pochuck Mountains, and farther north are Mount Adam and Mount Eve, all of granitic rock. The Schunemunk Mountains are separated from the Highlands by Woodbury Creek. These mountains are very abrupt and broken. The land is nonagricultural, and it is for the most part classified as Rough stony land and Rock outcrop.

In the western part of the county, just to the east of the Neversink River Valley, are the Shawangunk Mountains. These mountains

consist of a series of ridges extending in a northeast-southwest direction, separating Deer Park from the remainder of the county. Their altitude varies from 1,300 to 1,400 feet above sea level.

The entire region west of the Shawangunk Mountains is of little value agriculturally, with the exception of the Neversink River Valley, which is extensively cultivated.

The uplands for the most part constitute a somewhat broken plateau extending southwest from the Catskill region. This part of the county is hilly and ridgy, with some extensive areas of fairly regular topography. It includes a number of streams with narrow valleys. The ridges and hills are often composed of Rock outcrop, or are very rocky and broken. The elevated areas rise abruptly from the Neversink, Mongaup, and Delaware Rivers.

Granite has been quarried at different points in the Highlands and on Pochuck Mountain near the New Jersey line. Limestone is available for building purposes, road making, and for the manufacture of lime. It is widely distributed throughout the central part of the county. Flagging stone is obtained quite extensively on the plateau west and north of Port Jervis. The clays along the Hudson River are extensively used for building brick, the manufacture of which constitutes an important local industry. Clay from deposits in other parts of the county is used for the manufacture of brick and drain tile. Iron mining was an important industry at one time, particularly in the Highlands section of the county, but practically all of the iron mines have been abandoned. Zinc and lead mines have been operated at various places and arsenical deposits also have been worked.

The great central valley, which extends from the Hudson River on the east to the Shawangunk Kill and the Shawangunk Mountains on the west, consists of rolling upland broken by hills, ridges, and valleys. The hills and ridges have been smoothed and rounded by glacial action and are quite regular in surface features. Numerous small, abrupt peaks or ridges are found. The valleys are generally broad.

This central valley is divided by Wallkill River, a retrograde stream which enters the county from New Jersey on the south near Unionville, flows northeast across Orange County, entering Ulster County at a point just north of Walden and emptying into the Hudson River near Kingston. The Wallkill and its tributaries carry a large part of the drainage of Orange County. The river has a wide valley and many streams flow into it. The most important of its many tributaries are Pochuck, Quaker, and Rutgers Creeks, Muddy Kill, and Tin Brook. For several miles the Wallkill flows through the extensive area known as the "drowned lands." Along

this part of the stream the current is quite sluggish and the river course is extremely meandering. The "drowned lands" are naturally poorly drained and for many years were impassable swamps. By straightening the course of the river and constructing new channels to carry off the excess water these lands have been made the most valuable of any in the county.

Other important drainage ways are the Shawangunk Kill, which flows in a general northeast direction and for several miles forms the boundary between Orange and Sullivan Counties, Indigot Creek, which empties into Rutgers Creek, and the Dwaar Kill, which flows northeast into Ulster County. Wawayanda Creek flows southwest, passing through the town of Warwick into New Jersey.

In the eastern part of the county Moodna Creek, Woodbury Creek, and the Otter Kill are the principal streams. Gidneytown Creek and Quassaic Creek are the main drainage ways of the northeastern part of the county. Bushfield Creek empties into Orange Lake, whose outlet is Quassaic Creek. The southeastern section of the county is drained either directly by the Hudson River or by the Ramapo River, the outlet of Tuxedo Lake, which flows southward into New Jersey. West of the Shawangunk Mountains all of the drainage is into the Delaware River through the Neversink River and its main tributary, the Basher Kill, and through the Mongaup River on the west.

All of the drainage waters of Orange County are received by the Hudson and Delaware Rivers.

There are numerous lakes in Orange County, which are largely used for municipal water supply. While many of these lakes are the sources of streams, a few have no visible outlet.

Orange County was organized in 1683, and at that time it comprised areas now included in Rockland and Ulster Counties. The boundaries of the county were changed several times and were definitely established in 1801.

At the time of its organization Orange County was inhabited by only a few scattered families, mainly along the Hudson River. Settlement extended into the interior of the county about 1690 and a census taken in 1698 shows a total population of 219. Since the beginning of the eighteenth century the population of Orange County has had a remarkably steady growth.

In character and origin the population is quite varied. The earliest settlers were Dutch, English, French, German, Irish, and Scotch, and subsequent immigration was largely from the New England settlements. The present population consists largely of descendants of these early settlers. During recent years there has been a steady immigration of foreigners, who, as a rule, find employ-

ment in the manufacturing industries, though a great many are working on the farms, especially on the Muck soils in the vicinity of Florida, Pine Island, Big Island, and Durlandville, where trucking is important. The present foreign element is composed of Poles, Hungarians, Swedes, Norwegians, and Italians. There are some negroes in the county, mainly in the towns, although a part of the negro population furnishes farm labor.

Orange County is less thickly settled in the southeastern and western mountainous regions than in other sections. According to the 1910 census, the county has a population of 116,001. In 1900 it was reported as 103,859, and in 1890 as 97,859. Goshen, with a population of 3,081, is the county seat. It is situated on the main line of the Erie Railroad near the center of the county. Goshen is the terminal of the Montgomery and Pine Island branches.

Newburgh is the largest city in the county, having a population of 27,805. It is located on the Hudson River and is on the West Shore and the Erie Railroads. The main line of the New York Central & Hudson River Railroad is available at Fishkill, on the opposite side of the Hudson, by means of the ferries. Middletown and Port Jervis, with populations of 15,313 and 9,564, respectively, are important places because of their manufacturing industries.

The many varied industries of Orange County include bleacheries, iron foundries, and shipyards. Soap, wire, chairs, lace curtains, cotton goods, ice machines, engines, cement, and plaster are manufactured. One of the largest lawn-mower factories in the world and a large factory for the manufacture of fabrikoid, or imitation leather, are located within the county. The manufacture of woolen goods, the distilling of liquors, and the manufacture of paper were important industries at one time.

The transportation facilities of Orange County are good. The Hudson River furnishes cheap freight and passenger service between the county and its largest market, New York City, and to many local points. The freight boats on the Hudson River carry the bulk of all freight within reach of shipping points, with the exception of milk, which is generally carried by rail.

A number of railroads traverse different parts of the county. All of these roads provide special daily milk trains to the large markets in New York City. Special trains are also furnished for the truckers for transporting produce from the extensive trucking districts near Florida, Chester, and Pine Island. Two electric roads are also in operation within the county, and one—the Orange County Traction Line—carries passengers and operates freight and express cars.

The public roads are kept in good condition. There are many miles of excellent State highway connecting nearly all of the towns.

Owing to the good condition of the roads, transportation is easy, and little difficulty, aside from that caused by a few hills where the grade is steep, is experienced in marketing farm products.

A large number of excellent markets are available to Orange County; local manufacturing and industrial centers constitute ready markets for all agricultural products. The principal markets within the county are Newburgh, Goshen, Middletown, Walden, and Port Jervis. Practically all of the products of Orange County not consumed locally are shipped to New York City, which is only about 70 miles distant from the most remote parts of the county.

CLIMATE.

A fair idea of the general climatic conditions of Orange County is given by the tables below, the figures being compiled from data recorded at the Weather Bureau station at Port Jervis, lying at an elevation of 470 feet, and at West Point, at an elevation of 167 feet.

Normal monthly, seasonal, and annual temperature and precipitation at Port Jervis.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.[1]
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	28.2	66	−11	3.60	1.88	3.86	11.2
January	24.1	67	−20	3.38	2.65	3.00	10.1
February	25.2	69	−14	3.59	2.73	4.37	15.0
Winter	25.8			10.57	7.26	11.23	36.3
March	33.9	88	− 8	3.52	2.94	3.68	9.6
April	47.0	92	14	3.12	4.25	3.52	2.1
May	59.5	94	26	4.25	1.22	1.00	0.0
Spring	46.8			10.89	8.41	8.20	11.7
June	67.4	96	38	4.01	2.31	13.76	0.0
July	71.0	103	42	5.16	3.90	4.50	0.0
August	69.1	100	40	4.33	3.29	8.25	0.0
Summer	69.2			13.50	9.50	26.51	0.0
September	62.9	95	29	3.79	2.53	1.52	0.0
October	50.7	88	20	3.59	1.70	10.60	0.0
November	38.5	73	8	2.94	2.50	1.99	3.4
Fall	50.7			10.32	6.73	14.11	3.4
Year	48.1	103	−20	45.28	31.90	60.05	51.4

[1] Snowfall data are for the period from 1880 to 1903. Other data from 1880 to 1909.

Normal monthly, seasonal, and annual temperature and precipitation at West Point.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
	° *F.*	° *F.*	° *F.*	*Inches.*	*Inches.*	*Inches.*
December	31.4	65	− 2	3.55	2.89	2.26
January	27.7	64	−15	3.48	1.70	3.27
February	28.4	56	−11	3.38	1.00	5.45
Winter	29.2			10.41	5.59	10.98
March	36.4	72	− 1	3.64	2.40	3.23
April	48.6	93	18	3.68	1.70	5.84
May	59.9	95	28	4.48	2.41	7.99
Spring	48.3			11.80	6.51	17.06
June	69.6	99	39	3.53	3.18	3.77
July	74.0	103	40	4.62	1.10	10.48
August	72.2	97	35	4.61	4.57	7.87
Summer	71.9			12.76	8.85	22.12
September	64.8	99	30	3.72	2.78	3.95
October	53.4	90	20	3.76	2.18	3.85
November	42.0	73	5	3.92	4.73	5.60
Fall	53.4			11.40	9.69	13.40
Year	50.7	103	−15	46.37	30.64	63.56

There is quite a wide range in the temperature of the county, the tables showing an absolute maximum of 103° F. and an absolute minimum of −20° F. A mean annual temperature of 48.1° is recorded at Port Jervis and of 50.7 at West Point. The county has a heavy snowfall, averaging 51.4 inches annually at Port Jervis. The snowfall is practically confined to the winter and spring months, and is heaviest in February. The rainfall is fairly heavy and is generally well distributed throughout the growing season, although at times crops suffer from excessive precipitation or from drought at critical stages or during harvest time. The rainfall is greatest during the summer months, the mean precipitation for this period being 13.50 inches at Port Jervis and 12.76 at West Point. The means for the spring and winter months are about equal. There is a wide variation, however, between the annual precipitation for the driest and wettest years, the figures being 31.90 to 60.05 inches, respectively, at Port Jervis, and from 30.64 to 63.56 inches at West Point.

The average length of the growing season is approximately 161 days. At Port Jervis the average date of the last killing frost in the spring is April 30 and of the first in the fall October 10, while the latest date recorded in the spring is May 17 and the earliest recorded in the fall is September 15. The average date of the last killing frost in the spring, according to the records of the West Point station, is April 20, and of the first in the fall October 17, while the latest date recorded at this station in the spring is May 6 and the earliest recorded in the fall September 28.

Since the growing season in Orange County is limited mainly by the occurrence of killing frosts, this is a matter of importance to the farmers, and with a view to the protection of crops considerable attention is given to the exposure or slope of the land, the elevation, the physical properties and water content of the soil, and the air drainage.

The southern exposures are the warmest, the southeastern next, with the eastern, southwestern, and western, in order, the northern exposures being the coldest. With reference to liability to frosts these exposures may be arranged in opposite order, with the northern most liable and the southern exposures the least liable. This does not mean that a southern exposure is always best for the planting of crops, especially fruit, because the higher temperature resulting from exposure to the more direct rays of the sun often tends to bring out the buds too early and increases the danger of killing by late frosts. One of the best protected orchards in the county, where loss by frost is probably least likely to occur, is on an eastern exposure with a high hill to the west. The failures of fruit crops in this orchard have been rare.

In poorly drained and poorly cultivated areas crops are more subject to damage by frost than in areas where the soil is kept well drained and in good physical condition. Frosts are more destructive in the valleys than in the upland.

AGRICULTURE.

Throughout the history of the county the most important agricultural area has been the central belt, including the area in which the Dutchess and Dover soils predominate. The country occupied by Culvers soils, especially the large area lying west of the Basher Kill Valley, is not and apparently never has been of any agricultural importance. The latter area now supports a second growth of oak and chestnut brush and has very little value for anything but cordwood. The eastern part of the county, that part included in what is usually known as the Highlands, is also of very little agricultural

importance. The eastern slope of Shawangunk Mountain is extensively cultivated, but this area does not rank with the central belt of the county in production.

In general, the farming and stock-raising industries, as well as dairy farming, are well distributed over the agricultural part of the county, dairying being more prominent near the railways and stock raising and grain farming predominating in more distant sections. Similarly, the production of apples is widely distributed over the agricultural area of the county. The growing of small fruits, however, as well as the main part of the area in peach orchards, is confined to the eastern, mainly the northeastern, part of the county, though more or less development has taken place at other points in the Hudson River hills.

Prior to the settlement of Orange County, the aborigines of the region were engaged in the cultivation of corn. Immediately after establishing their homesteads the early settlers commenced the practice of agriculture.

The original forest growth consisted of oak, chestnut, butternut, hickory, willow, beech, birch, elm, mulberry, several varieties of pine, hemlock, cedar, tamarack, and cherry. Areas in the agricultural section were cleared, the timber being used for houses and fences and for the manufacture of charcoal and pot and pearl ashes. Some lumber was exported, and some of the timber was used in shipbuilding.

The early settlers began by growing whatever crops were needed to furnish food and clothing for themselves. After the county became more thickly settled additional crops were grown for market, but agricultural progress was slow, considerable attention being given to manufacturing. Wheat and corn were the earliest crops grown. These were the staple articles of food. Flax was grown for the manufacture of clothing. Wild blackberries, raspberries, and strawberries were abundant. Orchards of apples, pears, and cherries were planted. Sheep and cattle were raised, the wool produced being used for clothing and the hides for leather. With the development of farm lands in the western part of the State and in other States in the West, wheat became less prominent. The live-stock industry was more important in the central and western parts of the county, where good pasture land was available, than along the Hudson River, because travel was more difficult and transportation facilities meager, and stock could be grown, fattened, and driven to market more easily than grains could be handled.

The live-stock industry has always been of great importance, but it is not so extensive now as in the past. Dairying and horse raising are the principal branches of this industry now practiced, while poultry is also important.

The total value of live stock increased from $1,953,092 in 1850 to $4,672,529 in 1870. In the 1900 census the value of domestic animals is given as $3,347,806, while in 1910 it is reported as $4,654,754.

Dairying is the most important of the live stock industries. The value of dairy products is reported as $669,866 in 1840, while $3,537,640 was received from the sale of such products in 1909. Prior to 1842 the greater part of the milk was converted into butter. The greatest amount of butter produced is reported by the 1840 census, in which the total is given as 3,769,034 pounds. Very little cheese was produced at that time. The amount of butter produced decreased steadily until in 1900 only 327,057 pounds were made. The 1910 census reports a production of 212,111 pounds. The production of cheese has never been a prominent feature of the dairy industry. The greatest amount produced, as given by the census, is 33,800 pounds in 1870.

Since 1842 the production and sale of milk has gradually supplanted other phases of dairying. The shipment of milk began with the opening of the Erie Railroad. At the outset the principal dairy section was that between Otisville and Arden. At present milk is shipped from all parts of the county, with the exception of the roughest and most remote sections. Shipping stations, skimming plants, and creameries are distributed throughout the county and solid milk trains carry milk from all points to the large markets every day. The greatest amount of milk produced in any year, according to the census, was in 1900, when it reached 31,889,010 gallons, of which 29,617,072 gallons were sold. In 1910, 23,905,147 gallons were produced.

There are many herds of pure-bred cattle in the county, though for the most part the dairy cattle are grades. The pure-bred herds include Holsteins, Jerseys, Guernseys, and other dairy breeds. The Holstein is the most popular breed. In the 1910 census a total of 45,882 dairy cows is reported.

Horse raising has for many years received considerable attention. It consists for the most part now in the raising of light harness horses, race horses, and fancy carriage horses. Excellent pastures are available in many parts of the county.

The poultry industry is an important branch of agriculture. In 1910 the total value of poultry is reported as $209,660.

In the census for 1840 a total of 47,084 hogs was reported in Orange County. Since that time the number has decreased, with some fluctuation, and in 1910 only 8,838 hogs were reported. When the greatest number of hogs were raised the dairy industry was confined largely to butter making and the production of cream, so that an abundance of skimmed milk and buttermilk was left on the farms and was used as feed. With the increase in the amount of milk shipped the number of hogs raised has decreased.

The sheep industry has likewise undergone very decided changes. In 1840 a total of 50,218 sheep were reported in Orange County, and 108,876 pounds of wool were produced. In 1850 the number of animals had dropped to 23,562, and the wool produced to 47,438 pounds. The industry has never been revived. The 1910 census reports only 3,904 sheep in the county. However, the wool produced per head has increased somewhat. The farms of Orange County are well suited for the raising of sheep, provided barns are available for their protection during severe winter weather. The hills and valleys make excellent pasture land, and any grain and hay necessary can be grown. Owing to the nearness of the markets of New York and Boston, the raising of winter lambs could be made a profitable special industry.

The production of hay in Orange County has gradually increased during the past 70 years. In 1840 a yield of 75,368 tons is reported. In the 1910 census a production of 138,241 tons from 109,520 acres is reported.

Corn is the only one of the grains that has increased in the total amount produced and in the acre yield. According to the census for 1840, 410,194 bushels were produced. The 1850 census reports 491,074 bushels, and the 1870 census 459,343 bushels. According to the 1880 census 619,753 bushels were produced, 19,427 acres being devoted to the crop. In 1890 a yield of 365,098 bushels from 10,209 acres is reported, and in 1900, 589,730 bushels from 13,584 acres. In 1910, 10,479 acres were devoted to corn, with a production of 451,179 bushels. The average yield per acre increased from about 30 bushels in 1870 to about 43 bushels in 1900. A large part of the corn crop is used as feed for stock, mainly as a green feed in late summer and early fall, and as silage.

The production of oats has decreased. In 1840, 417,701 bushels were produced. The 1910 census reports a yield of only 114,215 bushels from 4,749 acres.

Rye has decreased steadily in the total amount produced. In 1840, 326,668 bushels are reported, and in 1910 only 48,960 bushels were produced from 2,777 acres. In 1890 a yield of 74,388 bushels from 5,194 acres is reported. In 1900, 4,433 acres were devoted to rye, with a production of 72,980 bushels.

In 1840 a production of 94,774 bushels of wheat is reported. The highest yield of wheat, 103,196 bushels, is reported in the 1870 census. The 1900 census reports a production of 42,430 bushels from 2,844 acres, and the 1910 census 24,190 bushels from 1,281 acres.

Buckwheat is grown to a considerable extent, though, as in the case of most of the other grains, the total production has declined. In 1840 a production of 112,883 bushels is reported. The crop was grown on 1,028 acres in 1890, with a yield of 12,956 bushels. This

increased to 23,640 bushels in 1900 from 1,383 acres, but the 1910 census reports only 17,782 bushels from 940 acres.

Potatoes are grown to some extent, but the average yield is low. The greatest total production was reported in 1840, when the yield amounted to 359,563 bushels. Only 288,341 bushels were produced in 1909 from 3,063 acres. In 1900 the yield was 312,373 bushels from 3,544 acres.

The onion crop has become important, being confined to the Muck areas. In 1900 a production of 783,781 bushels from 1,571 acres is reported.

The production of nursery stock and flowers receives considerable attention.

Alfalfa is successfully grown and has proved valuable as a feed for dairy cattle. This crop can be grown on much of the upland and requires a carefully prepared seed bed on land which has well-developed internal drainage, either natural or artificial. The application of lime in amounts varying from 1,000 to 1,500 pounds per acre on the light sandy soils to 2,000 or 3,000 pounds on the stony loams or silt loams is generally necessary. Best results are obtained where the land is inoculated with soil from an alfalfa field at the rate of 200 or 300 pounds per acre. The inoculation of limestone soils is not generally considered necessary. Where the land needs lime and inoculation the addition of manure before plowing is beneficial, as this insures a stand of alfalfa. The best time for seeding is during the first part of August. This permits the alfalfa to make a good growth before winter commences.

Soy beans are an excellent crop to be used in connection with corn for silage.

Orcharding is an important branch of agriculture in Orange County. Many of the soils are specially adapted to the production of fruit, and owing to the excellent shipping facilities available this is a profitable industry. Both the large and small fruits are grown extensively. The total value of orchard products reported in the 1900 census was $231,463. In the 1910 census the total value of fruits and nuts is given as $382,505. The census for 1910 reports 122,633 apple trees, 212,879 peach and nectarine trees, 33,098 pear trees, 7,863 cherry trees, and 11,479 plum and prune trees, with a production in 1909 of 277,355 bushels of apples, 124,262 bushels of peaches and nectarines, 21,994 bushels of pears, 3,635 bushels of cherries, and 4,617 bushels of plums and prunes. In addition 200,733 grape vines are reported. The 1900 census reports 240 acres in strawberries, with a yield of 383,100 quarts, and 232 acres in raspberries and loganberries, producing 361,360 quarts. The 1910 census gives the production of strawberries as 795,411 quarts from 310 acres, and of raspberries and loganberries as 274,352 quarts from 156 acres. The greatest problem

encountered in the fruit industry is that of securing labor during the picking season.

Farming is now more specialized than at any time in the history of Orange County. It is largely divided between dairying, fruit raising, and trucking. Dairying is the principal industry, and the crops grown, consisting largely of hay and forage, are those that are needed to supply the dairies. Most of the grain fed, however, is shipped into the county. Trucking on the Muck lands represents the most intensive farming.

Some income is derived from forested areas, mainly in the production of cordwood and railroad ties. The 1900 census reports the value of forest products as $94,295.

The adaptation of soils to crops is recognized to some extent by the farmers of the county. Areas of the rougher hill country and the low, wet valley lands are used for permanent pasture. The bottom land, while generally too wet in the spring, furnishes excellent pasture in midsummer, when the hill lands suffer most from drought. Fields of light sandy soils and the thin soils are used largely for rye. Oats, corn, and potatoes are generally grown on both the upland and valley soils. Areas of the stony upland soils or of shale loam, where the drainage is good, are devoted mainly to orchards, which are given less cultivation than the ordinary crops. The Dutchess stony loam and shale loam are the types most extensively used for fruit growing. The value of the gravelly and sandy types as early soils is generally recognized. General farming and dairying are practiced on nearly all of the types, sometimes being confined to one type, and in other cases being carried on on a number of types in combination. The Muck soil is largely devoted to trucking, to which purpose it is well adapted. Special crops of onions, lettuce, celery, carrots, potatoes, etc., are grown extensively, and the land has a high value. The areas of rough topography are mainly forested. In some cultivated areas the surface is so uneven that the land is best adapted to forestry.

A large part of each farm is generally kept in grass, for use as permanent pasture. Timothy is the most popular grass. Redtop, clover, and alfalfa are grown.

But little effort is made by the farmers of Orange County to develop systematic crop rotations. The rotation commonly followed is corn one year and rye or oats the following year, the land then being seeded to grass or timothy, or a combination of timothy and clover to be cut for hay three or four years or more, and then used as pasture for as much longer. Many areas used for meadow and pasture have not been plowed for the last 10 years, and some for even a longer time. Some of the pastures have been permitted to remain in sod for so long that nearly all of the cultivated grasses sown

have been displaced by the wild native species. While the general plan of this rotation is good, the sod is usually allowed to remain too long. The most satisfactory practice is to apply a top dressing of manure to be plowed under at the end of the fourth or fifth year.

Fertilizers are not extensively used, except on the Muck lands, where they are applied in large quantities, ranging from 500 to 2,000 pounds per acre, according to the crop and the condition of the soil. The 1900 census reports an expenditure of $63,150 and the 1910 census an expenditure of $130,088 for fertilizers in Orange County. On the dairy farms the manure produced is applied to the soil.

In general the greatest problem confronting the farmer of Orange County is that of securing satisfactory labor. The general farm laborers consist largely of Italians, Poles, Hungarians, and Austrians. The wages range from $20 to $35 a month with board. During harvesting seasons day laborers are secured from the cities. In 1899, $811,430 was expended for farm labor and in 1909, $1,092,116.

Although somewhat better conditions prevail in some sections than in others, the farms of Orange County are, in general, well improved. In many cases the farms are owned by residents of the cities who use them for summer homes. Other owners operate the farms on a business basis with varying results. The land is generally in demand, and much of that sold in recent years has been purchased by city residents at a price above its agricultural value. For the most part, the farm buildings and fences are kept in good condition, and the farms have a generally prosperous appearance. The total number of farms in the county reported in 1910 is 3,935. The average size is given as 97.6 acres, of which 67.7 acres are improved. The total value of all farm property is reported as $35,516,309.

SOILS.

A comparatively large number of soils are mapped in Orange County, 40 distinct types or classifications having been recognized. These comprise several series which include two or more types each, besides a number of miscellaneous types. The separations are based upon the mode of formation, influence of the underlying rock upon the glacial till from which the soils are derived, and the texture of the soil material.

The soils may be divided as to manner of formation into (1) glacial-residual, (2) reworked glacial (old alluvial), (3) recent alluvial, (4) cumulose, and (5) cumulo-alluvial soils.

The glacial-residual group includes all of the soils formed by glacial action or by combined glacial and residual forces, as is the

case where the country rock is covered by only a shallow mantle of glacial drift or, as in some extreme cases, is practically bare of glacial deposit and the soil is affected markedly by materials from the underlying rock. This group is represented by the Gloucester, Dover, Dutchess, and Culvers soils.

The reworked glacial division is represented by the water-worked and water-deposited materials found in the high lake and stream terraces and kame formations. The soils in this class comprise the Hudson, Hoosic, Fox, Merrimac, Chenango, and Otisville series.

The recent alluvial soils are found in the present stream bottoms and are generally added to by successive floods. They are included in the Genesee, Clyde, and the Basher series. The cumulose soils are those formed in depressions and poorly drained areas where an excessive growth of vegetation has decayed, forming muck. The term cumulo-alluvial refers to those soils along the Wallkill River composed in part of muck or decayed organic matter mixed with the silty and clayey alluvial deposit from the streams. These soils are mapped as Wallkill.

The soils of Orange County are further divided according to the origin of the soil material—or the underlying rock formation—from which they were derived. Each soil series represents a group of soils of the same origin and mode of formation; each type represents a separation based on the texture, structure, color, organic content, and other important features.

As a whole, all of the soil material of Orange County has been affected more or less by glaciation. The extent to which it has been subjected to glacial action varies widely. In some places the deposits of glacial drift are several hundred feet in depth, while on the higher elevations glacial action has been very feeble. Where the glaciation has been slight the soil is influenced by the underlying rock; but where the deposit is deep, little if any effect is shown from the underlying material. Deep glaciation is marked generally by a more or less regular topography of fairly smooth hills and ridges, which frequently have a drumlinoid shape. Sometimes these ridges and hills have a rock core, though generally those of smoother surface are composed entirely of unstratified, unassorted glacial drift. This material is of all grades, from the finest clay to large bowlders, crushed together in a heterogeneous mass.

The direction of the glacial movement has been northeast-southwest, along the longer axis of the underlying rocks. It resulted in little intermingling of materials from the different formations over which it passed, and a predominance of the fragmental rock on each separate formation is the same as the bedrock beneath, marking the separation of series quite definitely.

Geologically, the rock formations from which the soils have been derived range from those of the earliest pre-Cambrian through those of the Cambrian, Silurian, and Devonian ages.

The pre-Cambrian formation occurs mainly in the southeastern part of the county. It consists largely of granite, gneiss, and schist. It occupies parts of Cornwall, Highland, Blooming Grove, Woodbury, Monroe, Tuxedo, Chester, and Warwick Towns. The topography is rough and mountainous. Glacial action has been slight, and the soil mantle is thin and broken. Because of the extremely rocky condition, it is mapped mainly as Rough stony land and Rock outcrop. Where areas of soil are found of sufficient size and depth to be separated as a soil type, they are recognized as the Gloucester stony loam. In the extreme southern part of the formation south of the town of Warwick the less stony areas are mapped as Gloucester loam. The greater part of this land is nonagricultural and is in forest, for which it is best suited. In the stream valleys where terraces have been formed the material is largely granitic or quartzose gravel; this is mapped as the Merrimac gravelly loam.

Limestones, occurring in various parts of the county, are of the Wappinger, Neelytown, Helderberg, and other formations. South of Mount Adam and Mount Eve, in the vicinity of Amity, a large area of crystalline limestone is encountered. The soils derived from these various limestones are generally ridgy to hilly in topography, and usually quite stony and rough, with numerous ledges outcropping. In texture the soil is generally a silt loam. It is very desirable for cropping where not too stony. A small area south of Amity is of more loamy character and, being stony, it is mapped as a stony loam. All of the soils overlying the limestone and showing decided influence by the underlying rocks are mapped as Dover soils; those terraces containing a large amount of limestone material are mapped as the Fox.

The greater part of the county represents the Hudson River formation, of Silurian age. This formation occurs to the west and north of the Highland portion of the county and to the east of the Shawangunk Mountains. The region is rather broken by ridges of limestone, granite, and some Medina and Oneida shales and sandstones, but the Hudson River formation practically covers the part of the county known as the Newburgh-Wallkill Valley. This formation consists of shales, slates, etc., the strata of which dip at various angles to the surface. They often show partial metamorphosis and are warped and bent into many shapes. The predominance of the slates, or grits, determines to a great extent the character of the resulting soil. The soils derived from the Hudson River formation are the Dutchess. The more deeply glaciated material forms the stony loam

and silt loam types, which are largely derived from the more gritty material. The least glaciated of the Dutchess soils is the shale loam. This is found where the deposit of material is shallow and to a large extent of residual origin. Some areas of this soil are quite free from large fragments of rocks, while others have a large content of slabs and irregular pieces of shale. The soil on this type as a whole is shallow and not well suited to general farming.

The most important type of this series is the silt loam. The topography is usually regular and characterized by rather broad valleys. In the shallower areas it is affected more or less by the underlying rocks, but in general it is a good soil and retains moisture well.

The rocks of the Silurian and Devonian age—the Medina and Oneida and the Catskill formations—give rise to the Culvers series. East of the Shawangunk Mountains this soil is characterized by numerous rocks of Shawangunk conglomerate and sandstone in which many quartz pebbles are imbedded. These loose rocks have been transported from the mountains on the north and in some cases the soils overlie the Hudson River formation, though not perceptibly affected by the latter. West of the Shawangunk Mountains the only area marked to any extent by the conglomerate is along the Neversink River and Basher Kill. West of that the characteristic rocks are from the Catskill group and consist mainly of the gray and brown sandstones of the Medina and Oneida, with occasional areas of the red Medina, although the latter occurrence is rarely sufficient to influence the soil.

There are also extensive areas of "blue flag" and occasional outcrops of Ithaca shales. The larger part of the western section is an eroded plateau. The streams form rather narrow, steep valleys and the surface is rough and stony. This area of uplands is principally Rough stony land, Culvers stony loam, and Culvers stony sandy loam. The soil mantle is not deep and its rocky nature renders it unfit for agricultural purposes. The region is nearly all forested and a large part of it is best kept in timber.

To recapitulate the derivation of the glacial-residual group: The soils derived from the crystalline rocks are included in the Gloucester series, those from the various limestones in the Dover, those from the Hudson River slates and shales in the Dutchess, and those from the conglomerates and sandstones in the Culvers series. These represent the unmodified glacial drift, except as it may be affected by the underlying rock on which it rests.

The reworked glacial material is classified according to the rock material of which it is composed, and the depth of water at the time of deposition. It includes all of the glacial terrace soils, both

lake and stream. The material formed and deposited during later periods is either recent alluvial, cumulose or cumulo-alluvial.

Of the glacial terrace soils, the Hudson probably represents the oldest. It is found in deep deposits, principally in the vicinity of Newburgh and Cornwall-on-the-Hudson, and along the Moodna and Woodbury Creek valleys. These are the deepest terraces of the county and contain the greatest variety of rock material. This indicates that the materials forming the Hudson series are drawn from a much wider range than any other of the terrace series. The variability in texture, or size of individual particles, also shows that it has been affected by a greater difference in currents than other series of like formation. It varies from the coarsest gravel to the fine sand and silt. It was no doubt deposited in a glacial lake, probably at the time of the impounding of the water on the south as the ice retreated. Unlike other series of the terrace deposits, it does not seem to be derived from any definite geological formation or upland soil.

The most important terrace soils areally and agriculturally are the Hoosic. These represent glacial lake and stream terrace deposits and are derived from the glaciated material of the Hudson River shales and slates. The coarser material is marked by slaty and shaly gravel and sands. The Hoosic series is represented in Orange County by four types, the gravelly loam, gravelly sandy loam, fine sandy loam, and silt loam. From its source of material or origin it is readily seen to be closely associated with the Dutchess series of glacial-residual formation.

The Fox gravelly loam, another high terrace soil, is closely associated with the Dover soils and is characterized by a high limestone content. This type is not extensive, but is very distinct in its occurrence.

Another clearly marked glacial lake and stream terrace soil is the Merrimac gravelly loam. This occurs largely in the Ramapo River and Greenwood Lake valleys. It is derived from glaciated crystalline rock material and is characterized by fragments of granite and quartz gravel. It is closely associated with the Gloucester series.

The most complete series of high terrace soils is the Chenango. It occurs only west of the Shawangunk Mountains, and is distinguished by its peculiar reddish tinge. The Chenango soils are derived from the Medina and Catskill formations and have been reworked and redeposited since glacial action occurred. The gravelly loam, gravelly sand, fine sand, sand, fine sandy loam, very fine sandy loam, and silt loam types are mapped.

The kame moraine deposits also consist of reworked glacial material. They occur as hills, ridges, and kettles of kame formation.

The soils are mapped as the Otisville. This series is characterized by numerous quartz pebbles and sands, and by the many shale fragments encountered in the soil section. Two types of this series are mapped, the gravelly loam and gravelly sandy loam.

The recent alluvial deposits occur in the stream valleys and in depressions where material from the surrounding uplands has been washed down and deposited in its present position. Some of these depressions are the bottoms of old glacial lakes. They are generally small, and the soil seems to result mainly from the deposition of material washed from the uplands rather than from purely stream action.

Areas occur along the streams that are formed almost wholly by stream deposition during periods of flood. The Genesee silt loam and the Basher silt loam are the soils most clearly formed in this manner. The latter has only a local development and is confined to the flood plain of Basher Kill. Its peculiar color is due no doubt to its source of material and to the drainage conditions.

The soils that are less clearly stream deposited are the Clyde silt loam and silty clay loam. These types have the appearance of having been laid down under lake conditions, though they have been more or less modified by stream action.

Of soils of cumulose formation, only one type is mapped, Muck. Muck represents the accumulation and deposition of decayed organic matter. It occurs in poorly drained areas where conditions have favored the extensive growth of plants. The material is many feet in depth. Muck areas occur most extensively in the "drowned lands" of the Wallkill and constitute the most valuable soil of the county.

A few miscellaneous soil types or classifications are mapped. Meadow consists of wet areas that are generally rocky and of low agricultural value and in which the material can not be satisfactorily classified into soil types. Rough stony land is the least valuable of possible agricultural land. It is too rough and stony to be cultivated and is even in some cases too rough for pasture. It is best adapted to forestry.

Rock outcrop is entirely nonagricultural and is often sheer rock. Madeland, as the term implies, comprises land which has been transported to its present position by artificial means.

These various soil types and classifications are discussed in greater detail with respect to color, depth, structure, location, and general agricultural value in the following pages. In the accompanying map the location and extent of the various soils are shown by colors and symbols.

The name and actual and relative extent of each soil type mapped are given in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Dutchess silt loam	130,688	24.5	Wallkill silty clay loam	1,792	0.3
Dutchess stony loam	104,128	19.5	Hoosic gravelly sandy loam	1,664	.3
Rough stony land	71,552	13.4	Chenango fine sand	1,216	.2
Muck	28,800	5.4	Chenango sand	1,152	.2
Dutchess shale loam	23,936	4.5	Chenango fine sandy loam	1,088	.2
Gloucester stony loam	23,040	4.3	Chenango silt loam	1,088	.2
Clyde silt loam	21,504	4.0	Merrimac gravelly loam	896	.2
Culvers stony sandy loam	21,120	3.9	Otisville gravelly sandy loam	832	.2
Rock outcrop	20,480	3.8	Dover stony loam	768	.1
Dover silt loam	13,120	2.5	Hudson silt loam	704	.1
Culvers stony loam	10,688	2.0	Basher silt loam	704	.1
Meadow	10,112	1.9	Hudson fine sandy loam	512	.1
Hoosic gravelly loam	9,856	1.8	Madeland	448	.1
Hoosic silt loam	6,464	1.2	Chenango very fine sandy loam	384	.1
Culvers loam	5,888	1.1	Gloucester loam	384	.1
Otisville gravelly loam	4,288	.8	Chenango gravelly sand	384	.1
Genesee silt loam	4,288	.8	Hudson gravelly sandy loam	256	.1
Clyde silty clay loam	2,944	.6	Fox gravelly loam	128	.1
Wallkill silt loam	2,368	.4	Hoosic fine sandy loam	64	.1
Chenango gravelly loam	2,176	.4			
Hudson gravelly loam	1,856	.3	Total	533,760	.....

BLACK SOILS.

WATER-LAID MATERIAL—MIXED DERIVATION.

CLYDE SERIES.

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

CLYDE SILT LOAM.

The surface soil of the Clyde silt loam in Orange County has the range in color typical of the series, and varies in depth from 6 to 10 inches. The subsoil is a silt loam. It is yellow and mottled with gray, the mottling increasing with depth until at 30 to 36 inches the

gray color usually predominates. Although the type as encountered in this county is fairly uniform in characteristics, it is subject to a few local variations. In wet areas the soil is darker than where better drained. While the upper subsoil is generally yellow, in places the gray color predominates. In some areas the lower subsoil at 24 to 30 inches is a silty very fine sand or a heavy very fine sandy loam.

The Clyde silt loam occurs in all parts of the county, with the exception of the section west of the Shawangunk Mountains. It is not developed in large single areas, but is widely distributed along nearly all of the stream courses, about the heads of streams, and throughout low-lying semiswampy depressions. The surface is usually flat, or only gently sloping. The type often adjoins areas of Muck.

The drainage of the Clyde silt loam is very poor. Owing to its position along the streams and in low depressions, it receives much water from the overflow of the various streams, together with the seepage from the surrounding uplands.

The type is composed of sediments deposited in old glacial lakes or by the streams during periods of flood or washed down the slopes of the surrounding uplands.[1] In some places all of these agencies have been active in the formation of the type. Glacial action is manifested in many areas by the presence of rounded glacial bowlders of foreign origin which, in places, interfere with cultivation.

The native vegetation includes elm, soft maple, linden, and beech, with some oak and hickory, and shrubs and water-loving plants and grasses.

The type is mainly in grass, either for pasture or for hay. Its best use is for grass until after it has been thoroughly drained, when it may be successfully utilized for corn, root crops, etc. Its general wet condition makes it very desirable for grass, especially for pasture. Even during dry periods the type is sufficiently moist to furnish abundant pasture when the surrounding uplands are suffering from the effects of drought. It remains wet quite late in the spring, so that early pasturing is not practicable. Where not too stony this soil produces excellent crops of hay, mainly timothy.

In many areas artificial drains have been installed, with the result that good crops of corn, yielding from 40 to 60 bushels per acre, are produced. Hay yields from 1½ to 2 tons per acre. Some root crops, such as carrots, turnips, and mangel-wurzels, are grown successfully.

No fertilizer has been used on the type and none is greatly needed. The application of lime, at the rate of 1,000 to 1,500 pounds per acre, is beneficial.

[1] The Clyde silt loam, as mapped in Orange County, includes some Papakating soil, consisting of black alluvial or stream-bottom material.

The chief value of this soil lies in its proximity to upland types, and its use in connection with these lands. The price ranges from $40 to $75 an acre, according to its condition and the character of the surrounding soil.

CLYDE SILTY CLAY LOAM.

The surface soil of the Clyde silty clay loam has the typical color range of the series. It averages about 8 inches in depth, and varies in texture from a heavy silt loam to silty clay loam. The subsoil is a mottled gray and yellow or drab and yellow silty clay loam to silty clay. In places the subsoil is brownish gray or bluish gray, only slightly mottled with yellow or brown. The structure, particularly that of the subsoil, is compact, owing to the high content of clay and the generally wet condition of the type. Although difficult to cultivate in its present condition, the type where properly drained is a fairly friable soil.

This type is widely distributed throughout that part of the county east of the Shawangunk Mountains. The areas are somewhat smaller than those of the Clyde silt loam, but have the same flat or depressed topography. The soil retains moisture longer than the silt loam, and is more in need of drainage.

The type occupies low-lying semiswampy areas, lowland bordering lakes, and areas along the courses and at the heads of streams. Many of these areas are the beds of old glacial lakes, and the soil consists of sediment deposited in them. In places, however, the soil is composed of sediment washed from the surrounding uplands into basinlike depressions, while in areas along the streams the soil was formed by both the washing in of sediments from the upland, the deposition of materials in old glacial lakes, and by the addition of some sediment from the flooding streams.[1] The areas along the streams are generally narrow. The type in places is very stony. The stones are granitic bowlders brought in by the glaciers.

The native vegetation is practically the same as on the silt loam, consisting largely of soft maple, elm, linden, and beech, with shrubs and water-loving plants and grasses.

Owing to the poor drainage of this soil, the cultivation of such crops as corn, etc., is not successful. The type is best adapted to grass for pasture and hay. Some of the areas are too wet for mowing, and are only suitable for pasture during dry seasons. The supply of water is plentiful throughout the year, and the pastures are excellent throughout even the severest droughts. Where drains have been installed good yields of corn and other crops are obtained. The agricultural conditions on this soil, as a whole, are not very good. Its

[1] Some Papakating soil is included with the Clyde silty clay loam, as mapped in Orange County.

wet condition, the occurrence of floods in the spring and during periods of heavy rainfall, and the presence of stones in local areas make it generally undesirable as farm land, except in connection with the upland types. It is subject to great improvement by thorough drainage and the liberal use of lime. Where dairying is carried on with sufficient upland for the production of feed crops, the Clyde silty clay loam is best utilized as pasture land. It ranges in value from $30 to $40 an acre.

Wallkill Series.

The surface soils of the Wallkill series range in color from black or dark brown to gray or yellow. The subsoils consist of a dark-brown or black mucky and peaty accumulation of organic matter, often interstratified with the soil material and extending to a depth of 3 feet or more. The Wallkill types occupy low, flat, poorly drained areas in the beds of old glacial lakes or ponds, or along some of the more sluggish streams where alluvial sediments have been deposited over muck and peat. In places the deposition of alluvial material is still in progress.

WALLKILL SILT LOAM.

The surface soil of the Wallkill silt loam is a black or dark-gray silt loam, mucky in places and varying from 6 to 18 inches in depth. The subsoil is a black mucky silt loam, underlain at about 30 inches by a black muck or a brown peaty muck. The soil is grayish when dry and, occurring in connection with the muck deposits, it is locally known as "gray muck." In some small areas the subsoil is yellowish.

This type is not extensive in Orange County. It occurs along the Wallkill River in the "drowned lands," and is frequently flooded.

The native vegetation consists of elm, soft maple, and willow as the principal trees, with many varieties of water-loving shrubs and grasses, nettles, and "horseweeds." Much of this soil has never been cultivated, being used for pasture and the production of hay. Where drained, onions, potatoes, carrots, and corn are grown successfully. Onions are the most important crop and yield from 100 to 150 sacks of 140 pounds each per acre. Potatoes yield from 100 to 150 bushels, hay 1 to 2 tons, and corn 30 to 50 bushels per acre. Owing to its silty character the soil is not especially adapted to the production of onions, and the crop on drained land is likely to suffer from drought unless carefully cultivated. The type, however, is well suited to corn and hay.

In the improvement of this soil, the most essential factors are drainage and protection from floods. Diking is necessary along the streams to prevent overflow, and drains are needed to carry off excess moisture.

The soil requires frequent shallow cultivation during the growing season. When not carefully tilled there is a tendency toward the formation of large surface cracks, especially during periods of drought. These cracks facilitate the evaporation of soil moisture, and often seriously hinder crop growth.

The agricultural conditions over drained areas of this soil are usually good. The value of land ranges from $40 to $75 an acre.

WALLKILL SILTY CLAY LOAM.

The Wallkill silty clay loam to a depth of 6 or 8 inches has the predominating color of the series, and consists of a mucky silt loam high in organic matter. The subsoil to about 24 inches is a silty clay of brownish-gray color. Below this it consists of a dark-brown to black mucky silty clay loam. In some cases the lower subsoil is a fine, black or dark-brown muck. Where properly drained the soil is quite friable and easily tilled. The type is high in organic matter, which imparts to the soil its friable structure and dark color.

This type is not extensively developed in Orange County. It is associated with the silt loam along the flood plains and "backwater" areas of the Wallkill River. It occurs as flood plain deposits and as slight deltas where tributary streams enter the Wallkill River, in the "drowned lands" section.

The native growth is practically the same as that on the silt loam, including elm, maple, shrubs, willow, and water-loving grasses.

This soil is too heavy for the successful production of onions, but makes excellent corn and hay land when properly drained and cultivated. Since a large part of it is too wet for cultivation, large areas are devoted to the native grasses for hay.

For the improvement of this type, the same treatment is necessary as in the case of the silt loam. The main requirements are protection from floods by straightening the river channel and the construction of dikes, drainage either by open drains or tiles, and proper cultivation under favorable moisture conditions. The Wallkill silty clay loam puddles easily if worked when too wet, subsequently baking and forming clods.

This soil is usually held in connection with upland soil, and is valued chiefly as hay and pasture land.

BROWN SOILS.

ICE-LAID MATERIAL—SHALE AND SANDSTONE.

CULVERS SERIES.

The surface soils of the Culvers series are predominantly brown. The subsoils are yellowish brown, with a peculiar reddish cast.

These soils are encountered in the northeastern part of the United States. They are derived mainly from the intermixing, under glacial action, of material from the Medina sandstone and Shawangunk conglomerate, the material having been deposited in part over the Hudson River shales. The soils are only slightly influenced by the shale. The topography varies from rolling to slightly hilly.

CULVERS STONY LOAM.

The soil of the Culvers stony loam ranges from loam to silty loam in texture, from brown to dark brown in color, and is 4 to 6 inches in depth. The color of the subsoil is yellowish brown, becoming lighter at about 36 inches. Rock fragments of sandstone and conglomerate are encountered in large quantities on the surface and throughout the soil section, making cultivation of the type difficult.

This type occurs in the vicinity of Hopewell in the town of Crawford along Shawangunk Kill, extending south along the Shawangunk Mountains, and in the high upland west of Neversink River. It occupies rolling to semimountainous uplands, and much of it is unfit for cultivation because of its rough topography. The natural surface drainage is good, though in the more nearly level tracts internal drainage is poor.

The greater part of this soil is forested, chiefly with second-growth chestnut, oak, and pine. The cultivated areas are devoted mainly to dairying and the growing of grass for pasture and hay. Some corn, oats, and rye are grown. Small orchards of apples and pears are found on this type, and while not well cared for these do very well.

Much of this soil is suitable only for forestry. Where the topography is favorable and the rock content is not too great, the type makes good mowing and pasture land, and is well adapted to sheep raising and dairying.

The agricultural conditions over the Culvers stony loam are only fair. Corn yields from 20 to 30 bushels, hay one-half to 1 ton, and potatoes 50 to 70 bushels per acre. The value of land of this type of soil ranges from $20 to $30 an acre.

CULVERS STONY SANDY LOAM.

The soil of the Culvers stony sandy loam consists of brown sandy loam from 5 to 8 inches deep. In some areas the color becomes a lighter yellowish brown, and the texture also varies somewhat, here and there approximating a loam. The subsoil is yellowish-brown sandy loam, the color being deeper than that of the soil. Numerous rock fragments, varying in size from a few inches to 1 or 2 feet in diameter, and consisting largely of gray sandstone, are scattered on

the surface and throughout the soil section. When cleared of timber and the surface stones the type can be cultivated, but tillage is difficult. This soil, however, is more easily tilled than the Culvers stony loam.

The Culvers stony sandy loam occurs only in the western part of Orange County. It is encountered on the western slopes of the Shawangunk Mountains and on the Catskill Plateau west of the Neversink River.

The topography is rolling to steep and broken, and in places numerous rock outcrops are found. Natural drainage is good, except in those areas near the base of the slopes, which receive the surface and seepage water from the surrounding uplands and are sometimes quite wet.

Only a small part of the Culvers stony sandy loam is cleared. The uncleared areas support a second growth of pine, oak, and chestnut. Along the western boundary of the county, bordering the Mongaup River, some of the original forest growth, mainly of chestnut and hemlock, remains.

Small patches of land have been cleared of timber and stone and are used for hay, pasture, and some corn. Apples in small orchards do well, and when sprayed and cultivated yield good crops of excellent fruit. This soil type is best adapted to forestry.

The agricultural conditions are poor and the land values low.

CULVERS LOAM.

The soil of the Culvers loam is similar in texture and structure to that of the stony loam. It consists of a brown to dark-brown loam, 6 to 8 inches deep, underlain by a yellowish-brown loam to silty loam. The main differences between the two types are the more uniform topography and decidedly lower stone content of the loam. Cultivation of this type is easier than of the stony loam.

The type is developed in small areas, closely associated with areas of the stony loam having a more gentle topography.

The same crops are grown on this soil as on the stony loam, but the agricultural conditions are better, and land values are slightly higher.

DUTCHESS SERIES.

The prevailing color of the Dutchess soils is brown. The subsoils are bluish, light brown, yellowish, or reddish yellow. The surface soils are friable and somewhat lighter than the subsoils. The series is encountered in the northeastern United States. The soil material is of glacial origin and derived from the Hudson River shales, slates, and sandstones. The topography is rolling to undulating or rough, much of the area consisting of rounded drumloidal hills. The drainage ranges from good to fair.

DUTCHESS SILT LOAM.

The surface soil of the Dutchess silt loam ranges in color from light brown to a deep or yellowish-brown or grayish color and in texture from a true silt loam to a silty loam or in places to loam. It is about 6 to 8 inches in depth. The subsoil is a brownish-yellow to pale-yellow silty loam, varying to grayish or pale yellow mottled with gray in the lower part of the section, where it changes to a loam in texture. The line of separation between the soil and subsoil is fairly distinct. Both soil and subsoil contain large quantities of angular and subangular shale fragments, and in places the subsoil carries considerable quantities of sand and fine gravel.

Although the type is generally uniform, there is some slight variation in both color and texture. In some areas the soil is darker and more loamy than in others. In places the subsoil is comparatively compact, being known locally as "hardpan." The soil material is sometimes sandy and friable. In general, the type is easily tilled, though where it is heaviest it is considered a cold, wet land.

The Dutchess silt loam is by far the most extensive soil type in Orange County. It is distributed throughout the county between the Highlands and the Shawangunk Mountains. It generally occurs in large areas, and is best developed through a strip extending across the county from north to south in the vicinity of Walden, Montgomery, Goshen, and Warwick, and over the high ridges and hills across the Wallkill Valley.

The topography of the Dutchess silt loam is that characteristic of the series, as stated in the series description, and the natural surface drainage is good, though some of the more level tracts and low depressions between the hills require artificial drainage. The internal drainage is poor, owing to the compact nature of the soil material.

Although some foreign material is found in this soil, it is derived mainly from the underlying rock. As a whole the glacial drift composing this type is deeper than that forming the stony loam, and varies less widely in depth. Rock fragments are scattered over the surface of much of the type. Some areas, particularly in the vicinity of Walden, have the appearance of having been slightly reworked by water, possibly under lake conditions, and the rock fragments in such places are less numerous than usual. In most of the farms on the Dutchess silt loam the stones have been removed from the surface and used in the construction of fences.

The native vegetation includes chestnut, pine, hemlock, oak, elm, hickory, beech, and maple. The forest growth is mainly a somewhat patchy second growth. Some of the steeper areas are best adapted to forestry.

The greater part of the Dutchess silt loam in Orange County is cleared and under cultivation, and it is the most valuable general farming type in the county. It is well adapted to a wide variety of farm crops, but is generally devoted to dairying, little attention being given to any crop other than hay, with corn for ensilage or fodder. The main hay crop is timothy and redtop. Fields are kept in sod for 8 or 10 years. The yield of hay ranges from three-fourths to 1½ tons per acre. Clover and alfalfa are also grown successfully with proper care and management, including thorough drainage, the preparation of a good seed bed, and the application of lime. Some corn is grown for grain, but much of the corn and other grain used for feed is shipped into the county. Oats and rye are the principal small grains grown. These give fair yields. Buckwheat is also a crop of some importance. From 100 to 150 bushels of potatoes per acre are obtained on well-drained areas with proper fertilization and cultivation. The type is also used for the production of apples, pears, peaches, cherries, and small fruits. The Baldwin, Greening, Spy, and King are the leading varieties of apples grown.

The agricultural conditions as a whole are good, as is indicated by the general appearance of the farms, fences, and buildings. There is a general need, however, of greater diversification of crops, better drainage, more thorough methods of cultivation, and the rational use of fertilizers and lime. Best results are secured where feed for stock is produced at home and where a systematic rotation of crops, in which legumes have a prominent part, is followed. The most successful farmers make a study of the adaptation of crops to the existing soil conditions, and grow alfalfa and clover where the conditions are at all suitable. Sheep raising and hay production offer excellent opportunities.

The value of this type varies considerably according to the location and condition of the land, the improvements upon it, and the use to be made of it. In general, the farms range from $75 to $150 an acre. Some of the well-developed farms have a much higher value.

DUTCHESS STONY LOAM.

The soil of the Dutchess stony loam consists of a brown, grayish-brown or yellowish-brown loam or silty loam, varying in depth from 4 to 8 inches. Beneath this to a depth of 18 inches the color and texture change, the former becoming yellower and the latter somewhat more silty than the surface soil. From 18 to 36 inches the material is a brown loam mottled with yellow. Both soil and subsoil contain many angular and glacially rounded rock fragments. These, while not large, are frequently present in sufficient quantities to preclude cultivation. The larger fragments have been removed

and used in buildings, fences, and road construction. The rock is usually shale and slate, thin-bedded sandstone from the underlying strata, and rounded glacial gravel and bowlders of granite and quartzite of foreign origin. Frequent outcrops and ledges of the underlying formations add to the difficulty of cultivation.

The Dutchess stony loam is one of the most extensive types of the county. It is distributed throughout the great central valley which lies west of the Highlands and the Hudson River. It is encountered on the northwestern slopes of the Highlands and the Schunemunk Mountains and on the eastern slopes of the Shawangunk Mountains. The type is not found west of the Shawangunk range or in the roughest part of the Highlands. It is fairly well developed from Newburgh north to the Ulster County line. Some of this area is quite rough and broken. This rougher portion consists of the southern end of Marlboro Mountain, which extends from southeastern Ulster into the northeastern section of Orange County. The largest development of the type is west of the Wallkill River. This area is broken by areas of the Dutchess silt loam and shale loam, Meadow, Muck, and various other types.

The topography of the Dutchess stony loam varies widely, ranging from nearly level to very rugged and steep. As a rule the surface is very uneven, and is marked by numerous rounded ridges and hills. These sometimes have elevations above the surrounding country of 100 to 200 feet or even more in the rougher and steeper sections. The outcrops of rock from the underlying strata are most common on the higher elevations. The lower situations resemble drumlin formations, comprising relatively low, broad hills or ridges. As a whole the topography is distinct and characteristic of this soil type. The topographic features are such that natural surface drainage is generally good to excellent. However, the character of the soil material, where of considerable depth, is such that artificial drains of either tile or stone are beneficial, even on the steep slopes. At the base of the slopes where the surface is more nearly level, and between the many ridges there are tracts that receive the excess surface drainage and seepage from the higher areas. These tracts are often much too wet for cultivation, and can be permanently improved only by artificial drainage. The many creeks and brooks which traverse this soil afford good outlets for the drainage water.

This soil contains very little foreign material. The degree to which glaciation has taken place varies widely, but the resulting soil material does not seem to have been moved any great distance. The glacial drift or débris varies in depth from a few inches on the highest hills to 500 feet or more in the deepest deposits. This material is unstratified and unassorted, ranging in texture from the

finest bowlder clay to sand and from fine gravel to bowlders weighing many tons. In the deepest deposits, such as the large, rounded drumlinoid hills and ridges, the bluish, compact material characteristic of glacial till is encountered. While the mechanical action of glaciers has been the chief factor in the formation of the type, ordinary weathering processes have had an important part in the formation of the material in the areas thinly glaciated.

The native vegetation consists of oak, elm, maple, chestnut, cedar, and locust. Very little of this type supports the original forest, though a considerable area is in second growth.

The Dutchess stony loam is generally used for dairying and is largely kept in grass and pasture. It is well adapted to this industry. The type constitutes a good general farming soil where not too rough and stony. Hay yields from one-half to 1½ tons per acre, corn 40 to 50 bushels, oats 20 to 30 bushels, rye 15 to 20 bushels, buckwheat 10 to 15 bushels, and potatoes 50 to 100 bushels per acre. The rougher areas are utilized for pasture and the more level and less stony areas for the growing of corn for ensilage and grain. The greater part of the grain used for feeding purposes is shipped into the county. Sheep raising offers excellent opportunities on this type. Those areas which are too rough for grazing cattle might be used for sheep pasture.

Fruit growing is an industry to which this soil seems exceptionally well suited. This industry is most highly developed in the northeastern part of the county between Newburgh and the Ulster County line. Apples, pears, peaches, plums, and cherries are successfully grown and the increasing acreage devoted to these fruits indicates that their production is profitable. Strawberries, blackberries, raspberries, currants, and gooseberries also are grown successfully. These find ready markets in the local towns and in New York and Boston. Outside of this fruit section there are many farm orchards and a few market orchards in other sections on this type.

Agricultural conditions are fair to good. Land values range from $30 to $50 or more an acre, depending on the condition of the soil, the improvements, and location.

DUTCHESS SHALE LOAM.

The Dutchess shale loam consists of a brown to light-brown loam 4 or 5 inches in depth, underlain by a yellowish-brown material of the same texture. Shale fragments are mingled with this fine earth in both soil and subsoil, and where the subsoil is deepest it is often a mass of shale fragments, with very little interstitial material, below 30 inches. The fine material, as a whole, is very silty and approaches a silt loam. There is little difference between the deepest phases of

the shale loam and the shallowest phases of the silt loam of the Dutchess series, the principal difference being the greater quantities of shale fragments and the corresponding lack of foreign material in the shale loam. In some areas the type is plastic, and in others it is somewhat gritty.

The rock fragments found in the soil mass and scattered over the surface vary greatly in size, ranging from small chips to large, slabby blocks. In some areas they merely give the soil a gravelly nature, while in others they are present in such large quantities as to prevent tillage. In many places the larger rocks have been removed from the fields and used for building fences or roads. Very few rounded gravel or stones of foreign origin are found in this soil.

The Dutchess shale loam is widely distributed throughout the great central valley between the Highlands on the east and the Shawangunk Mountains on the west. Extensive areas are located in the vicinity of Maybrook and north of Unionville. Other large areas occur in the towns of Warwick, Chester, Goshen, Blooming Grove, and Hamptonburg, and along the eastern side of the Shawangunk Mountains.

The topographic features are peculiar to this soil type. They consist mainly of rounded hills, knolls, and ridges, with small intervening valleys. Many rock ledges and outcrops occur. The hills and ridges have an uneven surface and are sometimes precipitous. Surface drainage is usually good, though some of the areas between the hills are in need of draining. Owing to the general open structure of the underlying rock the internal drainage is good. The lower slopes are often wet because of seepage from the hillsides above. The soil in such places is usually deep.

The native vegetation consists largely of chestnut and oak with some pine and hardwoods.

Owing to its rock content the tillage of this soil is difficult. In some localities the underlying rock is so close to the surface that the land can not be satisfactorily plowed. The greater part of the land is in pastures or forest. In some cases it is devoted to the production of hay, but the yield is frequently low, and the crop unprofitable. The pasture and hay fields suffer for lack of moisture during periods of dry weather. Farm crops such as hay, corn, oats, rye, and buckwheat are grown, and while the quality is usually good the yields are low. Buckwheat, however, is one of the most profitable crops grown. The soil is well adapted to potatoes, where the land is not too stony and rough, and where a good supply of organic matter is maintained.

Fruit growing is carried on quite extensively on this soil, and excellent yields, particularly of peaches, are obtained. The gentler slopes seem best adapted to fruit. The bush fruits also do well.

The rougher and more stony areas are best suited to forestry, as they are too rough for cultivation, and during dry seasons the pastures fail because of lack of moisture. The agricultural conditions of this type are only fair. Land values range from $30 to $50 an acre.

Otisville Series.

The surface soils of the Otisville series are brown and the subsoils yellowish in color. The topography varies from rolling to hilly. The soils are encountered in the northeastern section of the United States. They are derived from noncalcareous kame and esker material. These soils differ from those of the Rodman series in the absence of limestone as an important constituent. Drainage is usually good.

Otisville gravelly loam.

The soil of the Otisville gravelly loam is a medium-brown to yellowish-brown gravelly loam, 4 to 6 inches in depth. The subsoil is a yellow to yellowish-brown gravelly loam, grading in lower depths in some places into a gravel. The materials composing this type are loose and open and become more gravelly and sandy with increasing depth. Rounded and waterworn gravel and stones, from one-half inch to 3 or more inches in diameter, are scattered over the surface and throughout the soil section. In places sand predominates in the subsoil, while in others it is not encountered at less than 6 feet. Deep cuts show considerable stratification. Where the topography is favorable the type is easily cultivated.

This type is comparatively inextensive, and occurs mainly in the western part of the county and in the Wallkill Valley. It is developed in the vicinity of Otisville and near Bloomingburg, Crystal Run, New Hampton, Denton, Breeze Hill, between Ridgebury and Slate Hill, and near Westtown. The areas near Bloomingburg are not typical, not being uniform in occurrence or texture. The soil approaches a gravelly sand or sandy loam. This development is too inextensive, however, to be mapped separately.

The surface features comprise rounded hills, knolls, and ridges, with an occasional flat plain, and deep intervening depressions. The depressions are frequently occupied by lakes or ponds suggestive of kettle holes. The drainage is good, the internal drainage in places being excessive.

This soil is derived mainly from the Hudson River shales and Shawangunk conglomerate. Very little foreign material is encountered. The flat areas are doubtless outwash plains or deltas formed by the glacial streams.

The native growth consists largely of chestnut, pine, oak, sumac, and some shrubs.

The topography is generally unfavorable for tillage operations. In places crops suffer from drought. The type is used mainly for pasture. Where cultivated, corn, oats, rye, and grass for pasture and hay are grown. The soil is adapted to alfalfa and clover, and to fruits such as peaches, cherries, raspberries, blackberries, dewberries, strawberries, currants, and gooseberries. The sandier phases are suited to early potatoes and truck crops.

The land is usually held in connection with the upland types, and is valued at $25 to $40 an acre.

OTISVILLE GRAVELLY SANDY LOAM.

The surface soil of the Otisville gravelly sandy loam is a brown to light-brown gravelly sand to gravelly sandy loam 5 to 8 inches in depth. The subsoil is a yellowish-brown to yellow gravelly sand to 24 or 30 inches. Below this depth there is usually an increase in the sand content. In places gravel and sand layers are interstratified, generally below the 3-foot section. The gravel varies from fine to coarse and is mainly quartz. There are few large stones in the soil or on the surface.

This type occurs mainly in the Wallkill Valley north of Walden, near Pellets Island, Phillipsburg, and Breeze Hill, in the Moodna Valley near Idlewild, and near Otisville. The surface comprises rounded hills, knolls, and ridges, and drainage is good to excessive.

The native growth, which is rather sparse, is practically the same as that on the gravelly loam type. The type is not important agriculturally, and very little of it is cultivated. This is largely due to the uneven topography, though the tendency to droughtiness is also a hindrance to cultivation. The type affords some pasturage.

The type is adapted to fruit and vegetables. It is an early soil, and on detached areas, peaches, cherries, grapes, all kinds of berries, and potatoes and other vegetables could be grown successfully.

Land values on this type range from $30 to $40 an acre.

ICE-LAID MATERIAL—CRYSTALLINE ROCKS.

GLOUCESTER SERIES.

The soils of the Gloucester series are light brown, ranging to grayish; the subsoils are yellow. Scattered rocks and large bowlders occur in places, and small quantities of mica are sometimes present. The topography ranges from gently undulating to rolling or hilly, the hills usually being high, broad, and rounded. Drainage is fair to good and in places excessive. The soils are derived from a rather local glaciation of crystalline rocks, consisting chiefly of granite and gneiss, with a small amount of schist, the material being left as a

thin mantle of ground moraine. These soils are developed in northeastern United States.

GLOUCESTER LOAM.

The soil of the Gloucester loam varies from a brown loam to silty loam of friable structure and from 5 to 8 inches deep. The surface color in Orange County is darker than typical. The subsoil to a depth of 24 inches is a yellowish-brown loam. Below this depth it is reddish brown and has a higher sand content. While the subsoil is more gritty than the soil it is quite compact at 18 to 24 inches and is retentive of moisture.

This soil type is not extensively developed and occurs only in the southern part of Warwick Town, near the county line. Owing to the rolling to hilly topography surface drainage is good. The compact structure of much of the upper subsoil, however, is such that underdrainage would be beneficial.

The chief differences between this type and the Gloucester stony loam are that the latter type is generally much shallower, more stony, and of rougher topography. There is, however, a slight difference in the types as the result of a greater admixture of residual material from the underlying rock in the soil and subsoil of the stony loam.

The native vegetation consists largely of pine, oak, and chestnut, most of which is second growth.

Where cultivated, corn, oats, buckwheat, and hay are grown, though the yields are not large. Hay is the most important crop and in general the soil is well adapted to hay production. Much of the land is too steep for growing intertilled crops. Hay yields from one-half to three-fourths ton per acre, oats 25 bushels, and rye 10 to 15 bushels. Drainage, liming, and green manuring are needed to increase crop yields.

Some orchards of apples and peaches are found, and where properly cared for these give good returns.

The value of this land is comparatively low—$25 to $40 an acre.

GLOUCESTER STONY LOAM.

The soil of the Gloucester stony loam consists of a stony loam to stony sandy loam, of light-brown to yellowish-brown color, varying in depth from 4 to 10 inches. The subsoil is a reddish-brown or yellowish-brown loam of relatively high sand content. Both soil and subsoil are usually friable, and where free from rocks easily cultivated.

The lower subsoil is sometimes partly residual. Both soil and subsoil frequently contain mica scales.

This soil is encountered mainly in Cornwall, Highland, Tuxedo, and Warwick Towns. Other areas are found in Monroe, Chester,

and Newburgh Towns. It is developed at the base of steep slopes, as narrow bands paralleling the narrow valleys, and on shelves of rock in the rough districts. The type is mapped in irregular areas which are usually the less rough portions of the mountains.

The topography is in general rough and broken, the surface varying from gently sloping to steep. The type is generally surrounded by areas of Rough stony land or Rock outcrop.

The drainage is good, except in those areas at the base of the Highlands, which often lack proper drainage, owing to the accumulation of seepage water. The natural surface drainage is excellent.

Where the glacial deposits are thin, the underlying rocks have influenced the soil in both color and texture. A large number of rounded bowlders of glacial origin are distributed over the surface. The stone content is generally great enough to make cultivation extremely difficult. The stones are of varying size and are generally of the same material as the underlying strata, gneiss and granite of pre-Cambrian age. Where the glacial deposits are deepest, the subsoil is often compact.

The crops to which the Gloucester stony loam is best adapted are those that require the least cultivation, such as grass for pasture or hay. Some corn is grown, and oats and buckwheat yield fairly well. Good orchards of apples, pears, and peaches are found. Grapes could probably be successfully grown. The best use for the type, however, is for pasture or hay. Some of the roughest areas are suited only to forestry.

ICE-LAID MATERIAL—LIMESTONE.

Dover Series.

The Dover series includes types with light-brown or dark-brown to reddish soils, and light-brown to yellowish or reddish subsoils. Limestone fragments are scattered over the surface and throughout the soil and subsoil. These soils occur in those limestone lowland belts of the Appalachian region which have been subjected to glaciation. The topography is undulating to hilly, and drainage is good. Outcrops of limestone are common. The soils are derived from glacial till material which has been considerably modified by the admixture of local limestone material.

DOVER SILT LOAM.

The soil of the Dover silt loam consists of 6 to 8 inches of brown to yellowish-brown, friable silt loam. The subsoil is a light-brown silt loam somewhat heavier than the surface soil.

The thickness of the drift material from which this soil is derived varies greatly. It is generally much more than 3 feet, and ranges

to perhaps 100 feet or more in depth. There are, however, many areas of shallow soil where the underlying limestone is within 3 feet of the surface. Where the rock approaches the surface, the subsoil is usually darker in color and is sometimes partly residual.

The Dover silt loam is not of large areal extent in Orange County, but the areas are widely scattered. It occurs wherever the various limestones lie near enough the surface to have any effect on the soil material. It is most extensively developed in Warwick Town. Scattered areas are found in Newburgh, Goshen, and Wawayanda Towns.

The topography is rolling to hilly and often quite broken. The surface drainage is good, although in the more gently sloping areas artificial drains are beneficial, especially where the subsoil is compact.

The native vegetation includes oak, chestnut, locust, cedar, and some hickory.

The Dover silt loam is locally known as "limestone land" and is considered an excellent farming soil. While some of the areas are quite suitable for cultivation, others are somewhat rough, and in these tillage is possible only in patches. The greater part of the type is cleared and cultivated. The crops most generally grown are corn, oats, rye, wheat, clover, and alfalfa. The type supports excellent orchards of apples, pears, and peaches. Corn is usually grown for silage, but where produced for grain it yields from 40 to 75 bushels per acre. Wheat yields as high as 40 bushels per acre, oats 35 to 50 bushels, and rye 15 to 30 bushels. The yield of clover and timothy hay ranges from 1 to 2 tons per acre. Alfalfa is successfully grown, especially where the soil is thoroughly drained. The Dover silt loam responds readily to good treatment and the application of barnyard manure. It is utilized largely in dairy farming, and this industry furnishes a good supply of manure, which is the principal fertilizer used. Lime has been used with success.

The value of land on this type ranges from $50 to $100 an acre.

DOVER STONY LOAM.

The soil of the Dover stony loam is 8 to 10 inches in depth. The fine soil varies from a loam to silt loam in texture, and from brown to grayish brown in color. The subsoil is usually very similar to the soil, although in some areas it is heavier and has a more compact structure.

The type is inextensive. It is encountered in only a few areas, and these are mainly in Warwick Town. The topography is generally rough and broken, and the drainage is usually good.

The native vegetation, other than the grasses, is scattering, and consists largely of cedar. Some of the rough and stony areas support a thick growth of cedar.

Cultivation on the Dover stony loam is very patchy, owing to the rugged surface and the great number of rock fragments on the sur-

face and in the soil. The type is best used for pasture. Where the small, irregular areas are tilled, clover, timothy, corn, oats, and buckwheat are grown. Some orchards of peaches and apples are found.

The price of the land is comparatively low, although the value of the type for pasture land is relatively high.

WATER-LAID MATERIAL—SHALE AND SANDSTONE.

Chenango Series.

The soils of the Chenango series are prevailingly brown, ranging to reddish brown. The subsoils are brown to reddish brown or yellowish. The occurrence of stratified gravel and coarse sand at a depth of 3 feet or more is characteristic of the series. These soils occur in the northeastern and central States. They are developed along the streams in those sections of the glaciated region where the upland soils result from the glacial grinding of limestone, shale, and fine-grained sandstone, with an admixture of small quantities of material from areas of igneous and metamorphic rocks. The Chenango material was deposited by relatively rapidly flowing waters from the melting and receding ice masses. Upon the disappearance of the ice and the subsequent deeper erosion by less voluminous postglacial streams this material was left as terraces, which are not now subject to overflow. The Chenango soils are often associated with the Dunkirk series, of lake deposition, forming southward extensions of similar material along old glacial drainage ways.

CHENANGO SILT LOAM.

The soil of the Chenango silt loam is a dark-brown silty, very fine sandy loam or silt loam, with a depth of 8 to 10 inches. The subsoil is reddish-brown silt loam in places, grading downward into a very fine sandy loam. The type is generally friable and easily tilled.

This type is inextensive in Orange County. It is encountered in the Neversink River Valley. The topography is flat to slightly rolling. The type is generally developed as a stream terrace, although occasional areas are apparently high first bottoms. The drainage is only fair, and during wet seasons much damage is caused to intertilled crops. The type is subject to overflow only by extremely high waters, and then only the low-lying tracts near the streams are affected. Artificial drainage is beneficial, especially during wet seasons.

The greater part of the Chenango silt loam is cleared and cultivated. Its principal use is for hay and pasture. Corn, potatoes, cabbage, oats, and rye are grown successfully.

The agricultural conditions on the Chenango silt loam are very good. Land values range from $60 to $100 an acre.

CHENANGO VERY FINE SANDY LOAM.

The surface soil of the Chenango very fine sandy loam is a dark reddish brown very fine sandy loam, with a depth of 5 to 8 inches. The upper subsoil is similar in color and texture to the soil, but in places changes in its lower depths to a very fine sand of pinkish-gray color. The soil and subsoil are friable and good tilth can easily be maintained by proper cultivation.

The Chenango very fine sandy loam occurs in the valley of the Neversink River. The surface is level to sloping and drainage is fair to good.

All of this soil is under cultivation, being utilized for the production of general farm crops or for dairying. It produces excellent crops of corn, rye, and oats and constitutes good pasture and hay land. The type is well adapted to fruits, such as peaches, cherries, raspberries, blackberries, gooseberries, currants, and strawberries. Potatoes give excellent results.

The agricultural conditions and the character of farming are very good. The value of this land ranges from $75 to $100 an acre, depending upon the location and improvements.

CHENANGO FINE SANDY LOAM.

The Chenango fine sandy loam consists of 6 to 8 inches of dark-brown, friable fine sandy loam, resting on subsoil of reddish-brown fine sandy loam, which in places is underlain at 30 inches by medium sand. Gravel occurs in places in the lower depths, and an occasional patch is found on the surface.

This type is developed as low terraces or high first bottoms, and is not subject to overflow, except during unusually high floods, when the water is backed up in the river valleys by ice jams. It occurs only in the Neversink River Valley. The topography is level to sloping, and the drainage is generally good. The Chenango fine sandy loam occurs at lower levels than the Chenango fine sand. It differs from the fine sand in that it is more loamy and has a much higher content of organic matter. It is better adapted to general farm crops, and makes excellent grass land.

The entire type is cleared and cultivated. Dairying is the principal industry. The soil gives good yields of hay, corn, oats, rye, and potatoes. Much of this soil is well suited to truck crops and small fruits.

Land of this type of soil ranges in value from $50 to $75 an acre.

CHENANGO SAND.

The soil of the Chenango sand consists of a dark-brown to reddish-brown sand or light sandy loam, from 3 to 5 inches deep. The subsoil to a depth of 36 inches or more is a reddish-brown sand. The type contains some rounded pebbles, and in small, irregular areas

a considerable quantity of larger gravel and stones is encountered. The material is loose and somewhat incoherent, and very susceptible to drought.

The areas of Chenango sand are small, and are located along the Delaware, Mongaup, and Neversink Rivers. They occur as stream terraces with flat to sloping surface. The drainage is good to excessive. The terraces along the Delaware River are higher than those in the Neversink Valley and the soil is more droughty.

The native vegetation includes pine, chestnut, hemlock, and some oak.

Very little of the Chenango sand is under cultivation. This is due in part to the droughty nature of the type, the result of its loose, open structure. In its present condition, also, it is not well adapted to cultivation, because of its low organic content. Fruits of all kinds, early potatoes, and truck crops should do well on the better areas, when this deficiency has been supplied.

CHENANGO FINE SAND.

The Chenango fine sand ranges from a dark-brown fine sand to a fine sandy loam, 6 or 8 inches deep, resting on a subsoil of light-brown fine sand, to 18 inches, in turn resting upon a reddish or pinkish-brown fine sand. The material has a loose, open structure, and in general is droughty. The more loamy areas, being somewhat more retentive of moisture, produce larger crops than the typical fine sand areas.

Areas of the Chenango fine sand are found in the valleys of the Delaware and Neversink Rivers, where they form stream terraces lying above overflow. The surface is level to gently sloping and the drainage is good.

Nearly all of this type has been cleared and is under cultivation, largely to general farm crops. It is an early soil and is especially adapted to truck crops, such as early potatoes, early sweet corn, asparagus, tomatoes, peppers, cabbage, peas, and beans. It is also suited to the production of strawberries and bush fruits.

No effort is made to keep the soil supplied with organic matter. This has resulted in a rather more open structure than is conducive to good crop production.

The agricultural conditions are only fair on this type and the land values range from $20 to $50 an acre.

CHENANGO GRAVELLY SAND.

The Chenango gravelly sand is a dark-brown to grayish-brown gravelly sand or light loam in places and ranges to a light gravelly loam. The soil varies in depth from 6 to 8 inches. The subsoil is a gravelly sand of yellowish or reddish-brown color. The material within and below the 3-foot soil section shows decided stratification.

This type is encountered only in the Neversink River Valley, where it occurs as high terraces. There is no danger from floods, and the drainage is well established.

The agricultural conditions are poor. Some corn, rye, and hay are grown. The best results are had where a regular rotation is followed, and the organic-matter content of the soil built up.

CHENANGO GRAVELLY LOAM.

The soil of the Chenango gravelly loam is a brown to dark-brown loam carrying much gravel and from 4 to 8 inches deep. This surface material is underlain by a reddish-yellow gravelly loam to a depth of 36 inches. The surface in places is thickly strewn with large, waterworn stones, often 8 to 12 inches in diameter. These areas are practically nonagricultural, unless the stones are removed from the surface. In other small areas the type is practically free of stones.

In general, the Chenango gravelly loam is friable and mellow, and a good tilth is easily maintained where the stones and gravel are not too numerous. As a rule the type is droughty.

The topography is flat to rolling, and drainage is excellent.

This type is developed west of the Shawangunk Mountains as bodies in the valleys of the Delaware and Neversink Rivers. It is also encountered in the uplands of the Catskill Plateau in the vicinity of Quarry Hill and Rio, where it occurs as a high lake terrace or as a delta plain.

The native forest consists largely of oak and chestnut. Only a small part of this type is under cultivation. The land is valued at $20 to $30 an acre.

Hoosic Series.

The Hoosic soils are predominantly brown, and the subsoils are yellow. The series, like the Chenango, is found on the high glacial terrace and delta soils of New York and western New England, but the material is derived from the mixed glacial and residual debris from crystalline and semicrystalline rocks of the region instead of largely from shale, sandstone, and limestone formations. The included gravel of the Hoosic soils consists of thin, waterworn slate and shale. The soils are gravelly and sandy, especially in their lower depths. The Hoosic soils differ from the Merrimac types, which occur as broad, flat terraces along the larger streams of New England, in that the latter are formed largely of wash from acidic rocks of more coarsely crystalline character.

HOOSIC SILT LOAM.

The soil of the Hoosic silt loam, which extends to a depth of 6 or 8 inches, consists of a grayish-brown to brown, friable silt loam. The subsoil has the same texture as the soil, but varies considerably

in color. Ordinarily the color is yellow, but it may be mottled with different shades of gray. The type is friable and mellow when worked under proper moisture conditions, but it is sufficiently heavy to clod badly if plowed when wet.

The Hoosic silt loam is not an extensive type in Orange County, but occurs in somewhat widely scattered areas. The largest lie in the vicinity of Pinebush, Walden, Montgomery, and Johnson.

The topography is flat to rolling, and surface drainage is fair to poor. The compact nature of the subsoil makes artificial underdrainage necessary in many cases, and it is beneficial on most of the type.

The soil seems best adapted to the production of grass and grain crops. It makes excellent pasture land, and the mowings produce from 1 to 2 tons of hay per acre. Timothy is the principal hay grass. Corn yields from 40 to 60 bushels, oats 30 to 50 bushels, and rye from 15 to 25 bushels per acre. Potatoes yield from 75 to 150 bushels per acre. Fruit is not generally grown, although there are some orchards of apples and pears.

Agricultural conditions are generally good, and the farms are in good condition. The price of land ranges from $60 to $90 an acre.

HOOSIC FINE SANDY LOAM.

The Hoosic fine sandy loam consists of 5 to 8 inches of light-brown to medium-brown fine sandy loam, underlain by a yellowish-brown fine sandy loam.

The type is of small extent. It occurs southwest and east of Pinebush. It is developed in such small areas that no definite value can be given it.

The type is generally well drained and easily tilled. It is an early soil and well suited to gardening, trucking, and to the growing of strawberries and bush fruits.

HOOSIC GRAVELLY SANDY LOAM.

The surface soil of the Hoosic gravelly sandy loam consists of 6 or 8 inches of brown gravelly soil of somewhat variable texture. Typically the fine earth is a sandy loam, but areas of lighter and of heavier texture occur. The subsoil ranges from a light-brown or yellowish-brown gravelly sandy loam to gravelly sand. In the lower depths it varies from pale yellow to dark brown. As a rule, the gravel varies from medium to coarse and is scattered on the surface and throughout the soil section. Small areas occur in which the finer material has been washed out and carried away by water, leaving only the gravel. Below 36 inches the material is generally either a gravelly sand or a sandy gravel. The deeper section always shows stratification. This soil is one of the easiest in the county to cultivate.

The total area of Hoosic gravelly sandy loam is not great, although the type is widely scattered throughout the central part of the county. It occurs as irregular bodies closely associated with other types of this series.

The country occupied by the Hoosic gravelly sandy loam comprises rounded hills and knolls, ridges, rolling plains, and nearly level tracts. The surface features are such as to permit good surface drainage and the open structure of the soil is favorable to good internal drainage.

Practically all of the type is cleared and under cultivation.

It is particularly adapted to the production of fruit. Peaches, cherries, and plums do well. Orchards of apples and pears appear to be in thrifty condition. Of the small fruits, strawberries, blackberries, raspberries, gooseberries, and currants do especially well. Grapes also are grown successfully. This is an early, well-drained soil and for this reason a good truck soil. Potatoes, sweet corn, melons, cabbage, peppers, asparagus, and cucumbers are among the crops successfully produced.

Ordinary farm crops do not yield heavily because of the open nature of the soil and its low organic-matter content. The type is too droughty to make good pasture land. Rye and oats are the principal grain crops, though some corn is grown. Clover and alfalfa are successfully seeded on this soil.

Agricultural conditions and land values are about the average for the county. The soil is generally in need of organic matter.

HOOSIC GRAVELLY LOAM.

The soil of the Hoosic gravelly loam consists of a light-brown to brown gravelly loam from 4 to 6 inches deep. The subsoil typically is a yellow to yellowish-brown gravelly loam, but in some areas it becomes sandier with depth to 18 or 24 inches, below which very little interstitial material is present. The soil and subsoil contain varying quantities of shale fragments, and similar material is scattered over the surface of most areas.

Areas of the Hoosic gravelly loam are scattered throughout the central part of the county, east of the Shawangunk Mountains. They occur as strips along streams and as larger, irregular shaped areas, the largest of which lie in the town of Montgomery, near Walden and Montgomery, in Wallkill Town, near Stony Ford, and in the town of Minisink, near Westtown and Waterloo Mills. Other areas are encountered near Warwick, Monroe, Washingtonville, Middletown, and in many other places.

The topography ranges from nearly level to sloping and ridgy. Where erosion has been active the areas are rolling and even hilly. Drainage, as a rule, is excellent, though areas lying at the base of

slopes are too wet during a part of the year, owing to seepage and surface drainage from the adjacent higher lands.

The material of which this type is composed is generally stratified. This may not always be discernible in the upper part of the deposits, but it is always seen in deep sections. The strata consist of roughly assorted waterworn and rounded materials.

The native vegetation includes oak, elm, hickory, pine, and some chestnut. Practically all of the forest has been removed.

Most of this soil is farmed. It is an easy soil to cultivate, and gives good returns of the general farm crops. It is not considered an especially strong soil and does not retain moisture and fertilizers well, but its good drainage and the general ease with which it can be cultivated make it desirable. Corn, oats, and hay are the crops most generally grown. Corn yields from 40 to 50 bushels, oats 25 to 35 bushels, and hay 1 to 1½ tons per acre. Potatoes yield from 80 to 150 bushels per acre. In addition to these crops, orchard and small fruits are grown profitably.

The agricultural conditions on this type are fairly good.

WATER-LAID MATERIAL—CRYSTALLINE ROCKS.

Merrimac Series.

The surface soils of the Merrimac series are brown. The subsoils are predominantly yellow, and consist largely of sand and gravel. The series occurs in eastern New York and the New England States, and comprises high glacial terraces along the streams of this region. The material is derived from crystalline rocks. It was ground up by the ice, reworked by water, and deposited during the close of the glacial period.

MERRIMAC GRAVELLY LOAM.

The Merrimac gravelly loam consists of about 6 inches of dark-brown to brown gravelly loam resting on a subsoil of yellowish-brown material of the same texture as the soil. The soil is friable and easily cultivated where the gravel content is not excessive.

The type is characterized by rounded rock fragments of varying sizes, ranging from fine gravel to stones 3 to 6 inches in diameter. While the greater part of the land is not too stony for cultivation, in some small areas tillage would be difficult. There are occasional areas of silty texture which, if of sufficient size, would be separated as a silt loam, although these areas contain pockets of gravel. The drainage of the type in general is good.

This Merrimac gravelly loam generally occurs as long, narrow strips, comprising flat terraces along the streams which flow through the Highland region. The most extensive areas are developed along the Ramapo River, and at the head of Greenwood Lake. Other

areas are found near Eagle Valley and Queensboro, in the southeastern part of the county.

The Merrimac gravelly loam is used in the production of corn, oats, rye, hay, and orchard crops. Corn yields as high as 40 bushels per acre, oats 30 bushels, rye 15 to 20 bushels, and hay three-fourths to 1 ton per acre. The agricultural value of the type, however, is not high, as the areas are small and occur mainly in a section that is not generally used for farming purposes. Its value ranges from $20 to $30 an acre.

WATER-LAID MATERIAL—MIXED DERIVATION.

Fox Series.

The Fox soils are brown to gray in color. The topography is level, except where varied by potholes or eroded valleys. The series occurs in northeastern United States. The material was deposited as outwash plains or as terraces along streams within the glacial area or flowing out of it. It is wholly or mainly of glacial derivation and consists largely of limestone.

FOX GRAVELLY LOAM.

The surface soil of the Fox gravelly loam consists of 5 to 8 inches of brown to dark-brown gravelly loam. The subsoil to a depth of about 30 inches is a yellowish-brown gravelly loam, but below this it passes into a bed of grayish gravel. The soil and subsoil are friable and porous.

This type is not extensively developed in Orange County. It occurs in small areas in the Wallkill Valley in the vicinity of Pine Island and Liberty Corners. The topography is rolling to ridgy, and both surface and internal drainage are good.

This type is generally held in connection with other soils. It is adapted where economic conditions are favorable to the production of leguminous crops and fruits.

Genesee Series.

The Genesee soils range in color from dark brown to grayish brown. They occur along the major streams and their tributaries throughout the northeastern glaciated region, particularly where the Dunkirk, Volusia, Miami, and Ontario series constitute the principal upland soils. The Genesee series extends a short distance south of the glaciated area, where the main streams have their headwaters in areas of the above-named series. The material consists of alluvial sediments. These soils are subject to annual or seasonal overflow.

GENESEE SILT LOAM.

The surface soil of the Genesee silt loam is 8 to 10 inches deep. In texture it is a friable silt loam and in color dark grayish brown.

The subsoil to a depth of 24 inches is a brown silt loam slightly tinged with gray. From 30 to 36 inches these mottlings are more prominent and the material is slightly more plastic. As is likely to be the case with alluvial soils, there is some variation in the texture, and small areas of a light fine sandy loam or very fine sandy loam are found. These, however, are not of sufficient size to separate from the surrounding areas of silt loam. In places the deep subsoil may contain layers of very fine sand, but such occurrences are comparatively rare. The type as a whole is easily tilled.

The Genesee silt loam is widely distributed throughout that section of the county east of Shawangunk Mountains. It does not occur in large bodies, but as narrow bands of first-bottom soil along many of the streams of the county. It is most extensively developed along the Wallkill River. The topography is flat to slightly ridgy and drainage is only fair.

Hickory, elm, soft maple, willow, and linden are the principal native trees.

As the Genesee silt loam is a first-bottom soil, subject to overflow, and is usually developed as narrow strips, it is generally utilized as pasture land, which is probably its best use. Where the areas are large enough to be cultivated corn and root crops are successfully grown. The soil is very productive and, when it is not overflowed during the growing season, corn produces 80 to 90 bushels and hay 1 to 2 tons per acre.

Commercial fertilizers are not used and as a rule are not needed, the high organic content and the frequent overflow keeping the soil productive. In many localities drainage is badly needed and protection from floods is generally necessary.

As this type is always held in connection with the surrounding upland soils, it is difficult to estimate its value separately. It is probably worth from $50 to $75 an acre.

Hudson Series.

The surface soils of the Hudson series are predominantly brown, ranging to yellowish. The subsoils are yellowish brown to yellowish in color, and are generally lighter in texture than the subsoils of the Vergennes series. The Hudson soils occur as glacial-lake terraces in the valley of the Hudson River. The material was deposited in glacial Lake Albany, and is composed mainly of wash from glaciated slate uplands. These soils are lighter in color than the Vergennes types, and are noncalcareous.

HUDSON GRAVELLY SANDY LOAM.

The surface soil of the Hudson gravelly sandy loam consists of a brown to dark-brown gravelly sandy loam 6 or 8 inches deep. The

subsoil is a yellowish gravelly sand, changing in places at about 30 inches to a fine gravel. Both soil and subsoil are loose and open.

This type occurs in small areas, closely associated with other types of the Hudson series. The largest area is within the limits of the city of Newburgh. The topography is sloping to rolling, and surface drainage is good. The texture and structure are such that artificial underdrainage is not needed.

Owing to its loose, open structure and low content of organic matter the type is quite susceptible to drought. This thoroughness of drainage makes the soil warm up early in the spring, and for this reason it can be used in growing early truck crops.

HUDSON GRAVELLY LOAM.

The Hudson gravelly loam consists of 8 to 10 inches of brown to dark-brown gravelly loam or light loam, underlain by yellowish-brown gravelly loam, gravelly sand or gravel. The soil and subsoil are light and open, and the drainage, both surface and internal, is good to excessive. Where the surface features are favorable, the soil is easily tilled.

Only small areas of this soil are found in Orange County. The type is best developed in the vicinity of Newburgh, Cornwall on the Hudson, Woodbury Falls, Central Valley, and Arden. The deposits are much deeper than those of any other terrace soil mapped in this county. Large quantities of shale and slate fragments are found, with fragments of quartzite, sandstone, and limestone. The immediate surface does not always show stratification, but within a few feet of the surface layers of assorted, waterworn material occur.

Little of this soil is under cultivation. Some truck crops are grown near Newburgh, while a few other areas are used in the production of the general farm crops. It is an early soil and gives good returns where used in trucking.

HUDSON FINE SANDY LOAM.

The Hudson fine sandy loam consists of a dark-brown, friable sandy loam about 12 inches deep, underlain by a light-brown to yellowish-brown fine sand to light fine sandy loam. Below the 3-foot section the material grades into a sand. The subsoil generally has the same texture as the soil. The organic content is low, and the soil appears lighter than it actually is.

The Hudson fine sandy loam is encountered south of Newburgh. It has a small total area, and occurs as a high, nearly level terrace, which rises abruptly from the Hudson River to an elevation of about 100 feet. The drainage is good and crops do well, even in unusually wet seasons.

Most of the area of this soil is in cultivation. It is an excellent trucking soil, its open structure allowing free drainage and making it one of the earliest soils in the county. The produce from this soil is sold in the local markets.

HUDSON SILT LOAM.

The surface soil of the Hudson silt loam consists of a friable brown silt loam, varying from 6 to 8 inches in depth. The subsoil is a light-brown to yellowish silt loam, extending usually without change to a depth of 36 inches or more. The line of demarcation between the soil and subsoil is usually quite distinct.

The only areas of Hudson silt loam in the county occur along the Hudson River in the vicinity of Newburgh. This type is closely associated with the other soils of the Hudson series and has the same general surface configuration. The topography ranges from sloping to rolling, and the surface drainage is usually good. The internal drainage, however, is generally inadequate, and artificial underdrainage is needed in many places.

The native vegetation includes elm, oak, hickory, and some pine and hemlock, with many smaller plants and shrubs.

Well-drained areas of this type give good yields of the general farm crops, such as corn, oats, rye, hay, and potatoes. Fruits are also grown successfully.

GRAY SOILS.

WATER-LAID MATERIAL—SHALE AND SANDSTONE.

BASHER SERIES.

The surface soils of the Basher series are gray. The subsoils are gray to pale yellow or yellowish gray. They occur in northeastern United States. These are first-bottom soils, derived from glacial drift composed mainly of sandstone and shale material from the glaciation of Shawangunk conglomerate and the Medina and Oneida sandstone. They comprise poorly drained material which in some other areas has been mapped as Genesee.

BASHER SILT LOAM.

The surface soil of the Basher silt loam, which is about 12 inches in depth, consists of dark-gray or brownish-gray silt loam. The subsoil is a light-yellow and gray mottled silt loam to 30 inches, where the color changes to mottled gray and chocolate. The surface soil is friable and is easily maintained in a good tilth.

The Basher silt loam is encountered only in the Neversink River Valley and in the valley of one of its tributaries, the Basher Kill. The total area is small. The type is a first-bottom soil, formed by

deposition of sediment over the flood plains of streams. In position it is similar to the Genesee, Clyde, and Wallkill soils.

Agriculturally, the Basher silt loam has no value at present, except as pasture and hay land. It is not devoted to intertilled crops, largely because of the frequency of floods. It is flat, low lying, and greatly in need of drainage.

MISCELLANEOUS MATERIAL.

MEADOW.

In texture the surface material of the Meadow type varies widely, ranging from a silt loam to sand or even clay. Some areas are quite mucky, but owing to the high content of stones and bowlders in such areas, no separation of muck was made. The subsoil varies quite as widely as the surface soil in texture, but is generally heavy or clayey. It is more or less impervious. The color of both soil and subsoil is generally dark, though the subsoil is gray or brownish gray in places. In depth the soil and subsoil are quite variable, although the surface soil usually is comparatively shallow.

Meadow comprises low-lying, poorly drained areas. These occur along stream courses or in depressions which are too wet for cultivation unless properly drained. In most cases the soil is very stony, and in some instances the areas are too stony to make good pasture land. Meadow is distributed over the entire county, generally in long, narrow, irregular strips. Along streams it is often mapped where the bottom soils are variable and no distinct type can be recognized.

The material of this type consists of wash from the surrounding slopes and uplands, with an accumulation of decaying organic matter. The areas usually support a good growth of shrubs, trees, and water-loving plants, grasses, and rushes. The principal trees are elm, soft maple, and occasionally, water beech.

The agricultural value of Meadow is low. Owing to its wet condition and high content of stone, cultivation is practically impossible. Where not too stony and where properly drained, the type furnishes good pasture, and in many cases the swamp grasses are cut for hay. Some of the type can be improved and made tillable, but in most cases the expense of draining and removing the stones would be so great as to render reclamation impracticable.

MUCK.

Muck is the most valuable agricultural land in the county. It varies somewhat in texture and color. In general, it consists of black or brown decayed organic matter. The surface material, extending to a depth of about 9 inches, is darker in color and finer in texture than the subsoil. In a few areas both the soil and the subsoil are gray. In places the deep subsoil is a brown, coarse, peaty material. The depth of Muck varies from a few inches to many feet. Near

Pine Island it is at least 18 feet in depth, and in other areas its depth ranges from 12½ feet to 18 feet. These deep deposits occur usually in the largest areas.

Muck is encountered in nearly all sections of the county, occurring in areas ranging from patches too small to be shown on the map to areas several square miles in extent. The largest and most valuable are located in the Wallkill River Valley between Denton and Florida, and extend south to the county line along the river. Other large areas occur near Chester, Mount Hope, and Smith Corners, and in the vicinity of Orange Lake. All of these occupy low-lying positions, and are naturally swampy. The poor drainage has been responsible for the formation of this soil type, which is due to the luxuriant growth of water-loving plants and their decay. The Muck contains more or less mineral matter. This is most abundant in the surface few inches and near the streams. It has been washed from the uplands and deposited in the depressions or along streams. Near the streams the mineral matter is distributed throughout the soil section. Marl sometimes occurs under very small areas.

The surface of the Muck areas is nearly level. This feature, together with their low-lying position, makes the natural drainage inadequate, although in nearly every case artificial drainage is feasible.

Those areas of Muck upon which elms and soft maples thrive are valued much more highly than those upon which cedars or tamaracks grow. In general, the soil will grow almost any of the farm crops except the small grains. Corn is probably the principal grain crop. Hay also is grown extensively. These two crops give excellent yields, as do potatoes. Hay produces as high as 4 tons per acre, corn as high as 75 to 100 bushels, and potatoes from 100 to 300 bushels per acre.

In Orange County the greater part of the area of Muck under cultivation is utilized for the production of truck crops, such as onions, celery, sweet corn, carrots, parsnips, spinach, beans, and lettuce. Of these, onions, lettuce, and celery are the most important.

Celery growing on the Muck is very remunerative. From $300 to $500 per acre is received from this crop. Fertilizer of a 2–8–10 composition is used for this crop at the rate of from 1,000 to 2,000 pounds per acre. Large quantities are applied in growing the other truck crops.

The agricultural conditions on cultivated areas of Muck land are good. The most intensive type of farming in the county is practiced on this soil. The land ranges in value from $50 per acre for uncleared, undrained land to $500 or more an acre for land which has been reclaimed and is under cultivation. The great markets of the East—New York, Boston, and Philadelphia—are readily accessible, so that the Muck type is very valuable for the special truck crops to which it is so well adapted.

ROUGH STONY LAND.

The Rough stony land of Orange County includes those areas which are too steep and stony or have too thin a soil mantle for cultivation.

This type occurs in practically all parts of the county, mainly along the tops and slopes of the ridges, although it is also encountered in the valleys and at the foot of ridges, where the rocks have been moved from the higher elevations. It is most extensively developed in the mountains of the southeastern part of the county, south and west of Warwick, along the Shawangunk Mountains, and on the Catskill Plateau in the western part of the county. The gneissic and granitic region of the southeastern section holds the largest areas and those of most rugged topography. The crystalline limestone in the vicinity of Warwick also gives rise to several areas of Rough stony land.

The forest growth includes principally oak, pine, hemlock, and chestnut, with some small cedar. Hemlocks are generally found along the streams and in the ravines. The undergrowth of brush consists mainly of rhododendron. Agriculturally the Rough stony land is of little value. Where it occurs in connection with arable types of soil it produces some revenue as pasture and wood lot.

ROCK OUTCROP.

Rock outcrop in Orange County consists of those areas where bare rock and ledges occupy so much of the surface as to render them of no agricultural value.

These areas occur mainly in the Highlands and on Schunemunk and Shawangunk Mountains. Some smaller areas occur on the Catskill Plateau and in various other sections of broken topography. Areas mapped as Rock outcrop are unfit for any use except forestry, and most of its area can not be used even for this purpose.

MADELAND.

The Madeland classification includes locations where the surface has been changed by the construction of extensive railroad yards, as at Maybrook, Port Jervis, and Newburgh, or by the building of docks along the Hudson River, as at Newburgh and Cornwall Landing, or by mining, as in case of the excavations made to obtain clay for brick manufacture at New Windsor, Roseton, and Jovas. At West Point many changes in the natural conditions have been made by blasting out rocks to be used in the construction of buildings and hauling in earth to replace the material removed. All such areas are included with this classification, but their total area is small, and the type has no present or prospective agricultural value.

SUMMARY.

Orange County is situated in the southeastern part of New York west of the Hudson River. It has an area of 834 square miles, or 533,760 acres. The topography ranges from nearly flat or rolling to mountainous. The elevations range from tide level to about 1,680 feet above sea level. The entire county has been glaciated.

The drainage is through two systems, the Hudson and the Delaware River. The largest tributary streams in the county are the Wallkill and Neversink Rivers.

The population in 1910 was 116,001. Newburgh is the largest city, with a population of about 28,000, and Middletown the second largest city, with 15,000. Goshen, the county seat, is centrally located on the Erie Railroad, and has a population of about 3,000. Many small towns are scattered throughout the county.

Railroads reach all sections of the county except the most remote and mountainous regions. These, with the steamboat lines on the Hudson River, furnish excellent shipping facilities.

Most of the farm products find ready markets either in the cities and towns of the county or in New York City, which is only a few hours distant.

The mean annual temperature is about 49° F. There is a mean annual rainfall of about 46 inches. The average growing season comprises 161 days.

Dairy farming and fruit growing are the principal industries. Dairying has increased steadily since the development of the railroads began. Butter making was formerly the most important branch of this industry. The shipping of milk began in 1842. This is now the principal branch of dairying in the county.

Fruit growing began to receive special attention about 1880. It is now an important industry. Apples, pears, peaches, and plums, and all kinds of small fruits are grown.

Trucking is most extensively practiced on the Muck soils, but is carried on to some extent on the light upland soils. Onions, celery, and lettuce are the most important crops on Muck.

The general farm crops now grown are mainly those needed in the dairy industry. Hay is the most important crop; next in order are corn, oats, rye, and potatoes. Much of the grain used for feeding is shipped into the county.

Crop rotation is practiced to some extent, but not systematically. The soils are adapted to a wide range of crops, and the need of rotations to include more grain and leguminous crops is obvious.

Forty types of soil are mapped in Orange County. They conform closely to the characteristics of the rocks from which they are derived by glaciation. Those soils associated with the crystalline rocks

are included in the Gloucester series; those derived from limestone are classed with the Dover series; and the soils from glaciated shales and sandstones give rise to the Culvers, Dutchess, and Otisville series. The terrace soils of the valleys are classed in the Hudson and Hoosic series, the latter being derived from assorted and reworked glaciated material from the Hudson River formation. Small areas of Fox soil and Merrimac soil are also mapped. The former is water-laid material, derived largely from limestones, and the latter from crystalline rocks.

The terrace soils west of the Shawangunk Mountains are derived from sandstone material and are included in the Chenango series. The stream bottoms have given rise to a number of soils—the Clyde Wallkill, Genesee, Basher, Muck, and Meadow.

Rough stony land, Rock outcrop, and Madeland are classifications rather than types. They are nonagricultural.

The Dutchess silt loam and stony loam are the most extensive soils in the county, and are the ones used most for general farming and dairying. The stony loam and shale loam of this series are the most important fruit soils.

Muck is the most valuable land in the county. It is held at $50 to $500 an acre. The most intensive system of farming in the county is practiced on this type.

Many of the soils of the county require draining in order that best results with crops may be had. The Muck and other bottom soils are most in need of drainage, and a large part of the upland soils would be decidedly benefited by underdrainage, even where the surface drainage is good.

There are 3,935 farms in Orange County. The average size of the farms, according to the 1910 census, is 97.6 acres. The value of all farm property is given as $35,516,309.

The values of farm land and farm products are increasing yearly. This is reflected in the improved condition of the farms and buildings. Improved roads are being built, which make all parts of the county easily accessible to market and shipping points.

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[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

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

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