

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

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

SOIL SURVEY OF THE WHITE PLAINS AREA,
NEW YORK.

CORNELIUS VAN DUYNÉ, OF THE U. S. DEPARTMENT OF
AGRICULTURE, IN CHARGE, AND J. H. BROMLEY, OF THE
NEW YORK STATE COLLEGE OF AGRICULTURE.

W. E. McLENDON, INSPECTOR, NORTHERN DIVISION.

(Advance Sheets—Field Operations of the Bureau of Soils, 1919.)



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., August 1, 1921.

SIR: I have the honor to transmit herewith the manuscript report and map covering the soil survey of the White Plains Area, New York, and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1919, as authorized by law. This work was done in cooperation with the New York State College of Agriculture.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

HON. H. C. WALLACE,
Secretary of Agriculture.

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SOIL SURVEY OF THE WHITE PLAINS AREA, NEW YORK.

By CORNELIUS VAN DUYN, of the U. S. Department of Agriculture, In Charge, and J. H. BROMLEY, of the New York State College of Agriculture—Area Inspected by W. E. McLENDON.

DESCRIPTION OF THE AREA.

The White Plains area is situated in the southeastern part of the State of New York. It is bounded on the north by Dutchess County; on the east by Fairfield County, Conn.; on the south by Fairfield County, Conn., Bergen and Passaic Counties, N. J., Bronx Borough of New York City, and Long Island Sound; and on the west by Orange County and the Hudson River. It embraces a rather irregular-shaped area, whose extreme length north and south and extreme width east and west are 44 and 40 miles, respectively. It includes Westchester and Putnam Counties east of the Hudson River, and Rockland County west of the river, and covers 856 square miles, or 547,840 acres.

The base map used in this survey includes all or parts of the following quadrangles of the United States Geological Survey topographic map; Carmel, Harlem, Norwalk, Oyster Bay, Ramapo, Schunemunk, Stamford, Tarrytown, and West Point. Corrections showing changes in culture since their publication were made upon this base.

The physiographic features of the White Plains area are those of a rolling to hilly and mountainous country, with little systematic arrangement of hills and valleys, but with a general decrease in diversity of relief and in elevation toward the south and southeast. The most prominent topographic feature is the valley of the Hudson River, which runs through or along the area for a distance of 40 miles. The river joins the area at Breakneck Point, across from Storm King, where the stream is about one-half mile in width, and continues southward as the western boundary to near Anthonys Nose, where it enters the area. With the exception of a few small bodies of Tidal marsh, the river has no flood plain, and the only terraces are isolated areas lying from 40 to 100 feet above the river level, and frequently so eroded that they have lost their terrace character. In the Highlands section the river flows in a deep, narrow gorge, whose sides rise abruptly from the river banks to elevations of 800



FIG. 1.—Sketch map showing location of the White Plains area, New York.

to 1,400 feet within short distances on each side.¹ South of the Highlands the country rises less abruptly to elevations of 300 to 600 feet or more. The Palisades in Rockland County are a prominent topographic feature of the Hudson River Valley. They rise perpendicularly, or almost so, from the river to heights of 150 to 700 feet, the lower part being largely a steep slope of débris, while the upper part is in places a perpendicular rock mass with columnar structure. On the inland side the decline is rapid to the Rockland Plain. The continuity of the Palisades is broken by Sparkill Creek at Piermont. They swing back from the river front at Nyack, returning at Verdrietege Hook, and again swing westward just south of Haverstraw. Another marked topographic feature is the abrupt rise of the Ramapo Mountains from the broadly rolling section of the central part of Rockland County. East of the river the break from the Highlands to the hilly country to the south is not so conspicuous.

The area comprises three quite distinct physiographic provinces or divisions: (1) The hilly to mountainous region; (2) the rolling to hilly section; and (3) the gently to broadly rolling division. The boundaries between these divisions are as a rule fairly well defined.

The hilly to mountainous division, embracing that part of the area located in the region known as the Highlands of the Hudson, covers the northwestern part of Putnam County, a strip of 4 to 5 miles wide along the northwest boundary of Rockland County, and the extreme northwest corner of Westchester County. It extends across the area in a general northeast-southwest direction, its continuity being broken by the trough of the Hudson River. It consists of a series of more or less continuous and parallel ridges and valleys having the same general trend and the former giving the whole a very rugged topography, with elevations ranging from 900 to 1,400 feet. In Rockland County the highest points occur in the Ramapo Mountains and on Bear Mountain, whose summit reaches 1,314 feet in Orange County. In Putnam County the Highlands are the southern extension of the Mattewan or Fishkill Mountains, the highest point, 1,560 feet, occurring on Breakneck Ridge on the Dutchess County line. Other prominent elevations are Bull Hill (1,425 feet), Sugarloaf, Canada, Tompkins, and Cat Hills and Anthonys Nose. The slopes are for the most part steep and stony, the soil mantle thin or entirely lacking, and rock outcrops common. The valleys are narrow, with seldom any bottom or terrace areas along the streams, but they widen locally to include upland areas of less rugged topography. There is a small area of terrace in the Hudson River trough near Cold Spring.

A tract a few square miles in extent in the extreme northeastern corner of Putnam County is included in this division on account of its high elevation and rugged surface features. It reaches an elevation of

¹ The Geological History of New York State, Bulletin 168, N. Y. State Museum.

1,280 feet. The Palisades also belong to this division, as well as an area of several square miles extent southeast of Peekskill, which is of rugged relief, though it does not attain as high elevations. The total extent of land of this character is about 200 square miles. The greater part of the hilly to mountainous division is in forest and is not adapted to agriculture. Here and there, principally in Philipstown, Putnam County, scattered areas are farmed. The region is popular as a location for residences.

The rolling to hilly region covers a small area north of Haverstraw in Rockland County, the southeastern part of Putnam County, and all of Westchester County, except those parts previously mentioned and the part east of the Bronx River south of White Plains. The approximate total area of this region is 490 square miles, or nearly 60 per cent of the area surveyed. The topography of the greater part of the region is rather smooth, though hilly, with elevations ranging generally from 300 to 700 feet, and running up to 800 to 1,000 feet in hilly areas of more rugged topography. In general there is a decrease in elevation toward the south and southeast. The region consists of a rather promiscuous arrangement of hills and valleys, with local surface features due to irregularities in the underlying rock, to deposits of glacial till, and to stream action in forming and modifying valleys and building up bottoms and terraces. Stream bottoms and terraces are of small extent. A considerable proportion of the land is too steep and stony for cultivation.

The gently undulating to broadly rolling division covers that part of Rockland County lying between the Highlands and the Palisades and that part of Westchester County east of the Bronx River and south of White Plains. This, the smallest physiographic division, includes about 175 square miles. The streams generally flow south or southwest. The divides are broad and rounded and of a comparatively uniform elevation. The slopes are seldom steep or stony. Areas of rugged topography are rare. The elevation in general ranges from 100 to 500 feet, gradually diminishing toward the south. The shore line of Long Island Sound is very irregular, and there is some Tidal marsh. Several islands lie just offshore. A considerable proportion of this physiographic division is in cultivation in Rockland County, but in Westchester County it is largely occupied by cities and country estates.

Nearly all the streams of the area belong to the Hudson River drainage system, the greater number flowing directly into the river, though several in Rockland County drain into New York Bay via the Hackensack and Passaic Rivers. Small areas in Lewisboro, Poundridge, and North Castle Towns, and the area extending from the Bronx River eastward in Westchester County, drain directly into Long Island Sound.

The drainage basin of the Croton River has an area of 339 square miles, practically all of which lies in Putnam and Westchester Counties. The East, Middle, and West Branches, which drain nearly all of Eastern Putnam County, join near Croton Falls to form the Croton River proper. Peekskill Creek, with its principal tributary, Conopus Creek, drains a considerable area in western Putnam County and empties into the Hudson River just above Peekskill. The Sawmill and Bronx Rivers flow in a general southerly direction across the lower end of Westchester County, the former emptying into the Hudson near Yonkers, the latter into Long Island Sound. Several streams, among which are Mamaroneck, Byram, and Mianus Rivers, and Blind Creek, flow directly into Long Island Sound.

Northern Rockland County drains eastward into the Hudson, mainly through Cedar Pond Brook and Minisceongo Creek. The Ramapo and Mahwah Rivers carry the drainage waters of the western part, reaching New York Bay through the Passaic River. The Hackensack River drains the remainder of the county, except for the small area in the basin of the Sparkill Creek, which crosses the Palisades through a narrow canyon and empties directly into the Hudson River.

Practically all of the drainage water of eastern Putnam County and northern and central Westchester County is a source of water supply for New York City. Many other streams in the southern part of the area are used as a source of water to supply the urban population.

The area is exceptionally well drained. The run-off is not rapid, and the rather porous soils absorb quite a proportion of the precipitation. Nearly all the streams have a fairly high gradient; they have built up little or no flood plain and are still cutting their channels, although the rate is very slow. Tidewater streams, excepting the Hudson River, consist of the extreme lower courses of those flowing into the Sound. The Hudson River is the only navigable stream. None of the streams is at present used as a source of water power.

The area contains some natural lakes, all of them small. The more important ones are Mahopac, Mohegan, Mohansic, Rockland, Oscawana, Waccabuc, Peach, and Trinity Lakes, nearly all of which are centers of summer camps and residences.

Westchester County was organized in 1683 and originally included territory later annexed to New York City. Its permanent settlement dates from the latter half of the seventeenth century. The early settlers were largely Dutch and English, the majority emigrating direct, though some were from Manhattan Island and Connecticut. A large part of the county was included in several manors or landed estates within which land could not be purchased. Settlement was at first confined to the parts bordering the Sound and the Hudson River,

but gradually extended inland, progressing more rapidly in the eastern part, where the land could be purchased from the Indians. The population of Westchester County was 1,063 in 1698; 27,373 in 1800; 99,497 in 1860; 146,772 in 1890, when the urban population first exceeded the rural; 283,055 in 1910; and 344,436 in 1920; 13.7 per cent of which was classed as rural.

Putnam County was originally a part of Dutchess County, from which it was separated in 1812. Early settlement was most active during the latter part of the seventeenth and the first part of the eighteenth century. As in Westchester, settlement was made more in the eastern part than in the western part, which was included in large grants or estates managed under the feudal system. The settlers in the eastern part were mainly English from Connecticut and those of the western part both Dutch and English. The county had a population of 11,866 in 1820; 14,002 in 1860; 15,181 in 1880; 13,787 in 1900; 14,665 in 1910; and 10,802 in 1920. All of which was classed as rural.

Rockland County, formerly a part of Orange County, was made a separate organization in 1789. Its early settlement was slow, as large purchases of land were made by speculators instead of by settlers. The number of its early settlers, mainly English and Dutch, steadily increased. The population numbered 27,690 in 1880; 35,162 in 1890; 38,298 in 1900; 46,873 in 1910; and 45,548 in 1920. In 1920 63.5 per cent was classed as rural.

The strictly rural population consists mainly of descendants of the early settlers. The population of the villages and cities is more mixed and includes many foreigners. The density of the rural population varies with the character of the country, being least in the hilly to mountainous section or the Highlands. The southern part of Westchester is the most densely settled part of the area.

The nearness of New York City and the many cities and villages of varying sizes within the area give a suburban character to most of this area.

With the exception of the Highland region, which is largely non-agricultural, the area is covered by a network of railroads which give excellent service, and no part of the area is remote from facilities for rail shipments. Boats on the Hudson and the Sound are also available to many parts of the area, but the volume of freight transportation by water is not heavy. On the other hand, there is a very large volume of local freight handled by motor trucks.

The area is well supplied with roads, which are for the most part maintained in good condition. Westchester County has more miles of macadam and concrete road than any other county in the State. A considerable mileage of State road occurs in Rockland County, and the least is in Putnam County. Most of the unimproved country

roads, though narrow, are suitable for automobile traffic, except in some of the rougher sections. The Boston post road, paralleling Long Island Sound; the Albany post road, paralleling the Hudson River on the east; and the White Plains post road are the oldest, best known, and heaviest traveled roads in the area.

The rural sections are reached by free delivery mail routes and telephone lines. The cities and villages are lighted by electricity and have municipal water systems. Good graded and high schools are maintained in the cities and villages, and the district schools are fairly numerous and efficient.

There are excellent local markets for all the products of the farms of the area, the demand being far greater than the supply. The dairy products, largely milk, are shipped to local cities as well as to New York. The hay not needed to feed farm animals is sold locally or shipped to New York. These markets also take the surplus vegetables and fruit, which make up an important part of the agricultural production.

CLIMATE.

The area has a temperate climate, with extremes of heat and cold of short duration. The winters are quite severe, with a mean temperature of 31.8° F. at New York City and 26° F. at Carmel, and an absolute minimum of -19° F. as recorded at this latter station. The summers are short and pleasant, with means of 71.4° F. and 69.9° F. at New York City and Carmel, respectively. July and August are the hottest months. The nights are usually cool. The absolute maximum is 100° F. at New York City and 100° F. at Carmel. The extreme range in temperature at New York City is 106° F., and at Carmel 119° F.

The mean annual precipitation at New York City is 44.76 inches, with extremes of 28.78 inches for the driest year (1835) and 59.68 inches for the wettest year (1859). At Carmel the mean is 50.43 inches, with extremes of 31.78 inches in the driest year (1917) and 64.86 inches in the wettest year (1901). The precipitation is evenly distributed through the year.

The average date of the last killing frost in the spring is April 10 and of the first in the fall is November 6, giving an average growing season of 210 days at New York City, while at Carmel the average date of the last killing frost in the spring and of the first in the fall is April 30 and October 12, respectively, giving a growing season of 165 days. The latest killing frost in the spring recorded at the New York station occurred on April 30 and the earliest in fall on October 15, and at Carmel on May 12 and September 29, respectively. Except in a belt of country near Long Island Sound and in a few areas elsewhere it is probable that the growing season

as recorded at the Carmel station represents approximately the length of the growing season for the area.

While there is seldom serious damage or loss of crops by droughts or by excessive rainfall, since the precipitation is rather evenly distributed during the growing season, the yields are affected by the amount of the rainfall, especially on shallow or excessively drained soils. As a rule the growing season is sufficiently long to insure the maturing of ordinary crops, but occasionally crops are damaged by frosts, especially in valleys and depressions where the air drainage is poor. This may result from a late spring season or from cool wet weather in the growing period, which delays the maturing of crops. Fruit buds are sometimes damaged by frosts, so that in many sections of the area care should be taken in the selection of sites for orchards.

The tables below, compiled from the records of the Weather Bureau stations at Carmel and New York City, the former in Putnam County and the latter several miles south of the area, give climatic data applicable to the northern and southern parts of the area, respectively:

Normal monthly, seasonal, and annual temperature and precipitation.

AT CARMEL,
[Elevation, 500 feet.]

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1917).	Total amount for the wettest year (1901).
	[°] F.	[°] F.	[°] F.	Inches.	Inches.	Inches.
December.....	28.7	65	-19	4.17	2.90	9.46
January.....	24.6	62	-16	3.75	2.51	1.65
February.....	24.9	54	-16	4.00	2.10	.81
Winter.....	26.0	65	-19	11.92	7.51	11.92
March.....	34.6	80	-14	4.80	3.49	7.89
April.....	47.5	88	18	4.05	1.63	7.93
May.....	58.7	91	28	4.10	3.87	7.49
Spring.....	46.9	91	-14	12.95	8.99	23.31
June.....	67.9	91	37	3.82	2.95	1.33
July.....	72.2	100	44	4.63	2.46	8.52
August.....	69.6	99	42	5.24	1.98	7.74
Summer.....	69.9	100	37	13.69	7.39	17.59
September.....	63.4	95	31	4.07	.94	5.81
October.....	50.9	83	22	4.32	6.25	4.15
November.....	39.6	72	11	3.48	.70	2.08
Fall.....	51.3	95	11	11.89	7.89	12.04
Year.....	48.6	100	-19	50.43	31.78	64.86

Normal monthly, seasonal, and annual temperature and precipitation—Conted.

AT NEW YORK CITY.

[Elevation, 314 feet.]

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1835).	Total amount for the wettest year (1859).
	° F.	° F.	° F.	Inches.	Inches.	Inches.
December.....	34.4	68	— 6	3.45	2.05	7.15
January.....	30.2	67	— 6	3.79	3.15	6.46
February.....	30.7	69	— 6	3.87	.63	4.51
Winter.....	31.8	69	— 6	11.11	5.83	18.12
March.....	37.5	78	3	4.10	2.17	7.53
April.....	48.1	90	20	3.30	3.93	5.35
May.....	59.3	95	34	3.18	.76	2.02
Spring.....	48.3	95	3	10.58	6.86	14.90
June.....	68.5	97	47	3.26	3.39	5.20
July.....	73.5	99	50	4.54	4.19	3.80
August.....	72.2	96	51	4.53	2.65	4.50
Summer.....	71.4	99	47	12.33	10.23	13.50
September.....	66.5	100	39	3.59	1.50	9.60
October.....	55.6	88	31	3.71	1.74	1.66
November.....	44.0	74	7	3.44	2.62	1.90
Fall.....	55.3	100	7	10.74	5.86	13.16
Year.....	51.7	100	— 6	44.76	28.78	59.68

AGRICULTURE.

Owing to the proximity of the White Plains area to the growing commercial center to the south, settlement began early and progressed rapidly. Necessity caused the early settlers to produce only subsistence crops. Clearings in the forest were made, and crops such as wheat, flax, and corn were planted and cattle raised. Gristmills were established to supply the local needs for flour and feed. Flax was made into clothing, wool was carded and spun, and hides were tanned at home. The building of roads, the early ones leading toward the city to the south, to the river, and to the Sound, and the opening of markets led to an extension of farming, surplus products being taken to market by wagon, sled, or boat.

Land was purchased by individual settlers or in large tracts for speculation, or was included in extensive grants, known as manors. The western parts of Westchester and Putnam Counties were divided among a number of these grants, which were managed as individual

estates, the settlers holding the land merely as tenants. This system retarded both settlement and agricultural development.

The area, especially the southern part of Westchester County, suffered greatly during the Revolution, but conditions again became stabilized at the beginning of the nineteenth century, and farming was established on a permanent basis. Wheat, oats, rye, corn, hay, and flax were grown, and cattle and sheep were raised. Other industries engaged in were fishing, quarrying, charcoal burning, lumbering, and brick making, weaving, and other manufacturing. Upon the completion of the Erie Canal the shipping of wheat from sections to the west led to a reduction in the acreage devoted to this cereal and to an extension of the dairy industry, chiefly the production of butter in the home.

The period of railroad building resulting in the completion of the Erie, now the Piermont branch, but formerly the main line, in 1841, with Piermont the southern terminus; of the New York & Harlem to White Plains in 1846 and to Croton Falls in the following year; of the New York, New Haven & Hartford in 1847 and 1848, and of the main line of the New York Central as far as Peekskill in 1849, and its later extension northward, increased the facilities for the transportation of products from the western sections, which were better adapted to the production of wheat and the raising of cattle. The quick transportation to New York City afforded by the railroads turned the attention of the farmers to the shipping of milk and other perishable products. Railroad building was interrupted by the unstable conditions during the Civil War, but again became active during the seventies, and the Nyack & Northern was completed in 1870, the New York & Putnam in 1871, the New Jersey & New York to Haverstraw in 1874, the Nanuet & New City in 1875, and the West Shore in 1880. The period was marked by a very large increase in population. As the construction of railroads made the southern part of Westchester County very accessible to the city, it opened the region as a place of residence.

The great increase in the population of the New York district has necessitated the building up of many suburban centers in the southern part of the area. Much land has been taken for the expansion of towns and cities, for country estates and summer residences, for public and private institutions, for public works such as reservoirs and aqueducts, for the grounds of golf and country clubs, and for rights of way of railroads, trolley lines, and public roads. These conditions prevail, for the most part, in Westchester County. The proportion of Putnam County thus owned and occupied is much less, but much of the western part is rough and stony, and probably less than one-half of the total area is agricultural land. In Rockland County there is quite an ex-

tensive area of nonagricultural land comprising the Ramapo Mountains along the northwestern side and the Palisades on the eastern side.

The conditions of settlement noted above have caused a general decrease in the agriculture of the area in the last four decades, so that the value of agricultural products is smaller at present than in 1880, and it is probable that these conditions will continue further to reduce agricultural activities in the future.

According to the 1920 census, hay and forage crops lead in acreage and value among the crop classes in 1919, occupying 42.8 per cent of the improved land in farms in the area. Tame grasses other than timothy, clover, or alfalfa lead in acreage, followed by timothy and clover mixed, and in turn by timothy alone. Clover alone and alfalfa were grown on 644 and 348 acres, respectively. Grains cut green, silage crops, and coarse forage are produced on a large acreage. The yield of hay varies widely, but averages a little more than a ton per acre. The Gloucester loam and fine sandy loam are the soil types used chiefly for the production of these crops. The greater part of the hay is fed on the farm, the surplus being sold locally. Probably not more than one-half the mowing lands produce profitable yields of hay.

Cereals rank second in acreage and sixth in the value of all farm products. Corn was planted on 6,311 acres of the 13,091 acres devoted to the cereal group. Corn is grown in all sections of the area, mainly on the Gloucester soils, and yields an average of 45 to 50 bushels per acre. About one-half of the crop is used for silage, but a larger proportion of it is used for silage in Putnam than in the other counties. Oats were grown on 3,355 acres in 1919, yielding 84,080 bushels, and the acreage in rye was 1,563, with a yield of 24,250 bushels, each being grown throughout the area. Wheat was grown on 939 acres and buckwheat on 831 acres in 1919.

Potatoes were planted on 2,698 acres in 1919, more in Putnam than in Rockland County, and over one-half the total acreage in Westchester County, with an average yield of 58.4 bushels per acre, the highest yield, 63.4 bushels per acre, being obtained in Rockland, and the lowest, 44.6 bushels, in Putnam County. The fields are for the most part small, the crop being planted mainly for home use. The surplus is marketed locally. There were 1,958 acres in crops classed as other vegetables, more than two-thirds of which was in Westchester, and only 36 acres in Putnam County. These consist mainly of truck crops grown for home use and for local markets.

The census of 1920 reported 140,547 apple trees of bearing age, distributed as follows: 73,090 in Westchester County, 22,345 in Rockland County, and 45,112 in Putnam County. The total production was

given as 363,714 bushels. The trees are for the most part old and receive very little attention in the matter of spraying or pruning. There are no commercial apple orchards, only the surplus over the needs for family use being marketed. There were 81,442 peach trees reported in 1919. The peach orchards are to a large extent rather recent plantings and on a commercial scale. The number of pear trees was 17,127; of plums and prunes, 5,576; and of cherries, 5,757. Small fruits occupied 401 acres. Rockland County leads in the production of all orchard fruits except apples. Small fruit is sold locally or shipped to the New York market. The number of grapevines reported was 17,472. The value of all fruit and nuts in 1919 was \$890,641.

Dairying is an important industry in the area, especially in the northern part of Westchester County and the eastern part of Putnam County. The income derived from the sale of dairy products in 1919 amounted to \$2,368,466, and is the leading source of income, furnishing 30.5 per cent of the total revenue from crop and live-stock sources. A total of 24,057 dairy cattle was reported, of which 10,601 were in Westchester, 10,976 in Putnam, and 2,480 in Rockland County. In Westchester County 3,369,233 gallons of milk were produced, of which 2,684,584 were sold; in Putnam County 3,375,082 gallons were produced and 2,126,864 sold; in Rockland County 827,803 gallons were produced and 657,454 sold. The dairies are for the most part small, but on farms operated by the owners they comprise the chief source of income. On quite a number of farms, however, dairying is a specialized industry and practically the only source of income. Milk is shipped by rail to the larger centers of population in the area and to New York City.

According to the 1920 census, there were in the area 25,429 cattle, 5,905 horses and mules, 9,625 hogs, and 1,938 sheep, with a larger number, in proportion to its size, in Putnam than in the other counties.

The value of poultry and eggs produced is given as \$1,148,805 for 1919. This industry is one of the most important sources of income in the area. There are a few strictly poultry farms, but the raising of poultry is seldom more than a side line on the farms. These products sell readily at good prices, and the supply is not equal to the demand.

As the greater part of the area is covered by the soils of one series, which have few variations except in stone content, depth, and topography, the soil material has had very little influence in determining the nature and distribution of crops. Climatic conditions, topography, and location with respect to markets have been more influential factors. Similar soils occurring at higher elevations or where the summers are cooler produce good crops of oats, but in this

area this cereal is not regarded as especially profitable. The existing type of farming depends upon the adaptation of the soils to grass and corn, tree fruits and small fruits, and to vegetables.

While there is a general recognition of the adaptation of soils to crops and the present system is an outgrowth of it, dairy farming requires the production of hay and forage crops to such an extent that much land which is better suited to other crops is used for producing hay and forage. It is quite generally recognized that the lighter terrace soils are adapted to potatoes and to early maturing special crops. At one time considerable land suitable for orchards was devoted to the production of fruit, and there seems to be a tendency toward reviving the industry, especially the growing of peaches.

In the strictly farming sections of Putnam and Westchester Counties methods and practices on most farms center around the dairy. Sod land is plowed for corn, which is used for silage or for grain. A considerable acreage must be kept in grass for hay and pasture. The production of small grains is reduced to a minimum, and these crops are sown mainly as a nurse crop in reseeding the land to grass. Concentrated feeds are purchased in large quantities. Stable manure is usually applied to sod just before plowing. Fields are generally well harrowed, and corn is planted in drills or check rowed. It is frequently harvested with machinery. Timothy and clover are commonly sowed with oats. When grown with rye the timothy is seeded in the fall and the clover the following spring. A large part of the apple crop is shaken off and made into cider. Hay and forage are usually stored in barns.

The farm buildings are fair to good, and of sufficient size to house crops, stock, and farm machinery. Some owners keep the farmyards and surroundings neat, while others are careless in this respect. The farmhouses are usually of adequate size and painted. There are a good many unoccupied houses in fair to good repair. These belong to farms that have been combined with others or that have been abandoned. Fields are commonly surrounded by stone fences, built of bowlders removed from the fields, but are in poor condition and frequently bordered by poison ivy and bushy growths. The farm machinery is generally adequate, though not always up to date, and receives only fair care. Many of the farmers have automobiles, which are used for business as well as pleasure. Some farms are equipped with trucks and a few have tractors. Milking machines and manure spreaders are not in general use. A fairly good grade of work stock, mainly horses, is maintained.

Of the farms reporting the use of commercial fertilizers in 1919, 141 farms, or 18.4 per cent of the total number in Putnam County, show an expenditure of \$55,562, or an average of \$394.06 per farm;

339 farms or 41 per cent of the total number in Rockland County expended \$68,787 or \$202.91 per farm; and 529 farms, or 34.4 per cent of the total number in Westchester County, reported \$111,899 or \$211.53 per farm. The use of commercial fertilizers is becoming more general every year, being applied to grain, corn, potatoes, and special crops. Stable manure is utilized for intertilled crops. Green manuring is not practiced, and the use of lime is not general.

About two-thirds of the farms in Putnam County, and about one-half of those in Rockland and Westchester counties reported expenditures for farm labor in 1919, with average amounts per farm of \$1,335.31, \$836.66, and \$2,338.80 respectively. These figures are much higher than for the average agricultural county. They do not represent conditions on the average farm, where the owner operates the farm and derives his income from that source. The high cost per farm, as shown by the census data, is due in a large degree to the expense incurred for labor, much of which is not productive labor, on so-called farms which are really country estates and on farms operated on a business basis for nonresident owners. Farm laborers are both native and foreign born and are moderately efficient.

The expenditure for feed for the year 1919 was also much higher than for the average county. About three-fourths of the farms in each county reported expenditures for feed, the total amounts being \$1,073,565 in Westchester County, \$665,156 in Putnam County, and \$467,381 in Rockland County. The high expenditure for feed is due to the small acreage in cereals on many farms where dairying is extensively practiced. The total average cost of labor, feed, and fertilizer for the farms reporting in 1919 was \$3,628.20 in Westchester, \$2,741.78 in Putnam, and \$1,760.84 in Rockland County.

The 1920 census gives the average size of farms in Putnam County as 147.3 acres, in Westchester County as 67.6 acres, and in Rockland County as 48.3 acres. The average size for the entire area is about 88 acres.

In 1919 the tenure of the farms was as follows: Westchester County, 70.1 per cent operated by owners, 13.7 per cent by tenants, and 16.2 per cent by managers; Rockland County, 82.4 per cent operated by owners, 8.9 per cent by tenants, and 8.7 per cent by managers; Putnam County, 69.1 per cent operated by owners, 19.4 per cent by tenants, and 11.5 per cent by managers. The share, share-cash, and cash systems of rental are in use, the latter being the most common. Under the prevailing lease in the share system the owner furnishes the land and one-half the seed and fertilizer and the tenant the remainder of the seed and fertilizer, the work stock, and the tools, with an equal division of the crops and other farm income.

The 1920 census gives the average value of all farm property per farm as \$31,023 for Westchester County, \$12,989 for Rockland County, and \$14,781 for Putnam County, and the average assessed values per acre as \$281.30, \$132.90, and \$40.98, respectively. The value of the land has been greatly influenced by the demand for farms for country estates and far exceeds the agricultural worth. Land for general and dairy farming can be purchased for \$100 to \$150 an acre; intensively farmed areas sell for much higher figures; and in the central and southern parts of Westchester County the selling price ranges from several hundred dollars to \$4,000 or more an acre.

SOILS.

The White Plains area lies within the region covered by the continental ice sheet, but the soil materials left by glaciation are closely related to the underlying rock formations. These range from metamorphosed gneiss and crystalline limestone of pre-Cambrian age and metamorphosed schist and dolomite of the Cambro-Silurian and Hudson River to sedimentaries—sandstone and shale—of Triassic age, with intrusions of igneous rocks, including granite, diorite, and diabase, in the forms of stringers, dikes, and bosses.

The oldest formation, known as the Fordham gneiss, is complex in structure and consists of massive to foliated metamorphic rocks, mainly gneiss with igneous intrusions and bosses. The area underlain by this formation includes not only the Highland region of the northwestern parts of Rockland and Putnam counties, but nearly all the remainder of Putnam County and large areas in the northern, central, and southern parts of Westchester County. It is the predominating rock formation over nearly all of the hilly to mountainous sections of the area. Associated with it at lower elevations, usually in valleys, are the metamorphic sedimentaries known as Manhattan schist and Stockbridge dolomite. The former is dark, micaceous, crystalline, and foliated, and the latter is coarse grained and light colored. The largest areas underlain by these rocks occur in the southeastern corner of Putnam and the northeastern part of Westchester counties, northeast of Ossining, east of the Sawmill River, east of the Bronx River, and near the State line in North Castle, Poundridge, and Lewisboro Towns. In an area southeast of Peekskill the underlying formation is a dark-colored basic rock known as Cortlandt diorite, while another area in the towns of Harrison and Rye is underlain by the Harrison diorite. The Newark formation which underlies a large part of Rockland County consists of red sandstones, cut by the trap rock or diabase of the Palisades of the Hudson. Granite occurs in scattered small areas east of the Hudson River.

Several geological ages intervened between the formation of the oldest and of the youngest of these rocks and previous to the invasion of the region by the ice sheet. In this interval the surface features, conforming in a general way to those of the present time, had been developed by the agencies of erosion, uplift, and intrusion, and the agencies of weathering had brought about the accumulation of a mantle of fine earth material on the surface. During the advance and retreat of the ice sheet this preglacially weathered mantle was reworked, mixed with the material ground up by the ice, transported, and deposited as glacial till. Streams from the melting ice front laid down much of the sandy and gravelly material of the terraces and deltas.

The soils of the area are therefore composed of materials derived from glacial till and water-laid deposits subsequently modified by agencies of weathering. They are separated on the basis of derivation and processes of accumulation into the following groups: (1) Soils derived from glacial till, (2) soils derived from stream-laid or terrace deposits, (3) soils derived from recent alluvial sediments, and (4) miscellaneous soils. Each group includes a number of soil series, and each series one or more soil types. The soil series consists of types of similar origin, mode of formation, color, structure, and topography; while the type represents a separation based mainly on texture, or the relative proportion of the different sized particles making up the soil mass.

The soils derived from glacial till constitute the largest, most extensive, and most important group of soils in this area. They occur in the rolling to hilly and rough sections. They are composed of fine earth material and rock fragments, ranging all the way from silt and clay to large boulders, indiscriminately mixed and resting upon an exceedingly irregular glaciated rock floor. The character of this material is closely related to that of the underlying rock, and varies little when overlying extensive areas of similar rock, but as a rule changes quickly when passing from a region of one distinct formation to another, though narrow local belts appear to have little modifying influence. The material is therefore almost entirely derived from local formations, with little or no admixture from other sources. Its depth ranges from a few inches to 50 or 100 feet or more, being as a rule deepest in the valleys and shallowest on the higher hills. Rock fragments and glacial boulders in varying sizes and quantities are found on the surface and in the soil section. As the whole area was glaciated, this material doubtless underlies the other soil groups to a large extent. Its character and topography indicate that it was deposited underneath the ice sheet as a ground moraine. The soils of this group are classified in the Gloucester, Wethersfield, Dover, Holyoke, and Whitman series.

The Gloucester series comprises soil types having light-brown to brown surface soils and a brownish-yellow to yellow upper subsoil which grades into a pale-yellow or yellowish-gray lower subsoil. The subsoil is usually as light or lighter in texture and more compact than the surface soil. Rock fragments and glacial boulders occur on the surface and throughout the soil mass. Outcrops are of common occurrence. The topography ranges from broadly rolling to hilly, the less stony types occupying smooth, rounded hills. Drainage is good. The soils of this series are the result of the weathering of glacial till derived mainly from the crystalline rocks, gneiss, granite, and schist. Three types, a fine sandy loam, stony loam, and loam, and two phases were classified in the Gloucester series in the survey of the White Plains area.

The Wethersfield series consists of soil types characterized by reddish-brown surface soils and a reddish-brown to red subsoil. The subsoil usually is the same in texture, but more compact in structure, than the surface soil. Fragments and glacial boulders of the crystalline rocks and sandstone are fairly common, but outcrops of the underlying red sandstone are of rare occurrence. The types occupy gently rolling to rolling areas and are well drained. The weathering of glacial till, derived in part from crystalline rocks, and to a varying but at least modifying degree from red sandstone and shale, has given rise to the types of this series. The fine sandy loam is the only representative of the Wethersfield series in this area.

The Dover series includes soil types which have brown surface soils and a light-brown to yellowish-brown subsoil of friable structure. Crystalline rock and limestone fragments are usually present in small quantities, both on the surface and in the soil section. Areas of shallow soil and outcrops of the underlying limestone are fairly common. The material is moderately to strongly calcareous. The surface is gently rolling to rolling, and the drainage good to excessive. Well-oxidized glacial till derived from crystalline and limestone rocks, the latter in modifying quantities, has given rise to the types of the series, which is represented by the loam in this area.

The types included in the Holyoke series have brown to reddish-brown surface soils and a yellowish to reddish-brown subsoil, which is fairly friable in structure. The stone content, which is usually high, consists mainly of angular to subangular fragments of dark basic rocks, with a small proportion of gneiss and granite. Outcrops are numerous. The topography is irregular to rough and the drainage good. The soils of the series have been formed by the weathering of a fairly thin mantle of glacial till composed of material derived from light-colored, coarsely crystalline rocks and from dark basic rocks, the latter occurring to a degree sufficient to dis-

tinguish the material from that of the Gloucester series. The Holyoke stony loam is the only type of the series mapped in this survey.

The surface soils of the types in the Whitman series are dark gray to grayish brown in color. The subsoil is yellowish gray to gray, mottled with yellow and rusty brown, and compact in structure. A layer of Muck is often present on the surface, and glacial boulders and other rock fragments occur both on the surface and in the soil profile and the substratum. The surface is level and the drainage poor. Material similar to that of the Gloucester series, but poorly oxidized and otherwise modified by poor drainage conditions, composes the types of this series, which in this area is represented only by the loam member.

The soils derived from stream-laid or terrace deposits, which are of small extent and little importance in this area, occupy well-defined terraces and deltas in stream valleys. They are composed of assorted gravel and sands consisting of water-deposited material derived from reworked glacial till or other ice-transported detritus of crystalline rock and sandstone origin. These deposits were laid down as flood plains and stream deltas when the valleys were serving as outlets for waters of the glacial or of later periods. In places the fine texture indicates a ponding of these waters. The areas are for the most part small and lie from 100 to 400 feet above sea level. They are underlain by glacial till or bedrock. The soils of the group are separated into the Merrimac, Hartford, Scarboro, and Hinckley series.

The Merrimac series embraces soil types which have light-brown to brown soils, a yellowish-brown to yellow subsoil, and a stratified, coarse-textured substratum, all of which have a moderately loose and porous structure. In only one type of this series in this area is the gravel content conspicuously high. The series occupies small to medium-sized terraces well above the present stream level. In places their original character has been so modified by erosion that the surface is undulating to gently rolling. The drainage is good to excessive. The types are composed of well-oxidized material derived from crystalline rocks. Modification since deposition by weathering, erosion, and wind action have resulted in the present stage of development of the types. The members of the series mapped in the present survey include the gravelly loam, sandy loam, fine sandy loam, and the loam and its rolling phase.

The types of the Hartford series have brown surface soils, a yellowish to reddish-brown subsoil, and a stratified gravelly substratum, all of which have a fairly open structure. Rounded gravel and cobblestones in places make up a considerable proportion of the soil material. The types have a level surface and occupy a terrace posi-

tion well above overflow. Only one member, the sandy loam, was mapped in this area. The types are composed of material derived from crystalline rocks and sandstone, reworked and deposited when the streams were flowing at higher levels.

The soils of the types in the Scarboro series are gray to grayish brown in color. The subsoil is brown to yellowish brown, grading below into material of grayish color. There is usually a thin layer of mucky material on the surface of areas of virgin soil, and the lower part of the upper subsoil may be partially cemented into a hardpan layer. The surface is level and the drainage is poor. The series consists of imperfectly oxidized deposits of water-laid material of crystalline rock or sandstone origin. Except for its poor drainage, it is similar to the Merrimac and Hartford soils. The Scarboro loam is the only type of this series identified in Westchester, Putnam, and Rockland Counties.

The types of the Hinckley series are characterized by light-brown to yellowish-brown soils and by a yellow subsoil as light or lighter in texture than the soil. The loose, porous structure of the 3-foot soil section continues into the stratified, coarse-textured substratum. The series occupies areas of terrace material so eroded that they have lost their original characteristics and have little agricultural value. Well-oxidized material derived from crystalline rocks gives rise to the Hinckley sandy loam, the only type of this series encountered in this survey.

The soils derived from recent alluvial sediments occupy first-bottom positions along some of the larger streams. They are composed of material derived from the soils of the glaciated uplands and of the terraces in the basins of the streams along which they occur. The sediments are deposited during periods of overflow. Material of this character is of small extent and is classed in the Podunk series.

The types of the Podunk series have light-brown surface soils and a yellowish-brown upper subsoil underlain by a mottled yellow, gray, and brown lower subsoil. The soils have a friable and the subsoils a moderately compact structure. The surface is nearly flat and only slightly above the stream level, and is subject to overflow. Drainage varies from poor to adequate. The material consists mainly of recent alluvium derived from the upland soil types of the stream basins. The Podunk silt loam is the only type of the series mapped in the present survey.

Muck is derived from accumulations of organic matter and occupies small upland basins or positions along stream courses where conditions have been favorable to the growth of water-loving vegetation and the preservation of its remains in various stages of decomposi-

tion. A small amount of mineral matter in the form of silt and clay has been incorporated with this material, which in this area is dark gray to black and finely divided.

Other miscellaneous soils mapped in this area are Rough stony land, Meadow, Tidal marsh, and Madeland, all of which are for the most part nonagricultural in their present condition.

Ten soil series, embracing 15 soil types and 3 phases, and 5 kinds of miscellaneous material have been recognized in the White Plains area.

The following table gives the names and the actual and relative extent of the various soils mapped in the White Plains area :

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Gloucester loam.....	170, 112	} 39.1	Merrimac fine sandy loam.....	5, 376	1.0
Deep phase.....	9, 536		Merrimac gravelly loam.....	4, 352	.8
Shallow phase.....	34, 688		Dover loam.....	3, 904	.7
Rough stony land.....	104, 128	19.0	Meadow.....	2, 560	.5
Gloucester stony loam.....	98, 752	18.0	Tidal marsh.....	2, 048	.4
Gloucester fine sandy loam.....	34, 368	6.3	Whitman loam.....	1, 536	.3
Wethersfield fine sandy loam.....	20, 352	3.7	Hartford sandy loam.....	768	.1
Merrimac loam.....	14, 592	} 3.0	Hinckley sandy loam.....	576	.1
Rolling phase.....	1, 664		Madeland.....	576	.1
Muck.....	15, 808	2.9	Scarboro loam.....	576	.1
Holyoke stony loam.....	8, 960	1.6			
Podunk silt loam.....	7, 104	1.3			
Merrimac sandy loam.....	5, 504	1.0			
			Total.....	547, 840

GLoucester Stony Loam.

The surface soil of the Gloucester stony loam is a light-brown to brown friable loam with a depth of 6 to 8 inches. The subsoil is a brownish-yellow light loam, grading into yellow and in places grayish yellow in the lower part. Below 36 inches the material is a pale-yellow to yellowish-gray sandy loam to loam. Glacial boulders of granite and gneiss usually occur on the surface in fairly large numbers and within the 3-foot section as smaller fragments distributed in such a way that the material is sometimes nearly stone free and again is made up almost entirely of stones. Rounded outcrops are fairly common. The structure of the subsoil and substratum ranges from loose to moderately compact, according to the proportion of stones.

In places the type carries few, if any, more stones than the Gloucester loam, but the soil mantle is on the whole shallower, outcrops are more numerous, and the topography rougher. In other places the soil profile has about the same stone content as the loam of the

series, but surface boulders are sufficiently abundant to preclude its use for farm crops. The type grades on the one hand toward the loam and its shallow phase, and on the other toward Rough stony land. In Rockland County and in the Highland section of Putnam County the texture tends to be lighter, approaching a fine sandy loam. This type represents land having some possibility of agricultural development, although very little of it has ever been cleared and almost none of it is in cultivation at the present time.

The Gloucester stony loam has a wide distribution, occurring in areas of a few acres to several square miles in extent in nearly all parts of the survey. It is most extensive in eastern Putnam and northern Westchester Counties and least extensive in Rockland County, where it is found only in the Highland section. It is associated with the Gloucester loam and its phases and with Rough stony land.

The Gloucester stony loam has a rougher topography than any other soil in the area, except Rough stony land, and occupies either high hilly to rough tracts covering a considerable acreage or local steep slopes or hills in association with land of rougher or smoother surface features. It lies at elevations between 200 and 1,100 feet, with the greater part more than 500 feet above sea level. In detail the slopes are frequently smooth and rounded, resembling in outline those of the Gloucester loam, but they are usually steeper and have a shallower soil mantle, more outcrops of rock, and a higher stone content. The drainage ranges from good to excessive. There is little run-off, as the rainfall is readily absorbed by the soil and subsoil.

This is one of the most extensive types in the area, but as very little of it is used for annual farm crops it has relatively little agricultural importance. Tracts here and there, at one time cleared, have been allowed to revert to forest, and at present only a very small acreage is used for crops. A considerable proportion is now included in country estates and in tracts held in connection with the New York City water system. Where found on farms, it is used largely as woodlots, as most of the trees suitable for lumber have been removed. Its chief use in farming operations is for pasture.

Scattered areas are suitable for cultivation, but the high price of land, the cost of clearing of timber and stone, and of making other improvements prohibit their development for farming. The best use of the greater part of it is for forestry. The better areas occurring in the farming section of the area should be utilized for grazing.

The type, when not forming too high a proportion of farms, sells with better agricultural soils without apparently affecting the price. As sites for summer residences and country estates it commands a much higher price.

GLOUCESTER FINE SANDY LOAM.

To a depth of 6 to 8 inches the soil of the Gloucester fine sandy loam is a light to yellowish brown or brown friable fine sandy loam. The subsoil is a light yellowish brown to yellow fine sandy loam, which normally grades at 2 feet into a pale to grayish yellow or mottled yellow and gray fine sandy loam of light texture. Material of practically the same character, except in color, which becomes still lighter with depth, continues below the 3-foot section. Both subsoil and substratum, though moderately compact, seldom greatly retard the downward movement of water. The stone content is made up of angular and rounded fragments of granite, gneiss, and sandstone, ranging in size from gravel and cobblestones to large boulders. Their distribution on the surface and within the soil section varies widely, both over the type as a whole and locally, but none of it is stone free and very little of it is sufficiently stony to forbid its use for crops. The stones are seldom abundant enough seriously to interfere with cultivation, especially where those on the surface have been removed as has usually been done. Outcrops of the underlying sandstone are uncommon.

In this area the greater part of the type overlies a red sandstone and is associated with the Wethersfield fine sandy loam, a reddish soil of similar origin. The boundaries are usually arbitrary, one type changing gradually into the other, so that near areas of the latter, as well as where the glacial till is sufficiently shallow, this type shows the influence of the red sandstone in places, through admixture of residual but more commonly of glacially accumulated material. Areas of loam doubtless occur, as well as gradations toward material of medium sandy grade.

This type occurs only in Rockland County, where it occupies, in association with the Wethersfield fine sandy loam, a considerable part of the rolling plain between the Palisades and the Highlands of the Hudson. The greater part lies between elevations of 200 and 500 feet above sea level.

The surface is broadly rolling, the divides smooth and rounded, and the slopes for the most part smooth and gentle. Practically none of it is too steep for cultivation. Although there is little runoff from the surface, the drainage is fairly good, as the precipitation finds its way downward through the till, a part of it reaching the streams by seepage and springs at lower levels.

The Gloucester fine sandy loam is an important type in Rockland County, where it is extensively developed. Probably 75 per cent of it is cleared, and of this a considerable proportion is used for the production of crops. It is well located with respect to transportation facilities and markets and is easily tilled. Though its organic

matter content is rather low, it holds moisture fairly well when properly cultivated. Settlement on the type is rather dense, as small-sized farms prevail.

The type occurs within a section devoted to mixed agricultural pursuits. No one crop or type of farming prevails. General, dairy, truck, and fruit farming, with combinations of one or more of these, and poultry raising are engaged in, so that the farm income is from a variety of sources. Corn, potatoes, hay, oats, wheat, rye, tree fruits, small fruits, and vegetables are grown. Hay yields from 1 to 1½ tons, potatoes approximately 100 bushels, corn 35 to 75 bushels, wheat 18 to 25 bushels, rye 15 to 20 bushels, and oats 30 to 60 bushels per acre. Good yields of fruits of good quality are obtained.

The cereal and forage crops are consumed largely on the farms where produced. Dairy products, poultry products, and fruits are shipped to near-by cities. The surplus of other crops finds a ready market. A general system of rotation is in use, consisting of plowing sod land for cultivated crops, followed by grain and seeding to grass, which occupies the land for two years or more. This is varied to meet the needs of the individual farms. The supply of stable manure is conserved and as a rule applied to sod land. Fertilizers are used rather extensively.

Prices of general and dairy farms range from \$100 to \$200 or more an acre, with smaller and more intensively farmed areas selling for higher figures.

GLOUCESTER LOAM.

The Gloucester loam consists of a light-brown to brown loam, from 6 to 8 inches deep, underlain by a brownish-yellow loam which grades through yellow to pale yellow and in many places to yellowish gray in the lower part of the 3-foot section. The substratum is made up of pale-yellow to gray, and in places faintly mottled, unassorted material. The surface soil has a friable structure, while the subsoil and substratum, though moderately compact, are not impervious and are usually as light or lighter in texture than the soil. Rock fragments of the gravel grades and larger occur on the surface and throughout the soil mass in varying quantities. Glacial boulders, from small to large and sometimes massive in size, mainly granite and gneiss in the case of the smaller fragments, are found in some places much more abundantly than in others, both on the surface and within the soil mass. These have largely been removed from improved fields and placed in piles or used in fences. Rock outcrops are comparatively few and are ordinarily small, low, and rounded, but areas of rather shallow soil are somewhat more common. Mica is often present in conspicuous quantities.

The bedrock is mainly gneiss, with some granite and a smaller proportion of schistose rocks.

In virgin areas there is an inch or two of medium-gray light-textured material, below which there is a yellowish-brown to yellow, slightly heavier material, in contrast to the solid brown color of the soil of cultivated fields. As the type is composed of unsorted material, it varies locally from the above description. The color of the soil and subsoil are fairly uniform, the chief variations resulting from differences in topography or in stone and sand content. Important variations that are not mapped as phases consist of gradations toward the fine sandy loam and the stony loam of the series, tracts here and there of both of these types being included. The latter may occur anywhere in the area, and the former chiefly in the northern part, where the topography is rougher and where the bedrock is entirely granite and gneiss. Although formed mainly of material from granite and gneiss, its character has in places been somewhat modified by the inclusion of material from limestone or dolomite and schistose rocks, which tends to give it a more loamy texture than is typical of material derived wholly from the coarser crystalline rocks. The smaller stone content and the smoother surface distinguish this type from the stony loam. The stones are usually largest and most abundant on the surface and decrease in size and quantity with depth, and wherever abundant on the surface the stones generally form a considerable part of the underlying material, and vice versa. The till from which this type is derived varies greatly in depth, and may range from 3 to 25 feet or more within short distances.

This is the most extensive and widely distributed soil type in the White Plains area. It is the dominant type in nearly all parts of Westchester and the southeastern half of Putnam County. It is associated with the shallow and deep phases of the type and the stony loam of the same series.

The Gloucester loam covers the smoothest parts of the uplands of the area east of the Hudson River. Its surface features are dependent upon the unevenness of the surface of the underlying rocks and to an almost negligible degree upon the depth of the glacial till. It occupies a series of hills and ridges irregularly arranged and separated by main and tributary valleys whose streams are from 100 to 400 feet below the crests of the hills. On the whole the hills rise to a fairly uniform elevation which decreases gradually toward the south and southeast. In detail these interstream areas are made up of a more or less promiscuous arrangement of hills whose outlines are long and sweeping and whose tops are smooth and rounded, with here and there steep slopes and high rocky crests occupied by the Gloucester stony loam. South of White Plains and east of the Bronx River a smoother topography, in general broadly rolling, pre-

vails. Except for local tracts, the surface of the type is favorable for cultivation. The greater part of the type lies between elevations of 400 to 600 feet, though some are 700 to 800 feet above sea level. In the section tributary to the sound the elevation is from 200 to 400 feet.

The natural drainage is good, only small areas being extensively or inadequately drained. As a rule the rainfall is readily absorbed, so that there is little run-off, except during heavy rains and on moderately steep slopes not covered with vegetation. Streamlets and draws do not ramify to all parts of the type, and only the main streams are perennial. Artificial drainage is required only for local tracts.

A greater proportion of this type is in cultivation than of the other type, but in percentage of total area in cultivation it is exceeded by a number of the minor types. Probably two-thirds of it, representing the cleared area, was at one time utilized for farm crops, though the cropped area has been greatly reduced by its use as sites for cities, villages, suburban homes, country estates, and as land reserved in connection with the New York City water supply. It includes a considerable acreage not devoted to farming, yet it is the most important type from the standpoint of acreage, production, and value of crops. The forest growth consists of a mixed stand of hardwoods. The factors controlling its original development for farming were topography, stone content, lack of transportation, and distance from markets. At present, with the extension of the railroads and the construction of a comprehensive system of State and improved county roads, none of it is remote from transportation facilities.

The soil carries a moderate quantity of organic matter, and upon the removal of the surface stone it is easily tilled, except upon some of the steeper slopes. The moisture-holding capacity, though varying with the depth of the soil material, is such that crops rarely suffer seriously from lack or from excess of moisture. Erosion is not serious, even in fields in tilled crops and on moderately steep to steep slopes. Fields on this type are usually fenced with stone. The elevation and the length of growing season are favorable to crop production, with certain positions on slopes better adapted to long-season crops. The type is regarded as moderately productive and adapted to a variety of crops.

Dairy and general farming, or a combination of the two, prevail over the present cultivated area, so that farming operations center for the most part around the production of forage crops for farm use. Hay and corn are the leading crops. Potatoes, oats, rye, buckwheat, fruits, and vegetables are minor crops, which, with few exceptions, are not grown in commercial quantities. Dairy products, mainly

milk, are shipped to the cities. Corn is grown either for grain or silage and is all consumed on the farm. Oats, on account of their light and uncertain yield, are grown only to a small extent for feed and as a nurse crop in seeding land to grass. Rye is grown on a larger acreage than wheat. Potatoes are grown chiefly to supply the home, the surplus being sold locally. The commercial production of fruit is confined mainly to peaches; the apple orchards are for the most part small, old, and neglected. A large acreage is in pastures, some permanent. Large quantities of feed are purchased by the farmers on this type. Some income is realized from the sale of cattle and hogs, but the stock-raising industry is not developed commercially. Poultry raising, though a source of considerable income, is a specialized industry with only a few farmers.

Hay yields from three-fourths to 2 tons, with an average slightly exceeding 1 ton per acre; corn from 35 to 100 bushels, with an average of about 50 bushels per acre; oats from 25 to 45 bushels; rye, 15 to 25 bushels; potatoes, 75 to 150 bushels per acre. Medium yields of other crops are obtained. Fruit does well when the orchards are given proper care.

Farming is based on the general plan of producing forage crops, a minimum acreage of grain, and subsistence crops for family use. The rotation usually consists of corn or some other tilled crop, followed by oats or some other grain and seeding to grass, leaving the fields as many years in sod as the stand of grass or the character of farming permits. Stable manure is applied to sod land before plowing, and fertilizers are quite generally used for tilled and grain crops. Methods of farming range all the way from poor to good, and the type is not made to produce crops to its full capacity. Too much of it is either lying idle or yielding a poor grade of hay.

The selling price of the greater part of this type is not based on its productive capacity. Even in the farming sections its sale value has been increased by the purchase of farms by nonresidents. Farms sell for \$90 to \$150 an acre.

Gloucester loam, deep phase.—The Gloucester loam, deep phase, consists of about 8 inches of grayish to light-brown loam underlain by a pale-yellow, compact, light loam, which either extends to a depth of 3 feet or grades at a depth of 20 to 24 inches into gray material faintly or strongly mottled with yellow. The substratum comprises a rather deep mass of grayish, unsorted, compact fine earth and rock material. Granite and gneiss fragments of different sizes and shapes occur on the surface and within the 3-foot section, though rounded boulders are less common than in the typical soil. Outcrops are seldom present, as the depth to bedrock is usually from 10 to 25 feet or more.

The deep phase is lighter in color of soil, has a greater tendency to become lighter in color with depth as well as mottled in the subsoil, and has less outcrops and greater depth than the type. It drains more slowly and is less well oxidized. It resembles in some respects the soils of the Dutchess series, but seems to be composed entirely of material derived from crystalline rocks. The boundaries between this phase and the typical soil are arbitrarily placed.

The largest areas of this phase occur in Cortlandt and Yorktown Towns, east of Peekskill, and northwest of Yorktown Heights. Other areas are located southeast of Brewster, north of South Salem and the village of Cross River, west of Salem Center, and southeast of Somers. It is associated with other Gloucester soils.

This phase covers moderately high, smooth, rounded hills whose surface is gently sloping to sloping. The greater part is included within elevations of 500 to 800 feet. There is little run-off except from tilled fields, as the greater part of the rainfall finds its way slowly downward through the soil material. The drainage is slower than in the case of other types, but crops seldom suffer from excess of moisture.

The deep phase, though not extensive, is moderately important agriculturally, as all of it is cleared and a large part of it farmed. Some of the best farms in the area are located on it. The surface soil is rather low in organic matter, but tillage is easy, and the use of modern farm machinery is practicable. It holds moisture fairly well and is regarded as a productive soil.

Corn, grain, hay, and some minor crops are grown, the yields averaging slightly higher than on the Gloucester loam. General and dairy farming prevails. A part of the phase is included within country estates.

The selling price for farming purposes has about the same range as that of the type, or from \$100 to \$150 an acre.

Gloucester loam, shallow phase.—The shallow phase of the Gloucester loam has a surface soil of brown loam to silty loam of smooth texture and friable structure, 6 to 8 inches deep. The subsoil is a brownish-yellow to yellow friable loam to very fine sandy loam, which extends to a depth of 3 feet or more. The substratum is a continuation of the subsoil, with a tendency to grade lighter in color and texture. Rock fragments of varying size occur, and glacial boulders, though present, are found in smaller quantities than in the typical soil. Low, rounded outcrops are common and are larger and more numerous than on the typical soil. In places the soil material has a slightly reddish color, due to the influence of the weathering of the underlying rock.

This phase represents a condition where the soil material rather closely resembles the Gloucester loam in color and texture, but other

factors combine to give it an agricultural value which warrants its separation from the type. It includes areas intermediate in agricultural value between the Gloucester loam and the Gloucester stony loam. It is not as hilly or as stony as the latter, but has more rock outcrop and less average depth of soil material over bedrock than the former. The outcrops are scattered uniformly over the surface, so that even fields of moderate size are not free from them. The soil mantle between outcrops ranges from a few inches to several feet, with an average exceeding 3 feet. Areas underlain by schistose rocks have a slightly darker colored and smoother textured soil, and those underlain by granite or gneiss have a lighter or more sandy texture.

This phase covers a fairly large area in eastern North Castle and southern Poundridge and Lewisboro Towns near the Connecticut line. A number of areas occur in the southern part of Westchester County in the towns of Rye, Harrison, and Mamaroneck and the cities of New Rochelle, Mount Vernon, and Yonkers. Several areas are also found in the northern part of Putnam County. The associated types are the Gloucester loam and stony loam.

The surface features of this phase range from broadly rolling to hilly, with local irregularities due to the presence of rock outcrops. Its elevation ranges from 200 to 600 feet above sea level. Its drainage is good to excessive. The surface run-off is slight, as the rainfall is readily absorbed by the fine-earth mantle.

In the southern part of the area the greater part of the phase is taken up by villages, cities, and country homes, the remainder lying within sparsely settled rural sections where farming operations are carried on in a more or less desultory manner. Much of it is still in forest, and the acreage now farmed is not as large as formerly. Its location is favorable, but the phase is not well adapted to extensive farming operations. The fields are often small, with crops grown mainly for home use. In places it is being developed for fruit and other special crops. Low to medium yields of the common crops are obtained.

The selling price of this phase has about the same range as that of the typical soil, and in most cases is high enough to prevent its purchase for farming purposes.

WETHERSFIELD FINE SANDY LOAM.

The surface soil of the Wethersfield fine sandy loam is a friable, reddish-brown fine sandy loam, 8 to 10 inches deep. The subsoil to a depth of 3 feet or more is a reddish-brown to red friable fine sandy loam. The substratum is red to pale red or pink, mottled with yellow and gray, and moderately compact. The type carries glacial boulders, usually of medium size and mainly of granite, gneiss, and

sandstone, on the surface and in the 3-foot section. Outcrops of the underlying red sandstone are common, the earth mantle ranging from a few feet to 15 feet or more in thickness. The subsoil is characteristically as light or lighter in texture than the surface soil.

There are two main areas of the type, one lying almost directly west of the Palisades in the drainage basin of the Hackensack River, the other extending in a general northeast to southwest direction from near Mount Ivy to the State line near Suffern. Several small, detached bodies are located near the larger areas. All the type is in Rockland County. It is associated mainly with the Gloucester fine sandy loam.

The type has a gently to broadly rolling topography, with no steep or stony slopes, and ranges in elevation from 100 to 250 feet in the eastern part and from 400 to 600 feet in the western part. The drainage is good.

The Wethersfield fine sandy loam, while consisting largely of unassorted material from crystalline rocks, derives its characteristic color from the associated red sandstone formation. It is fairly well oxidized within the soil profile.

Though restricted in occurrence to certain sections in Rockland County, the type has a fairly high agricultural importance, as it comprises at least one-fifth of the farming land of that county. More than 75 per cent of it is cleared, a large proportion of which is farmed. The type is well located, has a favorable topography, drains quickly, and holds moisture fairly well. The soil though somewhat low in organic matter, is moderately productive.

The type occupies a fairly thickly settled section, most of it being in small farms devoted to fruit, poultry raising, trucking, dairying, and general farming. The crops include hay, corn, grain, potatoes, vegetables, and apples and peaches, all of which return fair average yields. There is a tendency toward specialization on many of the smaller farms. The surplus crops find ready markets in the near-by cities.

Land values average fairly high, though frequently the selling value is not based on demand for farming purposes.

DOVER LOAM.

The surface soil of the Dover loam is a friable brown loam, 6 to 8 inches deep. The subsoil is a light-brown friable loam extending to a depth of 3 feet or more. The type carries some glacial gravel and bowlders of crystalline rock origin, together with some small angular and other larger fragments of limestone or dolomite, which is also the underlying rock. The type includes areas of shallow soil, frequently less than 3 feet in depth, in which outcrops are rather numerous, and the soil consists quite largely of material derived from

the underlying dolomite and has a slightly reddish color, especially when the moisture content is fairly high. In places where the larger proportion of the soil material is derived from the underlying rock the material has a distinctly reddish color and a sticky to plastic structure, as well as a texture heavier than typical. Much of the type as mapped in this area more properly belongs to its shallow variation. The subsoil and substratum are calcareous.

The type is not as stony or as irregular in surface features as the soils of the Gloucester series. It also occurs at lower elevations and is usually readily distinguished from the latter by its slightly reddish color under normal field conditions. The Dover and Gloucester loams grade into each other, especially to the north and south of areas of the Dover, so that limestone material in a gradually decreasing amount is found in the adjacent Gloucester soils. The boundaries have been placed in most cases near the contact of the two rock formations—the crystalline rocks and the dolomite.

A large development of the type is found in the northeastern part of Putnam County, near the village of Patterson. Other areas occur in the Bronx River Valley between Tuckahoe and Hartsdale, northeast of Yorktown Heights, near Pleasantville, south of Ossining, north of Elmsford in Westchester County, and south of Tompkins Cove in Rockland County. Areas too small to map, located in a number of other valleys, are included with adjoining soils. Gloucester and Merrimac soils are the most commonly associated types.

The type is conspicuous on account of its low position in valleys and its less rugged surface features. The surface is gently rolling to rolling, with here and there local tracts of irregular topography due to the presence of rock outcrops and of shallow soil. The drainage is good and in places excessive.

The Dover loam is composed of glacial till consisting of a mixture of material derived from crystalline rocks and limestone or dolomite. The till mantle is for the most part rather shallow and the underlying rock has in places contributed to the formation of the type.

The type has a rather wide distribution, but is not extensive. All of it is cleared, and the most of it was formerly farmed. At present practically all except the part located near Patterson, which is used for crops, forms the site of cities and villages and thickly settled suburban sections. It is regarded as a productive soil, though inclined to be droughty in places in some seasons. Transportation and markets are close by. The soil is well oxidized and is adapted to a variety of crops. It contains a medium amount of organic matter and is easily tilled.

Corn, wheat, oats, hay, and fruit are the leading crops, and a considerable acreage is used for pasture. Dairying prevails on the ma-

majority of farms wholly or partly of this type, and all farming operations center around the production of dairy products, mainly milk for the city markets. Medium to good yields of crops are obtained.

Farm buildings on this type are usually substantial, and the type on the whole is well farmed. A good grade of stock is kept.

The selling price of farms consisting largely or wholly of this type is \$100 an acre and upward.

HOLYOKE STONY LOAM.

The Holyoke stony loam consists of a brown to slightly reddish brown loam, from 6 to 8 inches deep, resting upon a yellowish to reddish-brown loam, which extends to a depth of 3 feet or more. Both soil and subsoil have a fairly friable structure. The type carries a high content of stones consisting mainly of angular to sub-angular fragments, medium to large in size, of dark-colored rock, chiefly diorite, but to a small extent granite and gneiss. The soil layer is moderately thin, and ledges and jagged outcrops of the underlying diorite are common. A more pronounced red color and heavier texture are found in places where the material is especially shallow. With the normal moisture content the reddish color is more marked in the surface soil than in the subsoil.

The type differs from the Gloucester stony loam in being influenced by the dark-colored basic rock, to which is traceable its reddish color, and in its characteristic stone content.

This type occurs in an area covering 10 square miles or more between Peekskill and the Croton River to the southeast.

The Holyoke stony loam has an unusually hilly surface, with an irregular arrangement of hills and valleys which contrasts strongly with the remainder of the area. As a whole it does not have the diversity of elevation of an area of equal size of the Gloucester soils, but is made up of irregular slopes and undulating country locally roughened by jagged rock outcrops. It ranges from 200 to 600 feet in elevation. Drainage is good to excessive, the latter condition existing in some of the shallower areas.

Though moderately extensive, the type is unimportant from an agricultural standpoint, as comparatively little of it is cleared and used for crops. The remainder has a medium to thick growth of hardwoods. There are a few farms, mostly small, with favorable tracts here and there in cultivation, but the greater part of the settlement consists of summer and suburban residents. Unlike a number of other types that have been diverted to uses other than agriculture, little of it has ever been farmed, as the productiveness of the soil does not warrant the high expense necessary to clear it and put it in shape for crops. This type finds its best use in the

production of timber crops and as sites for summer and suburban homes. Its sale value is not based on its demand for farming purposes.

WHITMAN LOAM.

The surface soil of the Whitman loam is a dark-gray to dark grayish brown loam, 6 to 8 inches deep. The subsoil is a yellowish-gray to gray loam, mottled with yellow and rusty brown, extending to a depth of 3 feet or more. Compact unassorted grayish material forms the substratum. The upper layer, 2 or 3 inches thick, is frequently mucky and underlain by a stratum of gray to drab material. Glacial boulders of granite and gneiss are present on the surface and in the soil mass. In its natural state the type has a compact structure.

In this area the type is subject to some variation, as it represents a condition rather than a true soil type. The texture ranges from a sandy loam to a silty loam, with a subsoil very little if any heavier than the soil. Color differences consist of gradations toward darker surface material and less mottling in the subsoil near the center of the individual areas.

The type is of very small extent but is quite widely distributed. It occurs in association with the Gloucester soils in areas containing from 8 to 50 acres and forming upland basins or troughs, or in glades near ponds and the heads of streams. Numerous areas from 1 to 5 acres in size, too small to map, are included with other upland soils. Though seldom traversing the areas in natural channels, streams frequently head in them. Seepage from higher lying land tends to keep the type wet during much of the year, as both the surface and internal drainage are very slow.

The Whitman loam has no present agricultural importance. It is partly forested and partly cleared, but very little is used for farm crops. Pasture is its chief use. Though in places open ditches have been made to carry off some of the surplus water, on the whole very little attention has been given to its improvement. Until reclaimed it is naturally unproductive and is adapted only to grazing and to the growing of timber crops. It has no sale value of its own, being sold only with larger areas of other types.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Whitman loam :

Mechanical analyses of Whitman loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
162821.....	Soil.....	5.0	9.6	4.6	16.8	15.9	36.1	12.0
162822.....	Subsoil.....	5.2	10.6	5.3	18.5	15.7	35.9	8.9

MERRIMAC GRAVELLY LOAM.

To a depth of 6 to 8 inches the Merrimac gravelly loam is a friable brown loam carrying rather large quantities of small to medium gravel. The subsoil is a yellowish gravelly sandy loam of loose structure, grading into a porous bed of gravel and sand which extends to a depth of 3 feet or more. Stratified sand and gravel deposits of some depth comprise the substratum. Variations consist mainly in differences in gravel content and in texture of the surface soil, which in some areas is comparatively light.

The type occurs mainly on small terraces along the Ramapo and Mahwah Rivers and other streams in the western part of Rockland County. An area is located from 3 to 5 miles northeast of Cold Spring, in Putnam County. Small areas lie southwest of Bedford, in Westchester County. The surface is level to slightly undulating and from 10 to 40 feet above the stream courses. Drainage tends to be excessive.

This type is unimportant from an agricultural standpoint. Practically all of it is cleared, but only a small part is in use for annual crops. A considerable proportion is covered by the villages of Suffern, Hillburn, Ramapo, and Sloatsburg. The type is close to market and moderately productive. The soil is easy to handle under a wide range of moisture conditions, but is inclined to be droughty. It is adapted to the production of special rather than general crops. About the same crops are grown and the same yields are obtained as on the other types of the series, and the suggestions for their improvement can be applied to this type.

MERRIMAC SANDY LOAM.

The Merrimac sandy loam consists of a light-brown to brown sandy loam, averaging 8 inches in depth, underlain by a yellowish-brown to yellow loamy sand to sand to a depth of 3 feet or more. The substratum is stratified sandy material several feet in thickness. Gravel and other rock fragments seldom occur. The surface soil has a friable structure and is low in organic matter. The subsoil has a loose and porous structure. In places the lower part of the 3-foot section assumes a grayish color.

The type is found on the river side of Westchester and Putnam Counties in relatively narrow, high benches, from Tarrytown northward to Croton, northwest and south of Peekskill, and near Manitou; in Rockland County, in the vicinity of Haverstraw and West Haverstraw, and also on terraces in the valley of the Hackensack River in the southeastern part of the county. The associated soils are types of the same series on the same level and of the Gloucester and Weathersfield series on the upland.

The original terracelike surface of many of these areas has been modified by the cutting of narrow V-shaped stream valleys or short draws which give an undulating to steeply sloping topography. The areas along the Hudson lie from 50 to 150 feet above the normal water level in that stream. Other areas lie 10 to 40 feet above the stream bottoms. The open structure of the soil material permits thorough drainage.

The Merrimac sandy loam is an unimportant type, both in extent and agriculturally. All of it is cleared, and a considerable acreage was doubtless cultivated at one time. At present a large proportion is occupied by cities and villages, other rather thickly settled sections, and country homes. The part in farms is used for growing hay, grain, potatoes, vegetables, and fruit. Light to medium yields are obtained.

Sales of land of this character for farming purposes are uncommon, as prices are too high and the demand for other purposes too great.

MERRIMAC FINE SANDY LOAM.

The Merrimac fine sandy loam to a depth of 6 to 8 inches, is a light-brown to brown fine sandy loam which has a friable structure and grades light rather than heavy in texture. The subsoil is a light-brown to yellowish-brown loamy fine sand, passing into a yellowish fine sand at a depth of 12 to 15 inches. Stratified sandy material comprises the substratum. Both subsoil and substratum have a loose, porous structure. The material is fairly free from gravel and larger stones.

An irregular-shaped area occurs in the town of Bedford, mainly to the west and south of Bedford Center. Two areas are found in the Hudson River trough, one near Cold Spring and the other east and south of Garrison in Putnam County. The Rockland County areas lie northeast of Suffern, near Tappan and Orangeville in the southeastern part, and south and southwest of Thiells.

The type has a level to gently undulating surface and for the most part lies on terraces 10 to 40 feet above the streams in whose valleys it occurs. The areas along the Hudson River in Putnam County occupy a higher position, 50 to 300 feet above the river, and in places have been so modified by erosion since deposition that their terrace character is not at first apparent. Rock outcrops occur and areas of shallow soil material are fairly common. The type is well to excessively drained.

The Merrimac fine sandy loam is inextensive. Though nearly all cleared and at one time farmed, only a small proportion of it is now in cultivation. Private estates, golf courses, and villages now cover a considerable part of it. The soil is rather low in organic matter,

and not sufficiently retentive of moisture for maximum yields of crops. It lies close to transportation, is easily cultivated, responds readily to good treatment, and is adapted to intensive crops. Grass, grain, tree fruit, and small fruit are grown. The yields are light to moderate.

Methods of cultivation which will enable the type to hold more moisture and to retain it within the reach of crops are essential to its successful use. The organic-matter content should be increased by turning under green crops. Deeper plowing and frequent cultivation should be practiced. Stable manure should be applied liberally.

MERRIMAC LOAM.

The Merrimac loam consists of a friable brown loam, about 8 inches in depth, underlain by a light-brown to yellowish-brown loam of light texture, grading at about 15 inches into a yellowish light loam to coarse sandy loam, which extends to 3 feet or more. The substratum is a yellowish to yellowish-gray mass of stratified material consisting mainly of more or less angular coarse to very coarse sand, mixed with which is some small gravel. The subsoil, especially the lower part, and the substratum have a loose porous structure. In places the surface soil carries a small quantity of gravel, and in such areas the subsoil contains larger quantities than typical. Angular quartz grains of the size of coarse sand are frequently conspicuous in the surface material.

The type occupies nearly all the terrace areas in the valleys of interior streams of Westchester and Putnam Counties, including the valleys of Croton River and its East, West, and Middle Branches, and of Stone, Mianus, Bronx, and Sawmill Rivers. One area is located along the Hudson River between Tarrytown and Dobbs Ferry, and another lies on the west side of the river near North Haverstraw. The associated types are usually those of the Gloucester and Dover series on the uplands and of Podunk series in the stream bottoms.

A terrace topography is characteristic of the type, its level surface breaking away abruptly toward the stream bottoms 10 to 40 feet below. The areas along the Hudson lie 75 to 100 feet or more above the level of the river. In places the surface is undulating, the terrace characteristics having been partly destroyed by erosion. The type is well to excessively drained.

The Merrimac loam is made up of material washed from the basin of the stream along which it occurs. Its loaminess appears to be due in part to its association with the Dover soils or with strata of limestone which have been the determining factor in the location of a number of these valleys.

While this is the most extensive of the terrace types, it covers a comparatively small area and also has a relatively low agricultural importance in the three counties. It is well located with respect to transportation and is moderately productive, though inclined to be somewhat droughty. The soil is easily cultivated under a wide range in moisture conditions. It is rather low in organic matter.

Practically all of it is cleared and a large proportion of it was at one time under cultivation. Probably not more than one-third of it is now farmed, the remainder being within city limits, in country estates or golf courses, or in reservoir tracts. Where farmed, it is handled in conjunction with the more extensive upland types under general farming methods. Hay, grain, potatoes, and other vegetables are grown in small quantities. Medium to good yields are obtained. There are a few orchards on the type. In places it forms a part of dairy farms and is sometimes used for pasture. On the country estates it is as a rule kept in grass.

The selling price of the greater part of this type is frequently higher than its value and demand for farming purposes warrant.

Merrimac loam, rolling phase.—The rolling phase of the Merrimac loam consists of areas of the type that are eroded to a considerable extent, but not sufficiently eroded to prevent their use for farming, as is the case with the associated Hinckley sandy loam. The soil is light and rather coarse in texture, often approaching a coarse sandy loam or loamy coarse sand, with a loose to porous structure in the 3-foot section.

The phase occurs in small tracts in the valley of the Croton River and in the Hudson River trough. It has a rolling surface and is rather excessively drained.

Practically all of it is cleared and much of it was at one time in cultivation. Its chief use at present is for pasture.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the typical Merrimac loam:

Mechanical analyses of Merrimac loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
162809.....	Soil.....	2.4	6.9	3.8	13.9	21.5	33.5	18.0
162810.....	Subsoil.....	2.0	8.6	4.3	15.0	17.1	40.9	12.0

HARTFORD SANDY LOAM.

The Hartford sandy loam consists of a brown to reddish-brown sandy loam, about 6 inches deep, underlain by a reddish-brown to pale-red, light sandy loam, which grades lighter with depth and con-

tinues beyond the soil profile. In places there are varying quantities of gravel, mainly granite and sandstone, on the surface and throughout the soil mass. The structure of the type is porous.

This type occurs only in the drainage basin of the Hackensack River near Tappan, West Nyack, and Valley Cottage, mainly in association with the Merrimac sandy loam. The surface is level and from 10 to 20 feet above the first-bottom and Muck areas. Drainage is good, with a tendency to be excessive in seasons of relatively little rainfall.

The Hartford sandy loam comprises stream-laid terrace material composed, to at least a modifying degree, of sediments derived from the Wethersfield fine sandy loam and the underlying bedrock or red sandstone. The soil carries a moderate amount of organic matter and may be tilled under a wide range of moisture conditions. The material is well oxidized. The type is better adapted to special than to general crops, and is well located. It is inextensive and local in distribution, and though most of it is cleared, very little is farmed. It has about the same value as the adjoining types.

SCARBORO LOAM.

The surface soil of the Scarboro loam is a grayish-brown loam from 6 to 8 inches deep. The subsoil is a compact pale-yellow to brown loamy sand, underlain at 15 inches by a grayish sand with red mottlings, which extends to a depth of 3 feet or more. The type grades both light and heavy in texture in different parts of the area. The surface of the virgin soil consists of a thin layer of dark-gray material underlain by a layer of gray to pale-yellow material. The hardpan typical of the series is absent in this area.

The type is mapped in small areas south of Bedford, west of Mount Pleasant, and south of Ardsley in Westchester County, and near Tappan and Orangeville in the southeastern part of Rockland County. It occurs on the same terraces as the soils of the Merrimac series.

The surface is level and the drainage poor. The type is inextensive and of little agricultural importance. Nearly all of it is cleared, but it is rarely used for cultivated crops, being kept in grass as much of the time as possible. Some of it is used for pasture. Medium yields of hay are obtained. Its productive capacity under present conditions is low, and the sale value depends largely upon the value of the associated type or types.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the Scarboro loam:

Mechanical analyses of Scarborough loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
162807.....	Soil.....	0.0	0.6	0.8	18.7	36.1	29.4	14.5
162808.....	Subsoil.....	.0	1.3	1.3	24.6	39.8	23.4	9.6

HINCKLEY SANDY LOAM.

The Hinckley sandy loam consists of a light-brown to yellowish-brown loamy sand to sandy loam, underlain at 6 to 8 inches by a loose yellow sand extending to a depth of 3 feet or more. Gravel is present in varying quantities in the soil, subsoil, and substratum. Boulders are uncommon. The type has a porous structure, and its soil is a light rather than a heavy sandy loam.

Several areas of this type occur in association with soils of the Merrimac series on terraces along the east side of the Hudson River between Croton Point and Anthonys Nose. It lies on steep slopes that are the result of the erosion of stratified terrace deposits. The drainage is excessive.

The Hinckley sandy loam is an unimportant type; none of it is in cultivation. Some areas have a scattering brush or forest growth, and others support a growth of native grasses or are almost barren of vegetation. Grazing is the only agricultural use to which it is adapted.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Hinckley sandy loam:

Mechanical analyses of Hinckley sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
162815.....	Soil.....	10.5	23.3	10.7	21.5	12.9	15.8	5.5
162816.....	Subsoil.....	12.0	35.3	15.4	25.1	5.5	4.7	2.0

PODUNK SILT LOAM.

The typical Podunk silt loam consists of a grayish to light-brown silt loam from 8 to 10 inches deep, underlain by a lighter brown to yellowish-brown silty loam to silt loam, which grades into mottled yellow, gray, and brown material extending to a depth of 3 feet or more. In this area the typical Podunk silt loam occurs only in places where the bottoms are well developed along some of the larger

streams. Along the smaller streams poor drainage conditions have resulted in the development of a soil of dark grayish brown color with a mottled yellow, gray, and brown subsoil. Lenses and pockets of fine sandy material occur, but gravel and other rock fragments are usually absent. The soil is friable in structure, and the subsoil, though compact, is seldom heavier than the surface soil. Variations in texture, usually toward a loam, occur as a result of different velocities of the currents that have deposited the materials.

This is the only strictly first-bottom soil type in the area. The bottoms are for the most part narrow, widening locally or pinching out to reappear elsewhere along the streams. The largest areas are found along the East Branch of the Croton River and near the headwaters of the Hackensack River. Other streams along which the type occurs are the Bronx, Sawmill, Kisco, Pocantico, Byram, and Mamaroneck Rivers and Hutchinson and Blind Creeks.

With the exception of a fall in the direction of the streamflow, the surface of the type is level. It lies only 2 to 6 feet above the stream channels, but overflows are infrequent. Drainage is somewhat imperfect and accessions of water are received from springs and by seepage from higher lying soils.

The Podunk silt loam is not an extensive type. It is widely distributed, but the individual areas are small and unimportant for farming. A considerable acreage which was at one time cleared and cultivated has reverted to forest conditions, or is within the limits of cities and villages and the rights of way of railroads or aqueducts. Hay, practically the only crop at present, yields more than 1 ton per acre. A considerable acreage is used for pasture, to which it is well adapted. The type has about the same selling price as the adjoining upland soils.

MUCK.

Muck consists of dark-brown to black, finely divided and thoroughly decomposed organic matter, with an admixture of mineral matter, usually in the form of silt and clay. The degree of decomposition becomes less with depth, so that in the lower part of the 3-foot section the material grades into a brown, more or less fibrous mass, in places of the nature of Peat. The organic accumulations as a rule exceed 3 feet and in some areas are 10 feet or more in depth. Only a few shallow areas occur. They are underlain by a bluish clay, glacial till, or bedrock in the upland basins, and by gray to drab or bluish clays to fine sands along drainage courses.

Muck has a wide distribution in the area, but the areas are not as numerous in the southern and western parts of Westchester and the western part of Putnam County as elsewhere. One of the largest areas occurs along the East Branch of the Croton River in the north-

eastern corner of Putnam County. Muck is also extensively developed along the Hackensack River and Sparkill Creek in the southeastern part of Rockland County. The majority of the areas are between 10 and 200 acres in extent. Muck is found in association with practically every soil series. It is mapped in upland basins, around ponds, and along stream courses where drainage conditions have been favorable for the growth and decay of water-loving vegetation.

The surface is practically level; even in areas along streams where there is some slope in the direction of the streamflow the fall is imperceptible. The areas range in elevation from 50 to 900 feet above sea level. Water often stands on the surface for long periods, and the material usually remains in a saturated condition during the greater part of the year. Many areas are traversed by streams which follow winding courses and have sluggish currents. Many of the streams head in areas of Muck.

Muck, though widely distributed, does not cover a large total area, and as only local tracts here and there are improved its present agricultural importance is negligible. A large part of it supports a forest growth consisting of a variety of trees, some of it is covered with native grasses, and the remainder has a cover of rushes and other water-loving vegetation. Its chief use is for pasture.

Small tracts have been cleared, ditched, and otherwise improved and are used successfully for growing potatoes, onions, and other vegetables. A large part of the Muck in the area lies near transportation and a considerable acreage could be reclaimed without excessive cost. Other areas may be improved only by cooperation among the owners. As crops to which Muck is adapted find a ready market at good prices in the near-by thickly settled sections, attention should be given to its development for farming purposes.

There is no active demand for land of this character. It is sold with the adjoining soils and is usually regarded as a liability rather than an asset on farms where it occurs.

ROUGH STONY LAND.

Rough stony land comprises areas whose rugged and stony character render them mainly nonagricultural. Wherever found, it occupies the highest elevations. The irregularities are due mainly to those of the bedrock, which frequently outcrops and is elsewhere covered by a shallow mantle of glacial till composed of material similar to that of the Gloucester series. Boulders, medium to large in size and chiefly of granite and gneiss, are abundant. Areas of rock outcrop which occur in the Palisades and in the Highlands are not differentiated. As mapped Rough stony land includes extensive areas of hilly to mountainous undeveloped country, within which there doubtless are

small tracts of Gloucester soils suitable for farming and also some that were formerly cleared and farmed but now abandoned or used only for pasture.

Land of this description is typical of the Highland region in the northwestern parts of Rockland and Putnam Counties. Another area covers the Palisades of the Hudson. Still other bodies, usually of small extent, cover high rocky hills or steep stony slopes elsewhere in the area. The Gloucester stony loam is the most commonly associated soil, followed by the loam of the same series.

There is usually enough soil material to support a growth of forest and grasses, the latter growing only where the trees are small and scattering. Aside from affording limited pasturage in places, it is not utilized for agricultural purposes. In certain sections it is in demand as sites for summer residences.

MEADOW.

The soil material or areas mapped as Meadow, though varying widely, is for the most part a dark-gray loam to slit loam underlain by a gray to mottled gray and yellow loam to silt loam or silty clay loam. In places there is a thin layer of mucky material on the surface, and occasionally a layer of Muck is encountered within the soil profile.

Meadow, though not extensive, is widely distributed over the area, occurring as narrow strips along stream courses where the drainage is somewhat obstructed and also in upland basins and troughs. The surface is usually flat. The drainage is poor on account of the low position of the areas, and the accumulation of water by seepage and from springs. Areas along streams are somewhat overflowed.

The material consists of alluvial, colluvial, and lacustrine deposits, modified by poor drainage conditions, but not sufficiently uniform in character to warrant its inclusion in a soil series and soil type. In some cases it represents very poorly drained material similar in origin and derivation to the soils of the Podunk series.

Some of the areas are forested, while others have a vegetation of grasses that thrive on wet soils. At present it is used for pasture, and to a small extent for the production of wild grass for hay. Its reclamation, though in most cases possible, is frequently not feasible on account of the size and shape of the tracts. It has about the same selling value as the adjoining soil types.

TIDAL MARSH.

The low, flat, treeless areas, locally known as "tide flats," are classified as Tidal marsh. They occur along Long Island Sound and tidal streams and support a growth of salt-tolerant vegetation, mainly coarse grasses and rushes. The mineral material consists chiefly of

silt and clay, in the surface layer of which organic matter has been incorporated in varying quantities; some of it well decomposed, the remainder coarse and fibrous. The fibrous matter in places extends into the lower part of the 3-foot section.

Several areas, most of them small and extending only a short distance inland, occur along the Sound. Other bodies are found along the Hudson River, southeast of Piermont, north of Haverstraw, south of Iona Island, on Croton Point, near Manitou, and south of Cold Spring. They are frequently located near the mouths of tributary streams and are traversed by one main channel, wide near the coast or river bank and narrowing inland, together with a number of winding branches. The material remains in a saturated condition and is subject to overflow, though completely covered only at times of the highest tides.

The formation of Tidal marsh has taken place slowly, the silt and clay being deposited in quiet water and gradually built up to the present level. The areas are undergoing very little change at the present time. The native vegetation is seldom used for any purpose.

MADELAND.

Madeland includes areas built up by material dredged from the river or the Sound or by material derived from other sources. It includes also areas from which material has been excavated, as in the case of clay pits near brickyards. It is mapped north of Haverstraw, at Croton, Ossining, Yonkers, and Piermont along the Hudson, and south of Rye on the Sound. It has no agricultural value.

SUMMARY.

The White Plains area is situated in the southeastern part of New York. It comprises Westchester, Putnam, and Rockland Counties and has a total area of 856 square miles, or 547,840 acres.

The area comprises three quite distinct physiographic divisions: (1) A hilly to mountainous division, including mainly the part lying within the region known as the Highlands of the Hudson and consisting of a series of more or less parallel ridges of rugged topography with elevations of 900 to 1,400 feet above sea level; (2) a rolling to hilly region, the surface of which is made up of a series of hills, 300 to 1,000 feet in elevation, of smooth, rounded to rugged outline, grouped between streams having a nearly north-south or northeast-southwest direction; (3) a gently to broadly rolling division with elevations of 100 to 500 feet above sea level.

Most of the streams of the area belong to the Hudson River drainage system. A few short streams drain directly into Long Island Sound. There are only local poorly drained areas.

This is an old settled section, the early settlers having come direct from Europe. Land was purchased in small holdings from the

Indians, or was held in large manors and managed like feudal estates. The population numbered 93,698 in 1880, 344,593 in 1910, and 400,786 in 1920, when the urban population was somewhat more than four and one-half times as great as the rural. The southern part of the area is densely settled and includes a number of cities, villages, and residential communities.

The area is well supplied with transportation facilities, including railroads, trolley lines, and public roads, in addition to water transportation on the Hudson River and Long Island Sound.

The climate is marked by rather cold winters and short, pleasant summers. The mean annual temperature is 48.6° F. at Carmel and 51.7° F. at New York City. The mean annual precipitation is 50.43 inches at Carmel and 44.76 inches at New York City. The growing season ranges from 165 to 210 days, being longer in the extreme southern part than in the remainder of the area. Climatic conditions are favorable for the production of a variety of crops.

Agriculture was a leading industry before the growth of cities and the development of the region as the sites of summer homes, country estates, and residential communities. Since then production has declined rapidly.

The present agriculture consists mainly of dairying, the dairy products being shipped to near-by markets, fruit growing, and the production of vegetables and small fruit, together with some general farming. Dairy products lead as a source of farm income, followed by hay and forage crops. The leading general crops are hay and forage crops, corn, potatoes, oats, and rye.

A considerable proportion of the area is taken up by publicly owned land in connection with the New York City water system, by country estates, cities, and villages, and there is much rough non-agricultural land, so that the area of strictly agricultural land is comparatively small.

The number of farms decreased from 5,276 in 1880 to 3,136 in 1920, or more than 40 per cent. There was also a reduction in percentage and acreage of improved land per farm and a decrease in the average size of farms.

The soils of the county are classed in four groups on the basis of derivation and processes of accumulation: Soils derived from glacial till, from terrace deposits, from recent alluvial sediments, and miscellaneous. Ten series, represented by 15 soil types, with 3 phases, and 5 kinds of miscellaneous soils have been mapped.

The glacial till soils are the most numerous and cover the greater part of the area. They include the Gloucester, Wethersfield, Dover, Holyoke, and Whitman series. The terrace soils are next in extent and are classed in the Merrimac, Hartford, Scarboro, and Hinckley

series. The soils derived from recent flood-plain and organic-matter deposits are of comparatively small extent.

The Gloucester stony loam has a hilly and rough topography, good to excessive drainage, a high stone content, and some rock outcrop. It is an extensive and widely distributed type, but has very little agricultural value. Its chief use is for pasture.

The Gloucester fine sandy loam is a broadly rolling type with fairly good drainage. It is an extensive and important soil in Rockland County. Much of it is in cultivation and produces good yields of general and special crops. All types of farming, including general, dairy, truck, and fruit farming and poultry raising are practiced successfully.

The Gloucester loam is broadly rolling to hilly, has good drainage, and contains some stone. It is the most extensive and widely distributed type in this area. A large proportion of it is suitable for farming, but much of it is occupied by cities, villages, suburban homes, country estates, and public works. Dairying and general farming are practiced on this type. Hay and corn are the chief crops, with fair to good yields. Small grains, vegetables, and fruit are grown mainly for home use.

The deep phase of the Gloucester loam is somewhat smoother than the typical soil and has greater depth to bedrock. All of it is cleared and a large part farmed. General and dairy farming prevail. Yields of farm crops average slightly higher than on the type.

The shallow phase of the Gloucester loam has less depth of soil material and more rock outcrop than the typical soil. Some of it is still in forest, and only a little of it is in cultivation.

The Wethersfield fine sandy loam has a gently to broadly rolling surface and good drainage. It comprises one-fifth of the farming land of Rockland County. A large proportion of it is in small farms devoted to fruit, poultry raising, trucking, dairying, and general farming. All crops return fair average yields.

The Dover loam occupies low positions in valleys and has a gently rolling to rolling surface and good drainage. It is usually associated with the Gloucester types and is a productive soil. Dairying is the leading industry on the part devoted to farming, but much of the type is occupied by cities and suburban villages.

The Holyoke stony loam is a shallow soil with an irregular surface, high stone content, and much rock outcrop. Comparatively little of it is cleared and used for crops. Part of it is occupied by summer and suburban residences.

The Whitman loam consists of small areas in upland basins and other poorly drained situations, occurring in association with the Gloucester soils. It is partly forested and is used chiefly for pasture.

The Merrimac gravelly loam occupies terraces with a nearly level surface and excessive drainage. Very little of it is farmed. It is moderately productive and adapted to the growing of special crops.

The Merrimac sandy loam occupies terraces that have been modified considerably by erosion. The type is agriculturally unimportant. The part in farms produces light to medium yields of general and special crops.

The Merrimac fine sandy loam occurs on level to gently undulating terraces, some of which have been modified in places by erosion. The type has good to excessive drainage and is inclined to be droughty. A small proportion is now in cultivation. It is adapted to intensive farming and responds to good treatment.

The Merrimac loam is found on level terraces, has good to excessive drainage, and is somewhat droughty. Much of it is occupied by cities, country estates, and golf courses. Where farmed it produces fair to good yields of hay, grain, and vegetables. The rolling phase represents eroded areas at present used for pasture.

The Hartford sandy loam occupies level terraces and has good drainage. Very little of it is farmed. It is well adapted to special crops.

The Scarboro loam represents poorly drained areas on level terraces. Most of it is kept in grass for pasture or hay.

The Hinckley sandy loam occurs on steep slopes of eroded terraces. It has no agricultural value except for grazing.

The Podunk silt loam occurs on level first bottoms, with restricted drainage and subject to occasional overflow. The individual areas are small and widely distributed. Its principal use is for pasture.

Muck is found in upland basins and other places that are saturated during most of the year. It is associated with nearly every soil type. Its chief use is for pasture. Some tracts have been cleared and drained and produce good crops of vegetables.

Rough stony land occupies the highest and most rugged areas, and includes the Palisades and much of the Highlands. It is mainly nonagricultural. Some of it supports a growth of forest and grasses and affords limited pasturage.

Meadow represents a mixture of material modified by poor drainage conditions, and is found in basins and along streams. At present it is used mainly for pasture.

Tidal marsh consists of sediments of silt and clay and accumulations of decaying organic matter. It is continuously saturated, supports a growth of salt-tolerant vegetation, and has no agricultural value.

Madeland represents areas that have been filled in or excavated.

[PUBLIC RESOLUTION—No. 9.]

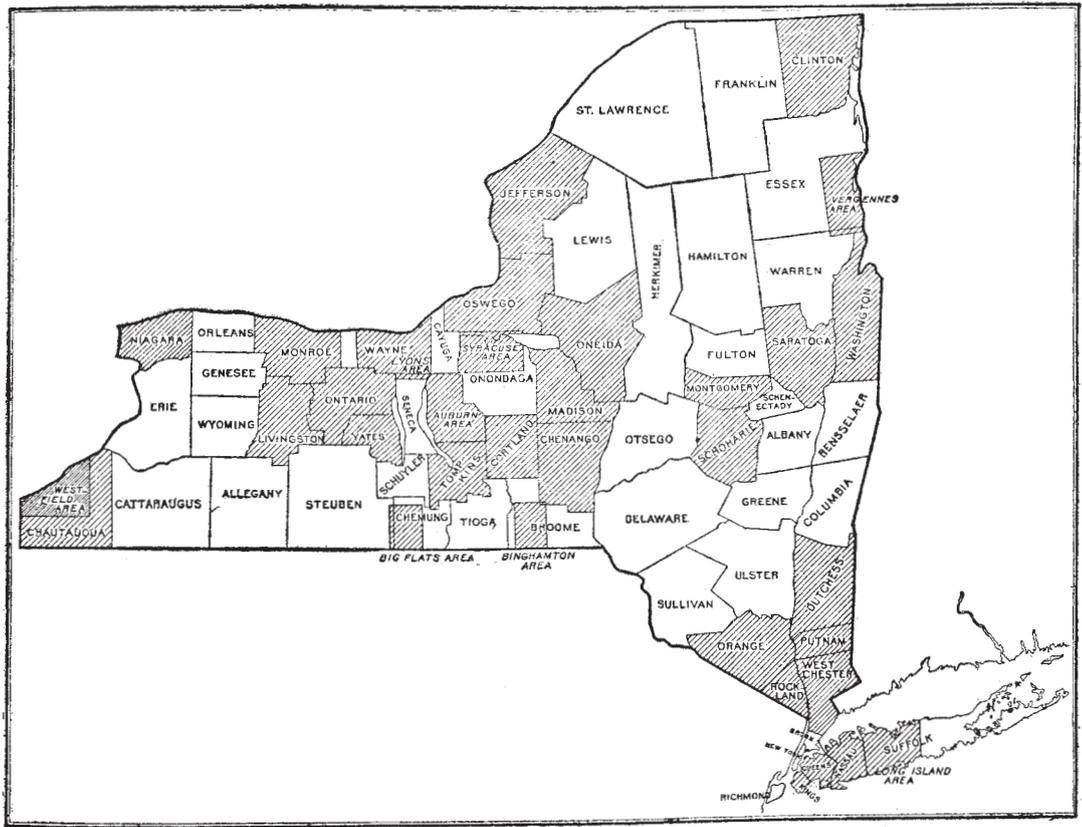
JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

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 operation, 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.]



Areas surveyed in New York, shown by shading.

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