U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS.
IN COOPERATION WITH THE DEPARTMENT OF CONSERVATION AND DEVELOPMENT OF NEW JERSEY.

SOIL SURVEY OF THE CHATSWORTH AREA, NEW JERSEY.

BY

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[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

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

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SOIL SURVEY OF THE CHATSWORTH AREA, NEW JERSEY.

By L. L. LEE, In Charge, C. C. ENGLE, and WILLIAM SELTZER, of the Department of Conservation and Development of New Jersey, and AUSTIN L. PATRICK and E. B. DEETER, of the U. S. Department of Agriculture.

DESCRIPTION OF THE AREA.

The Chatsworth area is situated in the southeastern part of New Jersey, and is bounded on the east by the Atlantic Ocean. It includes all of Ocean County, about half of Burlington County, one-third of Atlantic County, and small parts of Monmouth and Camden Counties. It is bordered by the Camden area on the west, the Millville area on the south, and in part by the Freehold area on the north. The area has a maximum length of 45 miles and its greatest width is 37 miles. It includes all of atlas sheets No. 32 and No. 33 and approximately half of sheet No. 29 of the New Jersey Geological Survey, and contains 1,195 square miles, or 764,800 acres.

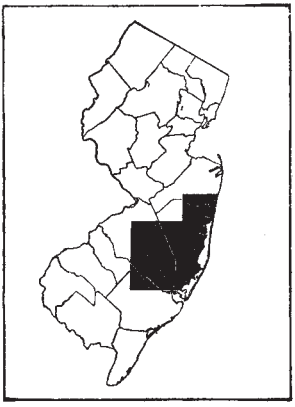

FIG. 10.—Sketch map showing location of the Chatsworth area, New Jersey.

The Chatsworth area is one of very slight surface relief over wide areas. (See Pl. I.) Isolated hills, rising abruptly from 60 to 80 feet or more above the surrounding country, are in such striking contrast to the prevailing surface that they are locally called "mountains." There are many low and swampy areas, especially in the vicinity of Browns Mills, Chatsworth, Batsto, Harrisia, and Double Trouble. The northeastern part of the area shows the greatest relief, the undulating to gently rolling topography standing out in bold contrast to the flat almost level plain to the south and west.

The range in elevation is from sea level to about 200 feet, the elevation of Apple Pie Hill, 3 miles southwest of Chatsworth, in the west-central part of the area.

The general drainage slope is to the east and southeast to the Atlantic Ocean, and to the southwest to the Delaware River. The crest of the drainage divide, which is relatively flat, passes approximately through Tabernacle, Woodmansie, and Whitings in an irregular northeast-southwest direction.

The area, except in the northeastern part, is drained by the Mullica, Wading, Bass, Toms, Metedeconk, and Manasquan Rivers, all flowing directly into the Atlantic Ocean or Barnegat Bay. The north and south branches of Rancocas Creek, flowing into the Delaware River, drain the northwestern corner. Many smaller creeks feed the larger streams or flow directly into Barnegat Bay. The larger streams have cut their channels to base level, and are meandering and sluggish. They and their tributaries are bordered by broad areas of Tidal marsh or low swampy flats, and most of them have their sources in broad, low, swampy depressions.

Excepting the swampy areas at the heads of streams and bordering parts of their courses, the area is well drained. Prominent swampy areas lie near the heads of streams tributary to the Mullica and Wading Rivers, and the two branches of Rancocas Creek.

In places, as at Pleasant Mills and Wells Mills, some water power has been developed by damming the local streams. At Batsto, Atsion, Tuckerton, Harrisia, Cedar Crest, Manahawken, Forked River, and Double Trouble ponds or artificial lakes have been formed by the construction of dams and flood gates. Most of these are reservoirs for the storage of water used in flooding cranberry bogs. At Lakehurst, Lakewood, and Browns Mills small lakes are used for boating and fishing by guests of these resorts.

Several bays indent the coast line. Barnegat Bay, the largest, is about 20 miles long and from 2 to 5 miles wide. Manahawken Bay and Little Egg Harbor are farther south. All these are connected with the open sea through Barnegat Inlet.

The native forest consists mainly of pine and oaks. In most places the growth is scrubby or stunted, as the result of fires or soil conditions or both. The oaks include blackjack oak, scrub oak, black oak, chestnut oak, and white oak. Pitch pine predominates among the evergreens, with some shortleaf pine. There are abundant and valuable stands of white cedar in most of the swamps. In the more sandy country the forest is predominantly pitch pine with an admixture of oak; on the heavier, well-drained soils the ratio is reversed. An undergrowth is abundant, except on the plains and in some extremely sandy areas. It consists mainly of scrub oak, huckleberry, cranberry, mountain laurel, bracken, greenbrier, staggerbush, wintergreen, sandwort, and holly. Sweet fern is abundant in depressions and the lower imperfectly drained situations, and sphagnum moss is plentiful in the swamps. This moss is important locally, being gathered, dried, baled, and marketed for use as a packing material. Azalea is common on the wet lands.

Burlington, Ocean, Atlantic, and Monmouth Counties were all established during the early part of the eighteenth century. The

Dutch and Swedes made the first settlements, later followed by the English. Part of Burlington County was annexed to Ocean County between 1890 and 1900.

The present population consists chiefly of descendants of the early settlers, together with a considerable number of foreign birth. Ocean County is comparatively thinly settled, the population in 1920 being 22,155, or 34.8 persons per square mile. There being no town with more than 2,500 inhabitants, all the population is classed as rural. In 1920 Burlington County had a population of 81,770, of which 19.5 per cent are classed as urban and 80.5 per cent as rural. The rural population has a density of 80.7 persons per square mile, but the more densely populated part of this county is not included in the Chatsworth area. Atlantic County in 1920 had a population of 83,914. Of this only 21.8 per cent were classed as rural. The density of the rural population is 32.1 persons per square mile. Most of those listed as urban are in Atlantic City, which is outside the limits of the Chatsworth area. The figures for Burlington County are fairly representative for that part of Monmouth County included in the surveyed area.

The population centers of the Chatsworth area are along the seacoast, railroads, and larger river valleys. Settlement is especially sparse in the central part, there being many square miles in this part without a single inhabitant.

Lakewood, in the northeastern part of the area, with a population of 6,110 in 1920, is the largest town.[1] Toms River, the county seat of Ocean County, has a population of about 2,000[2] and is important as an agricultural center as well as a summer resort. Manasquan, with a population of 1,705, is an important agricultural center. Pemberton has 800 inhabitants and is the most important town in the northwestern part of the area.

The northeast coast resorts, of which Spring Lake, Sea Girt, Belmar, and Point Pleasant are the most important, have permanent populations ranging from a few hundred to 2,000, which is approximately the population of Belmar. During the summer months many city families make their homes at these resorts. Farther south Bay Head, Mantoloking, Lavalette, Seaside Park, Barnegat City, and Beach Haven are resorts of less importance. Toms River, Island Heights, and Beachwood also have many summer visitors, but the two latter have only a small permanent population.

Tuckerton, with a population of 1,106, and Egg Harbor, with 2,622, are the only towns of importance in the southern part of the area. Only a part of Egg Harbor City is included within the boundaries of the Chatsworth area.

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[1] Not incorporated. Population given is that of township.

[2] Estimated.

Mount Holly, with a population in 1918 of 5,900,[3] Asbury Park, an important northeast coast resort with a permanent population in 1920 of 12,400, and Hammonton in Atlantic County, with a population of 6,417, are important towns situated a few miles from the boundaries of the area.

The Chatsworth area is not so well supplied with railroads as other parts of New Jersey, although several lines cross the region. The main lines of the West Jersey & Seashore and the Atlantic City railroads pass through the southwestern part. The Central Railroad of New Jersey passes through the heart of the region and provides an outlet to New York City, and another line of this railroad furnishes Barnegat and other towns to the north along Barnegat Bay with transportation direct to New York. A line of the Pennsylvania Railroad system connects the northern part of the area with Philadelphia and the coast resorts, and a branch of this line runs to Camp Dix and Trenton via Pemberton. The Tuckerton Railroad serves the bay shore towns farther south, and at Whitings has direct connections to Philadelphia and New York.

The county roads of the area as a whole are unimproved. The loose sandy surface, together with the numerous boggy places of the swampy sections, make travel difficult over many of them. In the better developed sections, however, there are many improved gravel roads. The three main trunk-line roads carry a heavy motor traffic between the larger cities to the north and west and Atlantic City, Lakewood, and other coast resorts.

The metropolitan districts tributary to New York and Philadelphia, together with the coast resorts, are the chief markets for farm products, but cranberries are shipped to all parts of the United States.

CLIMATE.

The climate of the Chatsworth area is somewhat milder than might be expected for the latitude, the ocean having a modifying influence on both summer and winter temperatures. The winters are not as severe or as long as in northern New Jersey, and the summers are relatively cool. The snowfall is usually light and soon melts, especially along the seacoast.

The rainfall is everywhere sufficient for successful farming, and it is rather evenly distributed throughout the year, but during extremely dry seasons crops suffer, especially on the more sandy soils. At Lakewood the average rainfall for 14 years is 48.37 inches, and at Tuckerton the average for 19 years is 44.06 inches.

The length of the growing season averages 183 days at Lakewood and 178 days at Tuckerton. Killing frost has been experienced as early in the fall as October 7, and as late in the spring as May 5.

[3] Population of Northampton Township is practically the same as Mount Holly.

The tables below, compiled from the records of the Weather Bureau stations located at Lakewood in the north and at Tuckerton in the south, give the normal monthly, seasonal, and annual temperature and precipitation applicable to the area surveyed.

Normal monthly, seasonal, and annual temperature and precipitation at Lakewood.

[Elevation, 54 feet.]

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1904).	Total amount for the wettest year (1903).
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December	33.8	68	−11	3.72	3.77	3.74
January	32.1	71	−7	3.78	2.25	4.44
February	29.8	66	−4	3.85	2.47	4.46
Winter	31.9	71	−11	11.35	8.49	12.64
March	40.0	78	6	4.43	3.83	4.69
April	49.7	93	18	3.73	3.70	3.46
May	60.5	97	29	3.86	5.11	1.02
Spring	50.1	97	6	12.02	12.64	9.17
June	67.6	95	40	3.67	2.70	6.62
July	72.9	98	45	5.03	5.55	7.36
August	70.7	97	43	5.07	6.01	8.77
Summer	70.4	97	40	13.77	14.26	22.75
September	65.4	91	34	3.88	2.48	3.35
October	55.3	88	22	3.70	2.48	8.17
November	43.2	76	14	3.65	1.91	1.02
Fall	54.6	91	14	11.23	6.87	12.54
Year	51.7	97	−11	48.37	42.26	57.10

Normal monthly, seasonal, and annual temperature and precipitation at Tuckerton.

[Elevation, 23 feet.]

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1896).	Total amount for the wettest year (1903).	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December	37.5	70	−8	4.28	0.94	4.52	3.7
January	31.7	73	−13	3.66	1.50	4.55	7.1
February	32.1	68	−6	3.79	6.82	6.28	8.1
Winter	33.8	73	−13	11.73	9.26	15.35	18.9
March	39.0	84	−1	4.39	3.63	8.07	2.6
April	47.9	92	19	3.79	1.17	4.19	.5
May	59.7	98	28	3.43	2.71	.76	0
Spring	48.9	98	−1	11.61	7.51	13.02	3.1
June	69.0	102	38	3.57	4.47	8.02	0
July	74.1	103	42	.88	2.81	7.17	0
August	72.2	102	44	5.78	1.27	6.55	0
Summer	71.8	103	38	10.23	8.55	21.74	0
September	66.0	96	32	3.36	1.37	2.87	0
October	54.8	92	21	3.67	3.16	9.41	0
November	44.0	76	10	3.46	1.93	1.44	1.5
Fall	54.9	96	10	10.49	6.46	13.72	1.5
Year	52.2	103	−13	44.06	31.78	63.83	23.5

AGRICULTURE.

The early settlers of the Chatsworth area were attracted more by the opportunity to engage in fishing and lumbering than in agriculture. This was in part due to the low productivity of much of the deep sandy and the poorly drained soils of the region, and these conditions have been the principal cause of the slow development of agriculture over extensive parts of the survey.

At the present time fully 80 per cent of the Chatsworth area still remains in forest—an undeveloped wilderness seldom traversed by anyone except the few natives living at isolated places, those interested in the lumber and cranberry industries, and hunters. Agriculture is very largely restricted to the extreme northeastern, northwestern, and southwestern parts of the area and to a narrow strip of cleared land bordering the seacoast. Not only is this the present condition, but it is one which will probably be changed very slowly. The productive power of several of the soil types, notably the Lakewood sand and Lakewood sandy loam, deep phase,

apparently is of a character better suited to forestry than to agriculture.

Considerable areas heretofore occupied by remnants of forest have in recent years been cleared for fruit, berry, and truck farms. Such utilization of the land is justified when the agricultural possibilities of the soil are known. Those areas off the improved highways however, and far from markets, unless of the better grades of soil, should be brought into cultivation, if at all, only after very careful consideration of all the factors involved in successful agriculture.

The census figures for Ocean County, which lies wholly within the area, are representative of a large part of the included sections of Burlington and Atlantic Counties. Corn was planted in Ocean County on 5,042 acres in 1899, and on 4,336 acres in 1919. In 1899 there were 1,898 acres of rye, 54 acres of oats, and 167 acres of wheat, and in 1919 there were 1,770, 99, and 61 acres, respectively, in these crops.

In 1899 there were 7,486 acres devoted to hay and 608 acres in forage crops. In 1919 the hay and forage crops occupied 7,146 acres, of which 4,709 acres were in wild hay, 1,984 acres in tame hay, mainly timothy and clover, and smaller acreages in silage and coarse forage crops.

The production of special crops, such as Irish potatoes, sweet potatoes, and other vegetables, is a well-established industry that has varied very little during the last 30 years. In this county cranberry production has suffered a marked decline. In 1899 there were 1,784 acres of cranberry bog; in 1919 only 736 acres were under cultivation. Between 1899 and 1919 the number of apple, pear, and peach trees decreased from 76,415 to 18,369. Grapevines decreased in number from 9,364 vines to 2,377 vines during the same period.

In the production of poultry products, however, a marked contrast is apparent. From 1900 to 1920 the number of chickens in Ocean County increased from 34,134 to 64,882. The value of poultry and eggs produced in 1919 was reported as $475,080. There were 1,868 dairy cows reported in 1900 and 1,901 cows in 1920. The value of dairy products, excluding milk and cream used on the farm, increased in 20 years from $37,269 to $149,763. It can readily be seen that other types of farming are rapidly giving way to poultry raising and dairying, especially the former.

Except for the poultry and dairy industries, farming appears not to be making any noticeably forward strides at the present time in Ocean County, or in similar parts of Burlington and Atlantic Counties included in the Chatsworth area. In these parts of Burlington and Atlantic Counties, however, neither poultry nor cattle are raised extensively.

In the Monmouth County part of the area lying in the northeast corner, and in that part of Burlington County adjacent to Pemberton, agriculture is of more importance and has been constantly increasing since 1879.

The cash crops are vegetables, wheat, rye, cranberries, orchard fruit (principally peaches), potatoes, milk, eggs, and poultry. The corn and grass grown are commonly used on the farm.

Dairying is extensively practiced in the vicinity of Vincentown and Pemberton in the northwest section and north of Lakewood in the northeast. From the northwest section milk is shipped directly by rail to Philadelphia (25 miles) or is sold to creameries at Pemberton. In 1919 the average price received was 8 cents a quart, the cans being furnished by the buyer. Herds in this section average between 15 and 20 head. Grade Holsteins are the common breed.

From the Lakewood region, known as the "shore dairy section," milk goes to the shore resorts, in most instances directly to the consumer, so that producers receive nearly twice as much as those of the Pemberton and Vincentown districts. This seeming advantage is in large measure offset by the lighter and more sandy character of the soil, necessitating the purchase of part of the dairy feed, whereas in the Pemberton district practically all the feed is grown on the farm, the soils being more productive. Farm practices in the sections are much the same, except that north of Lakewood less small grain and more potatoes and truck crops are grown and the yields per acre are better. The truck crops are chiefly tomatoes, cabbage, peppers, and beets; they are marketed at the shore resorts. Potatoes are sold through the county exchange or local dealers.

In the northern part of the area very large areas of swamp land have been cleared, diked, drained, and planted to cranberries. The production of cranberries is perhaps the most important agricultural industry of the Chatsworth area. Several companies and individuals have long "chains" of bogs, large areas being so used south of New Lisbon, near Hanover Furnace, Hampton Gate, Atsion, Rockwood, Batsto, Martha, Penn Place, Stafford Forge, and Double Trouble.

Between Toms River and Lakewood are many large highly specialized and successful poultry farms, the section being second only to the poultry-raising districts of Petaluma, Calif., and of Vineland, N. J. Lakewood, the shipping center, is only 63 miles from New York and 13 miles from "the shore," both excellent markets, where fresh eggs and poultry bring the best prices. The White Leghorn is raised almost exclusively. A poultry association, under efficient leadership and management, is active in cooperative buying and selling. It includes among its members nearly all the breeders of the Lakewood section. The practical value of such an organized body has here been demonstrated.

In the Chatsworth area there is a close relationship between the character of the soils and the agricultural development. This is of course to be expected in a region which has been open to settlement for 300 years. The relatively heavy and well-drained soils of the northwestern and northeastern sections of the area are mostly cleared, and the agricultural practices followed on these are of the modern type, while the lighter, more sandy, rather unproductive soils of the central and southern parts very largely have been left in forest. This selective differentiation of soils by the farmers is shown even in the numerous small clearings which have been made in the wooded sections. Although most of these clearings, for one reason or another, have been abandoned, their soils are almost invariably of a better type than those of the surrounding uncleared land.

There is also a marked tendency among the farmers of the Chatsworth area to recognize that certain soils are best adapted to the production of certain crops. For example, in the northeastern part of the area vegetables are grown on the lighter sandy soils, and corn, potatoes, and grass on the heavier lands. It is not unusual to find, on the same farm and in the same field, corn on the more sandy part of a field and potatoes on heavier land, the contact line of the two crops marking a distinct boundary between two soil types. Even in the selection of the variety of potatoes soil texture is frequently one of the first considerations. The American Giant does better on the more sandy soils and is grown almost exclusively on sandy soil types, while on the heavier soils round varieties, such as Cobbler and Mills Prize, are more extensively grown.

Corn, the principal cereal crop, is grown on practically every farm in the area. On the better farms the seed bed is well prepared. The seed is planted, with a corn planter or by hand, the latter part of May or early in June. The crop is intensively cultivated with weeders and cultivators. Fertilizers, when used, are applied at the rate of about 800 pounds per acre. The mixtures used run close to a 3–8–10[4] mixture.

The hay crop is largely timothy, red clover, and alsike clover seeded together. Mixed hay is harvested the first year, with clover predominating, but in the second and third years the crop is mostly timothy. Seeding is done late in August, on land from which a crop of potatoes or rye has been harvested, and cutting begins in June and October. Salt marsh hay is cut from the Tidal marsh in summer, or, if the season is wet and the meadows are flooded, the cutting is delayed until the ground is frozen in winter. Only one cutting is made each year. The alfalfa acreage is small, but it is increasing yearly. Three cuttings are made and occasionally a fourth. The well-drained heav-

[4] Percentages, respectively, of nitrogen, phosphoric acid, and potash. The mixtures quoted are those used before 1917. War conditions eliminated the potash entirely or reduced it to 1 or 2 per cent.

ier soils, when limed and inoculated, give good yields. More attention should be given to this crop, especially in those sections where dairying is important.

Rye and wheat are important grain crops, and usually follow corn in a 4-year rotation of corn, rye, or wheat, followed by grass. When potatoes are grown, the grains are usually planted as a cover crop in the fall after the potatoes are dug to be plowed under the following spring. Normally the acreage of rye greatly exceeds that of wheat. Rye straw brings a much higher price than that of wheat, and rye can be grown on a wider range of soil types than wheat, being specially adapted to sandy soils. The great demand for wheat and the high prices during the World War temporarily stimulated the production of wheat. The oats crop is of little importance in the Chatsworth area.

Potatoes are frequently grown year after year in the same field, following a cover crop of rye or wheat, or a mixture of one of these with crimson clover. The mixed seeding apparently gives better results, as the clover adds nitrogen; and possibly the tender clover plants are protected somewhat from winterkilling by the rye or wheat. This practice of mixed seeding of cover crops is rather unusual, but in many instances the potato yields appear to be increasing where it is used. Most of the potato seed comes from Maine. Potatoes are planted early in April, using a machine planter. A 4–8–10 fertilizer mixture is commonly applied at the time of planting, at the rate of about 1,000 to 1,500 pounds per acre. Some farmers use more, others less. The shortage of potash brought on by the war necessarily lessened the applications of this element. Production, however, has not been seriously affected, and the question has been raised whether potash was not being applied in excessive amounts before 1917. Potatoes are harvested between July 15 and September 1, depending upon the variety grown. Potato diggers of the elevator type are generally used. American Giant and Irish Cobbler are the favorite varieties, but many acres of Green Mountain, Mills Prize, Norcross, and Gold Coin also are produced.

Tomatoes are seeded under glass in April and set out by hand about May 10. The late varieties, used principally for canning, are transplanted 2 or 3 weeks later. The crop is fertilized with various mixtures at the rate of about 500 to 800 pounds per acre. Manure is used when available and gives excellent results. As much as 10 tons per acre is applied. Careful and frequent cultivations are given. Among the early varieties Earliana, Bonny Best, and Chalks Jewel are the most important. For the late market, usually grown upon the heavier soils, the Stone, Greater Baltimore, Paragon, and Matchless are the favorites.

Peppers are set out in rows about 3 feet apart as soon as danger from frost has passed. They are fertilized somewhat heavier than tomatoes, the average application in normal times being about 1,000 pounds per acre. Careful attention is given to cultivation during growth, and the fields are picked over several times each season. The crop is shipped either in barrels or hampers. The principal varieties are Ruby King, Cheese, Bull Nose, White Cap, and Chinese Giant.

Fruit production in the Chatsworth area is limited chiefly to peaches, but some apples and pears also are grown. There are excellent opportunities in the area, however, for fruit growing, especially in peach production on the well-drained sandy soils. At present there are a few commercial orchards in the area where modern methods are understood and practiced. Among the peaches the Elberta is the favorite variety, and some Carman, Belle, and Champion are grown. Peaches usually are shipped to New York packed in Georgia carriers or baskets. The production of apples and pears is not important.

The berry crops include blackberries, raspberries, dewberries, and strawberries, grown chiefly in the southwestern part of the area. The crops are heavily fertilized, and under careful attention excellent yields are obtained. The berries are placed in quart or pint boxes, packed in crates, and shipped to outside markets, usually New York or Philadelphia.

The cranberry industry is of great importance. According to the census of 1920 there were grown in 1919 in Atlantic, Ocean, and Burlington Counties, 7,172,719 quarts of cranberries on 6,011 acres of bog. The acreage and production increased in Atlantic County in the last 10 years, and decreased in Ocean and Burlington Counties. Burlington County in 1919 produced about 73 per cent more cranberries than Ocean and Atlantic Counties combined. Practically all the producing cranberry acreage in Burlington County lies within the boundaries of the Chatsworth area.

Bogs are laid out in low swampy areas by clearing off the forest and building dikes, drainage ditches, and flood gates. Damage from frost and winterkilling is prevented by flooding the bogs during freezing weather. Flooding usually begins late in November, and the plants remain under water until early spring. The larger growers maintain reserve supplies of water in large reservoirs ready for instant use. Streams are frequently diverted from their courses and ditches dug at considerable expense in order to maintain an adequate supply. A bog is certain to prove unsuccessful and the plants will be injured by frost or winterkilled if sufficient water is not obtainable when needed. Many failures in the cranberry industry are due to the lack of sufficient supplies of water for flooding the bogs. The flow from reservoirs is regulated by systems of ditches, dikes, and flood gates.

A full crop of cranberries is not obtained for from 4 to 7 years after the plants are set out, but, once started, some bogs are known to have produced for 60 years without replanting. One of the growers in the area has estimated that the cost of clearing cranberry land and developing a bog, from the time the timber is cut until a full crop matures, is about $300 per acre.

Bogs are usually carefully cleared of weeds during the late spring and summer and sprayed or flooded when dangerous insects threaten damage. Frequently the plants are fertilized with a 2–8–10 mixture broadcasted about June 15, about 500 pounds per acre being applied.

Harvesting begins late in September and lasts about six weeks. Since danger from frosts demands rapid progress, large numbers of foreigners from near-by cities, principally Philadelphia, are employed. Berries are picked with a cranberry scoop or by hand. The scoop method sometimes injures the vines unless the operator is well trained for the work. Pickers are paid by the bushel. The berries are carted to storehouses where they are cleaned, sorted, and packed, usually in barrels with a capacity of 100 quarts. The berries are then stored in large warehouses to await favorable market conditions.

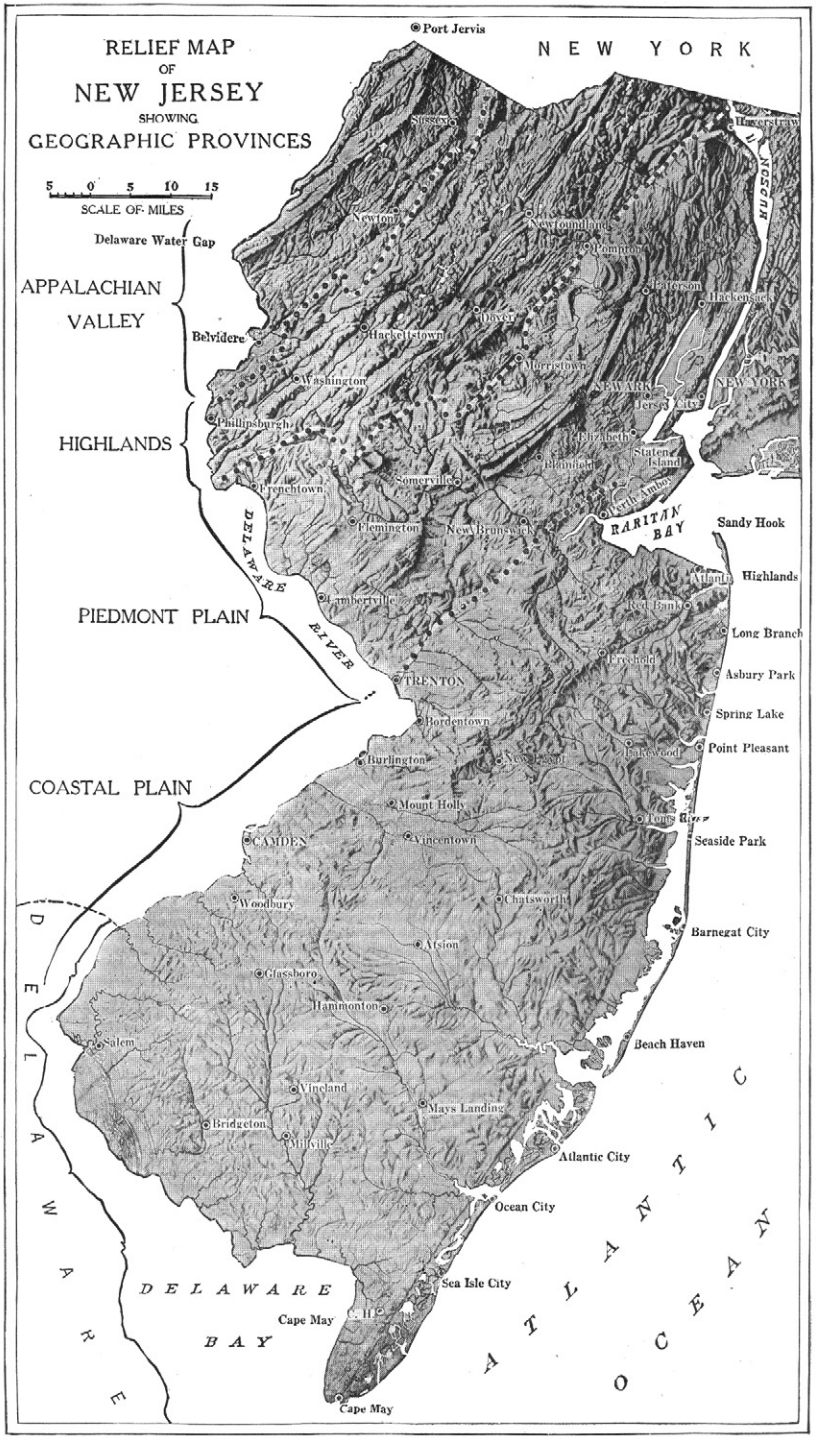
The average bog produces between 40 and 60 bushels per acre, but frequently during favorable seasons much higher yields are obtained. Berries are sold mostly through a growers' association and are sent to all parts of the United States. Prices range from $6.50 to as high as $18 a barrel of 100 quarts; in 1919 the average price obtained for the whole crop was about $7.50 per barrel.

Wild blueberries and huckleberries grow extensively in the open wooded sections. Harvesting these berries is an important industry, thousands of bushels being picked and shipped to market annually.

Cultivated blueberries are being grown on a plantation at Whitesbog, about 4 miles east of Browns Mills.[5] A part of this plantation is used, in cooperation with the United States Department of Agriculture, as a testing ground for thousands of hybrid blueberries. The improved varieties developed by selection from these hybrids are the result of breeding experiments conducted by Dr. Frederick V. Coville, botanist in the United States Department of Agriculture. The berries are several times as large as the wild blueberries. A number of excellent varieties have also been developed at Whitesbog by Miss Elizabeth C. White, through careful selection of wild plants.

The growing of cultivated blueberries promises to become an important industry in this part of the State, especially in view of the fact that they flourish on soils that have little value for the other crops commonly grown in this region. The berries require a soil

About 26 acres are (1922) set out to cultivated blueberries. About 1,000 bushels of berries were harvested this season and marketed at prices about 50 per cent higher than those obtained for wild berries.



GEOGRAPHIC PROVINCES OF NEW JERSEY.

that is strongly acid, and they appear to grow best on soil composed largely of peaty material and sand, such as is found in many places in or near areas mapped as Swamp, St. Johns sand, and Leon sand.

Farms of the Chatsworth area are in general only moderately well equipped. In sections where certain crops have been specialized, as, for example, in the vicinity of Pemberton and northeast of Lakewood, more modern labor-saving implements are used and less hand labor is performed. Only a small number of tractors are used in the area. Poultry farms surrounding Lakewood are generally well equipped.

Good methods of cultivation are followed throughout the area, especially where the land is farmed intensively, as in growing truck. Cultivations usually follow each rain, at first relatively deep and becoming more shallow as the crop matures.

Considerable attention is given to the rotation of crops, especially on the general farms and dairy farms. The common rotations cover a 4-year or 5-year period, and consist of corn, followed by rye and then by grass, the last-named occupying the land 2 or 3 years. Where potatoes are grown the rotation is corn 1 year, potatoes 1 to 3 years, or rye 1 year followed by grass 1 to 3 years. Frequently a field that has been in corn is cropped in part to potatoes and in part to rye, the potatoes occupying the heavier soil. This forms an elastic rotation well adapted to the needs of the farm and soil. Occasionally on the lighter sandy soils cowpeas follow the rye harvest. These are plowed under the same fall and the field is again seeded to rye. When wheat is grown it replaces rye in a 4-year rotation consisting of corn 1 year, wheat (sown with grass) 1 year, and grass 2 years. When potatoes are grown for several years continuously on the same field, careful attention is given to cover crops. These consist usually of rye, wheat, or crimson clover, or a combination of rye or wheat with clover. The seeding is done late in August and the crop plowed under the following spring. Where the truck crops are extensively grown, less attention is paid to rotations.

Fertilizers are almost universally used. Stable manure is usually applied to corn ground, and commercial mixtures are used on rye, potatoes, and corn. Both manure and fertilizers are extensively used where truck crops are grown. Potatoes receive from about 1,000 to 1,600 pounds of commercial fertilizer per acre during normal times, the mixture analyzing 4–8–10. Corn receives from 300 to 400 pounds of a cheaper mixture, analyzing about 2–8–7. From 10 to 12 tons of stable manure may be applied instead of the commercial fertilizer. Rye receives much the same treatment, except when following potatoes, tomatoes, or other truck crops, in which case it is rarely fertilized. Applications to truck crops vary within wide limits, depending upon soil conditions and the crop grown. In 1909 the

average expenditure for fertilizer in Ocean County was $59.19, and in Atlantic County $95.48 per farm reporting. In that part of Monmouth County included in the area and in the better developed parts of Burlington County, where farming is more important and farm capital more plentiful, expenditures for fertilizer are much higher.

Farm laborers are scarce and consist mainly of white persons of foreign birth. Ordinary farm laborers, when obtainable, receive from $60 to $75 per month with board.[6] Special harvest help is employed on many farms and especially on the cranberry bogs. Hundreds of Italian families are brought from the large cities, principally Philadelphia, to help harvest the cranberry crop. Living quarters are provided near the bogs, where the pickers camp until the harvest is complete. They are paid according to the number of bushels of berries picked. It is not unusual for an Italian family to earn between $500 and $700 during the 6 or 8 weeks of the harvest season. On poultry farms practically all the labor is done by the owner or tenant.

The table below shows the present status of agriculture in Ocean, Atlantic, and Burlington Counties, so far as it is dependent upon the occupation of land, as well as the changes in occupation that have taken place between 1900 and 1920:

Number of farms and land in farms in 1900 and 1920.

County and year.	Number of farms.	Area in farms.		Improved land.	
		Proportion of total area.	Per farm.	In farms.	Per farm.
		Per cent.	*Acres.*	*Per cent.*	*Acres.*
Ocean:					
1900	984	20.8	86.2	47.3	40.8
1920	666	12.1	73.8	48.3	35.7
Atlantic:					
1900	1,295	18.6	49.7	51.2	25.4
1920	1,726	19.5	41.2	45.7	18.8
Burlington:					
1900	2,549	65.8	134.6	55.6	74.9
1920	2,172	52.0	124.9	56.7	70.8

In Ocean County the number and average size of farms and the area of improved land per farm are decreasing. Farmers here appear to be abandoning some of the poorer land and locating elsewhere. In Atlantic County the number of farms is increasing from year to year, but the average size of farms is decreasing. In Burlington County less land is being cleared, and the number of farms and the area in farms have decreased. Here the gradual decrease in the average size of farms is the natural result of more intensive methods of production.

[6] Prevailing wages in 1919, when the field work of this survey was in progress.

In Ocean County 79.8 per cent of the farms were operated by owners and 14.7 per cent by tenants in 1900. In 1920 owners were operating 86 per cent of the farms. In Burlington County, between 1900 and 1920, the farms operated by owners increased from 59.2 per cent to 68.9 per cent, and in Atlantic County, in 1920, 91.7 per cent of the farms were operated by owners, as compared with 77.7 per cent in 1900. Various systems of renting are practiced throughout the area. Cash rents range between $2 and $10 per acre, depending upon soil, market conditions, and the crops grown. Share rents are usually on the basis of equal shares, the tenants bearing half the expenses and receiving half the crops.

The prevalence of mosquitoes during the summer months throughout practically all the Chatsworth area tends to retard agricultural development. It is believed that steps for their extermination, which could be accomplished at a relatively low cost in proportion to the probable resultant increase in land values, should be taken without further delay.

The value of farm land varies widely in different parts of the area. Prices to a large extent depend upon soil conditions, agricultural development, and location. The highest priced land in the area is found north and southeast of Lakewood, in the vicinity of Allenwood and Manasquan, where improved land sells for as much as $200 an acre. The nearness of these farms to Lakewood and the shore resorts and the fact that the soils are among the best in the area, account for the high price. Between Lakewood and Toms River improved farms with equipment, generally for poultry raising, bring from $75 to $250 an acre. Their value depends more on improvements suitable for poultry raising and upon location with respect to market than upon soil conditions. Around Pemberton $125 an acre is the prevailing price for improved land. Uncleared land sells for $3.50 to $20 an acre, depending largely upon location and character of the soil. The average price for such land is probably about $7.50 an acre.

SOILS.[7]

The Chatsworth area lies wholly within the Coastal Plain. The materials of this physiographic province in New Jersey consist mainly of unconsolidated beds of sand, gravel, clay, and greensand marl, which were deposited in the sea under varying conditions of depth,

[7] The soils of the Chatsworth area join well with the soils of the Millville area, with the exception that some areas of the Sassafras sand in the Millville area abut upon the Lakewood sand, shallow phase, in the Chatsworth area. In the Chatsworth area it was decided to map some of those areas having a shallow white surface soil as the shallow phase of the Lakewood, regardless of the fact that the same soil had been mapped previously as Sassafras sand in the Millville area.

The soils of the Chatsworth area join up with those of the Camden area in all essentials, except that the areas which were mapped as Hyde loamy sand in the Camden area have been mapped simply as Swamp in the Chatsworth area, the latter classification being considered the better because of the wide variation in the character of the material and the very wet, swampy nature of these lowland areas.

agitation of water, and distance from shore. Since the elevation of this part of the ocean floor, streams, winds, and other agencies of erosion have removed some of the materials, shifted and redeposited others, and more or less modified and rearranged the original marine deposits. Undoubtedly there has been considerable removal by leaching of the soluble substances formed through the weathering and decay of the mineral particles in the soil. There is no considerable amount of lime carbonate in any of these soils, at least none of them effervesce with hydrochloric acid.

The surface parts of these modified and shifted materials, with the addition of varying amounts of organic matter, constitute the present soils of the Chatsworth area. Under the influence of the processes of weathering and the wide variations in the drainage, due to topographic differences, a relatively large number of soil types have been developed within a small area, and with such degrees of gradation that it is not everywhere easy to determine accurately their limits.[8]

The upland soils are dominantly sandy, highly quartzose, with low content of mineral particles other than quartz, except where greensand particles are present. Much of the well-drained sand is a clean white to light grayish color; but in the low wet areas dark-colored vegetable matter has accumulated in the soil in varying amounts, ranging in portions of the areas of Swamp as high as that of peat, which contains 90 per cent or more of partially decomposed plant remains. The marshes, swamps, and wet soils include much material in which processes of weathering, as oxidation and excessive leaching have been retarded, owing to the saturated condition. In other words, those natural processes which act toward the development of mature or normal upland soils have here been retarded or inhibited by accident of position and consequent presence of moisture in excessive amounts.

Soils that are similar in origin, color, drainage, mode of formation, and structural characteristics are classed in a soil series. Each series is divided into soil types on the basis of difference in the texture of the surface soil. The type is the unit of soil classification and mapping. The phase is a minor variation from the type.

The types of the Sassafras series are characterized by brown or light-brown surface soils, underlain by a reddish-yellow or orange-colored to dull-red, friable subsoil. Generally the lower subsoil is coarser textured than the soil or upper subsoil. This coarse texture

[8] The weathering of the soil material does not necessarily develop greater diversity in the soils; in fact the general tendency is in the opposite direction. As the drainage improves there is a tendency toward unification of color; with time the fine particles are removed from the surface layers, leaving more nearly uniform textured layers; the impress of plant life is in the direction of development of more or less uniform brown soil colors; while the decay of the complex mineral particles allows the removal of the more soluble particles, leaving behind the least soluble, consisting largely of quartz, iron oxide, and the hydrous silicates of alumina.

of the subsoil and substratum insures good underdrainage and ready permeability by plant roots. The Sassafras soils are mellow and easily worked. The types of the Sassafras series mapped in the Chatsworth area range from loam to coarse sand.

The types of the Collington series are distinguished by the brown or grayish-brown color of the surface soils, the reddish-yellow or orange color of the subsoil, and the presence of varying amounts of greensand marl in the soil or subsoil, or both. The Collington soils usually have a decided olive-green or greenish-brown tinge in the subsoil, and, in places, in the soil, and a characteristic greasy texture. Except for the very heavy types, the Collington soils are mellow and easily worked. This series has a level to very gently sloping topography and the drainage is good. The material of the heavier types is often of a strong green color and stiff structure, but this very green material consists mainly of the unweathered parent beds. Four types of the series are mapped in this area.

The Shrewsbury soils are closely associated with the Collington soils, occupying lower positions or flat areas where the drainage is imperfect. They are characterized by the brown or slightly grayish-brown color of the surface soils, and the mottled, greenish, yellowish, and reddish color of the subsoil. Glauconite (greensand marl) is present in varying quantities. The Shrewsbury sandy loam is the only type recognized in the Chatsworth area.

The types of the Keansburg series have black surface soils and a mottled, greenish, bluish, grayish, and yellowish subsoil. Their drainage is imperfect, rather poorer than that of the Shrewsbury series. The Keansburg soils bear the same relation to the Collington soils as the Portsmouth soils do to the Sassafras and Norfolk soils; that is, they are of the same derivation but have developed under conditions of poor drainage. The Keansburg loam is the only type mapped in this area.

The Norfolk soils are closely associated with those of the Sassafras series. They are distinguished by their grayish to light-brown surface soils and pale-yellow to yellow, friable subsoils. The Norfolk fine sand and an imperfectly drained phase of the Norfolk sandy loam have been mapped in this area.

The surface soils of types of the Lakewood series are white and the subsoil is orange or orange yellow. The organic content of these soils is very low, and they are composed very largely of quartz sand. The drainage is usually excessive, the topography level to hummocky, and the productivity low. The sand, with a shallow phase, the fine sand, and a deep phase of the sandy loam have been mapped here.

The types of the St. Johns series are characterized by the dark-gray or black color of the surface soil, the coffee-brown to dark-brown color of a compact or "hardpan" layer beneath, and the

whitish, grayish, brownish, or mottled color of the deep subsoil. The "hardpan" layer shows a concentration of organic matter and to some extent of iron. The drainage is imperfect. These soils occupy depressions and lower situations. The sand is the only type mapped here.

The types of the Portsmouth series are poorly drained. The surface soils are similar to those of the St. Johns series, but the subsoil is white or mottled white, gray, and pale yellow. There is no hardpan layer, but the subsoil is saturated. The Portsmouth soils occur in the lower situations, without adequate drainage outlets, adjacent to or near areas of Sassafras or Norfolk soils. The sandy loam and loam have been mapped in this area.

The types of the Scranton series have black surface soils underlain by a pale-yellow subsoil, mottled in places with gray. Their drainage is better developed than that of the St. Johns or Portsmouth series. Frequently the Scranton soils occupy intermediate positions between these imperfectly drained soils and the well-drained soils of the Sassafras, Norfolk, and Lakewood series. The sandy loam is the only Scranton type mapped in the Chatsworth area.

The types of the Leon series have white or light-gray surface soils overlying a white subsoil with a coffee-brown "hardpan" layer, like that of the St. Johns, occurring at variable depths. This hardpan material passes down into light-brown, orange, or yellow, looser material. The Leon soils of the Chatsworth area differ from the typical Leon soils in other parts of the Coastal Plain in that the material below the hardpan layer is not so frequently dark colored, being generally orange or yellow. These soils occupy flats and depressions where the drainage is imperfect. They are associated with the better drained Lakewood soils and the more poorly drained soils of the St. Johns and Portsmouth series. Only the sand type has been mapped.

The types of the Freneau series consist of alluvial material which has been washed into stream bottoms mainly from near-by areas of Sassafras and Collington soils. The surface soils are dark brown, rusty brown, brownish gray, or mottled with these colors, and the subsoil is mottled greenish, yellowish, reddish, bluish, and rusty brown. They occupy first bottoms of streams, and have poor drainage. Some of the material consists of greensand or material washed from upland soils derived partly from greensand. Only the loam type occurs in the Chatsworth area.

The miscellaneous classifications of the area include Swamp, occupying many local depressions and broad strips along streams; Tidal marsh, consisting of low, level areas subject to tidal inundation along the bays and lower river courses; and Coastal beach, consisting of narrow strips of beach sand along the coast.

In the following pages the various soils are described in detail. Their distribution is shown on the accompanying soil map.

The names and the actual and relative extent of the soils mapped are given in the table below.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Lakewood sand	173,248	26.9	Sassafras loam	5,120	.7
Shallow phase	31,808		Collington fine sandy loam	5,056	.7
Sassafras sand	116,992	15.4	Norfolk fine sand	4,992	.7
Flat phase	640		Sassafras loamy sand	4,352	.6
Swamp	114,624	15.0	Flat phase	512	
St. Johns sand	60,800	7.9	Keansburg loam	3,968	.5
Sassafras sandy loam	29,184	.....	Scranton sandy loam	3,968	.5
Deep phase	23,488	7.0	Shrewsbury sandy loam	3,776	.5
Flat phase	256	.....	Freneau loam	3,136	.4
Sassafras gravelly sandy loam	50,816	6.6	Norfolk sandy loam, imperfectly drained phase	3,136	.4
Tidal marsh	48,576	6.3	Collington sand	1,920	.2
Lakewood sandy loam, deep phase	30,912	4.0	Collington sandy loam, deep phase	1,792	.2
Sassafras fine sand	8,448	1.1	Portsmouth loam	1,664	.2
Coastal beach	7,680	1.0	Sassafras coarse sand	576	.1
Sassafras fine sandy loam	7,296	.9	Collington loam	128	.1
Leon sand	5,504	.7			
Lakewood fine sand	5,312	.7			
Portsmouth sandy loam	5,120	.7	Total	764,800	.....

SASSAFRAS GRAVELLY SANDY LOAM.

In its typical development the Sassafras gravelly sandy loam is a brownish-gray gravelly sandy loam or loamy sand, which passes within a few inches into reddish-yellow gravelly sandy loam, forming the lower part of the soil and upper part of the subsoil. This grades into a gravelly sandy loam or gravelly sandy clay, in which the gravel and sand are coarser and below depths of 24 to 30 inches into still coarser material, consisting of a mixture of gravel and sand or coarse sand and sand. The gravel throughout the profile consists of rounded, waterworn quartz fragments.

This type is quite variable in texture. In many places in wooded areas the surface soil to shallow depths is gray to nearly white, approaching in appearance the Lakewood gravelly sandy loam. Below depths of 2 to 4 inches, however, the color is brownish gray, light brown or yellowish brown, and like the typical Sassafras. Much of this type as mapped in the vicinity of Barnegat Park, Elwood, Lacey, Forked River, and Cedar Grove has these characteristics. These areas would have been classified with some other series than the Sassafras, but for the fact that the white layer is very shallow, and that the material below has the Sassafras characteristics. In places there are areas mapped with the Sassafras in which the surface soil is yellowish brown or even reddish brown.

In the northeastern part of the area practically all of the Sassafras gravelly sandy loam is under cultivation. In this section much of the soil is a light-brown sandy loam, overlying reddish-brown or reddish-yellow sandy loam, which passes down into heavy friable reddish-brown to yellowish-red sandy clay, with an abundance of small quartz pebbles throughout the 3-foot section. The gravel is rarely more than 1 inch in diameter and most of it is smaller. Large areas of this kind occur in the vicinity of Glendola, Allenwood, and Herbertsville.

In many places throughout the entire area the surface soil of this type consists of light-colored sand or loamy sand, containing gravel, underlain at various depths, generally quite shallow, by the more heavy sandy loam or sandy clay.

The Sassafras gravelly sandy loam is an extensive type. It occurs in large areas in the northeastern part of the region surveyed, near the coast, and in the extreme southwestern part. Other large areas lie west of Forked River and Barnegat Park, and smaller bodies are scattered throughout the area.

This type usually occupies the slopes and caps the higher parts of low hills in rolling country. A number of large tracts, however, have a level or nearly level to gently undulating topography. The drainage is good, and is excessive in some of the higher situations.

This is one of the most important types of the Chatsworth area. Probably 30 per cent of it is cleared and under cultivation. Practically all of that part north and west of Toms River is being farmed. It is well adapted to a wide range of crops, and is extensively used in this section for potatoes, corn, clover, and grass, with a small acreage devoted to small grains. Also a considerable acreage is used for late truck crops. Potatoes yield 75 to 150 bushels per acre. In some years yields of 200 bushels are obtained.

In the adjoining Camden area on the west and the Millville area on the south, this type of soil is highly esteemed for fruit production, peaches, apples, and pears having proved very successful. In the Chatsworth area, however, only a small acreage is used for fruit, apparently because farmers here are not interested in orchard fruits. Several peach orchards on this soil in the vicinity of New Columbia are producing good crops. Blackberries and raspberries are also grown successfully on this type in this vicinity.

West of Barnegat Park and Forked River large areas of this soil are still in woodland. The growth consists chiefly of various species of oaks and some pine. Frequent fires, however, have damaged the timber greatly, and the growth is rather stunted. Some cutting is being done.

Improved land of this type in the northeastern section of the area sells for $150 to $200 an acre, depending upon the location, the con-

dition of the farm buildings, local topography, and condition of the soil. Farther south and a few miles west of the coast forested land can be bought as low as $10 to $15 an acre. Land values, however, over the area north and west of Toms River are depreciated at the present time by the presence throughout the spring and summer months and even late into the fall of numerous salt-marsh and fresh-marsh mosquitoes. Until some provision is made for the elimination or control of these pests, much of this land may remain undeveloped for some time.

The material of this type is used extensively for road construction, the gravel having just sufficient natural binding or clayey material to form a good road bed. The main highways of the area are at present constructed of this material, and pits from which it is obtained are numerous, as the map shows.

The productiveness of this soil can be increased by increasing the content of vegetable matter. This can be accomplished by growing clover, peas, and other humus-supplying crops in the rotations. Commercial fertilizers and manure give marked results in increased yields.

SASSAFRAS COARSE SAND.

The typical Sassafras coarse sand is a brownish-gray or light-brown coarse sand, about 6 to 8 inches deep, overlying yellow or reddish-yellow gravelly coarse sand. In wooded areas the surface soil is brownish gray to gray, in cultivated fields light brown.

This type occurs mainly on gentle slopes, where the drainage is good to excessive. It is not extensive and not important agriculturally. It is held at prices ranging from $10 an acre upward depending chiefly on the desirability of the location.

Heavy applications of fertilizer or manure are necessary for the production of good crops. The cost of production on such a coarse-textured soil is so high that there is considerable doubt whether it can be farmed profitably under present economic conditions. For certain crops, such as blackberries, dewberries, and asparagus, it may he possible to use favorably located areas with profit. Generally such land can best be used for forestry.

SASSAFRAS SAND.

Most of the Sassafras sand in this area consists of a layer of gray to whitish sand, about an inch thick, underlain by brownish-gray sand, which at a depth of 5 to 8 inches passes into orange or reddish-yellow slightly loamy sand subsoil. There is not much variation in the subsoil, except locally where in the lower part it is yellower and less loamy or redder and more loamy. In places there a is gravel or coarse sand stratum between the depths of 20 and 36 inches.

In virgin forest areas and in some abandoned fields the surface of the Sassafras sand is almost snow white, having the appearance of the Lakewood sand, but this white material is present in a very thin layer, and with cultivation the surface becomes brownish gray or grayish brown, conforming better with the characteristics of the Sassafras series. This change in color upon cultivation is due to the mixing of the more yellowish or orange subsurface or subsoil sand with the whitish surface layer and whatever vegetable matter may be present. In some places the surface is light brown even in timbered areas, with some spots which are reddish brown.

There are included in this type, as mapped, small areas of typical Lakewood sand and of Lakewood sand, shallow phase, and also flat or low areas in which the subsoil is yellow, such areas representing the Norfolk sand. The degree of redness in the subsoil depends considerably upon the drainage, the lower poorly drained areas showing more yellow in the subsoil than those having better drainage.

Areas having a scattering of small quartz gravel in the surface soil are indicated on the map by gravel symbols. In places small areas of Sassafras gravelly sandy loam are thus shown, but most of these areas are characterized by a slightly loamy subsoil resembling the Sassafras loamy sand. In other places no difference in texture can be noted. Where this type approaches a coarse sand in texture, small gravel is in many places present throughout the 3-foot section.

Where this soil adjoins areas of the Collington series it contains small quantities of greensand marl or glauconite. In such places the surface soil is generally light brown to a depth of 6 or 8 inches, where it changes into an orange sand, this passing abruptly at 18 to 20 inches into reddish-brown sand, which is loamy in places in the lower subsoil. In such areas the glauconite is usually present in small quantities in the brown surface soil, and only traces are found in the underlying material.

Next to the Lakewood sand the Sassafras sand is the most extensive of the upland soils. It is developed in all parts of the area, but is most extensive near the coast and in the northeastern, northwestern, and southeastern parts. In general this type has a nearly level to gently undulating topography. It is found also on knolls and slopes. The drainage is good to excessive, and in dry seasons crops are likely to suffer greatly from drought, especially if a liberal supply of organic matter has not been worked into the soil.

Except in the southwestern corner, along the seacoast, and between Toms River and Lakewood, this type is not farmed extensively but remains uncleared. The farmed areas give good yields of the truck crops, including sweet potatoes, early and late tomatoes, and some watermelons and muskmelons. Blackberries and raspberries are grown extensively in the vicinity of Egg Harbor, Elwood, and New

Columbia. Some peaches also are produced. Yields in general are somewhat lower than on the heavier Sassafras types, and more organic matter and fertilization are required for good yields. This soil responds readily to liberal applications of commercial fertilizers, but the effects soon disappear. Cowpeas, clover, and rye are crops that can be advantageously grown to build up the humus content of the soil.

The forest growth is far superior to that on the Lakewood sand or St. Johns sand. Various species of oaks predominate, with some pine and scrub oak. When such forested areas are protected from fire and systematically thinned excellent stands of oak and pine follow.

This type when in forest can be bought at the present time for about $15 to $25 an acre; sometimes for less. Cleared land brings from $75 to $100 an acre, depending upon location, character of improvements, and state of productiveness.

Sassafras sand, flat phase.—The Sassafras sand, flat phase, consists of a light-brown to brown sand passing at 6 to 8 inches into an orange, reddish-yellow, or yellow sand, which usually passes into pale-yellow, wet sand in the lower part of the 3-foot section. In places a gravel stratum is present at depths of 24 to 36 inches. Small areas of Sassafras sandy loam, loamy sand, and sand have been included on the map, owing to their small extent.

This phase is associated with the better drained Sassafras types along Barnegat Bay. It occupies flats in which the drainage is not everywhere adequate and the lower subsoil is generally wet. A considerable part of it is cleared and used for berries and truck crops. Strawberries are an important crop. Liberal applications of fertilizers or manure are required for the production of best yields.

SASSAFRAS LOAMY SAND.

The typical Sassafras loamy sand is a grayish-brown or light-brown loamy sand, about 6 to 8 inches deep, overlying reddish-yellow loamy sand, the lower part of which is less loamy, coarser textured, and in some places more yellow. Gravel is present locally in the subsoil, and here and there in the surface soil. In forested areas a thin layer of the surface soil in places is brownish gray and in spots almost white.

The Sassafras loamy sand occurs in comparatively small bodies widely distributed throughout the area, being most abundant in the vicinity of West Creek, south of Tuckerton, and around Lakewood. Many areas occur upon flats in higher situations and others upon gently undulating slopes. The drainage is well established.

Some of this type is cleared and used for the production of late truck crops, especially in the northeastern part of the area in the

vicinity of Lakewood and Bennetts Mills. Tomatoes, peppers, cabbage, potatoes, sweet potatoes, and beets are grown.

The soil is easy to cultivate and responds readily to the application of manure and commercial fertilizers. The more loamy structure of this type makes it slightly better than the Sassafras sand, and yields are somewhat higher. Without manure or rather liberal additions of fertilizer, light yields may be expected, especially where the supply of organic matter has been allowed to dwindle. Cowpeas, clover, or rye should be grown as a source of organic matter.

Sassafras loamy sand, flat phase.—The Sassafras loamy sand, flat phase, is a brown loamy sand about 10 inches deep, underlain by orange-colored loamy sand, which in the lower subsoil consists of yellow sand carrying some gravel. The lower part of the 3-foot section is generally pale yellow and wet. Small areas of Sassafras sandy loam, flat phase, and Sassafras sand, flat phase, are included within this phase as mapped.

This soil occupies level areas, mainly in low situations where the drainage is not always the best. It is developed principally near the coast along Barnegat Bay.

Probably 50 per cent of this phase is farmed, being managed and treated much the same as the Sassafras sand, flat phase. Good yields of corn, potatoes, and garden truck are obtained under skillful management, including the use of manure or fertilizers or both in rather liberal quantities.

SASSAFRAS FINE SAND.

The Sassafras fine sand in its typical development is a grayish-brown to light-brown or brown fine sand, with a depth of about 6 inches, underlain by orange-colored fine sand passing into slightly reddish-yellow fine sand, with gravel and considerable medium or coarse sand in the lower subsoil. In places the surface soil is a brown fine sand 10 or 12 inches deep, passing into yellow fine sand, or first into slightly reddish-yellow fine sand and then into yellow fine sand. In timbered areas the surface soil, to a depth of a few inches, is a grayish-brown fine sand or in places a white fine sand.

This soil is quite extensively developed in large areas in the vicinity of Atsion, West Farms, Bennetts Mills, and Squankum. It occurs in broad flats and gently rolling areas where the drainage is good. Prolonged droughts have less effect upon this type than upon the Sassafras sand or coarse sand, which makes it a slightly better type of agricultural land.

The type is extensively farmed, especially in the northeastern part of the area. The principal crops are potatoes, peppers, tomatoes, and melons. Near Atsion much of the type is still in forest, chiefly of oak, with some pine. Liberal additions of fertilizer or manure

are required in order to obtain good yields of most crops. The soil could be improved by growing cowpeas and clover or by plowing under a crop of rye or other humus-supplying vegetation.

SASSAFRAS SANDY LOAM.

The surface soil of the Sassafras sandy loam in cultivated fields consists of light-brown to brown loamy sand or sandy loam, about 6 to 8 inches deep, grading into yellow or reddish-yellow loamy sand or sandy loam, which at about 12 to 15 inches passes into yellow or reddish-yellow sandy clay, and this, in turn, into reddish-yellow sandy clay, which may contain gravel or coarser sand, or both, in the lower part of the profile. The lower subsoil is nearly always more sandy and contains less fine material than the stratum above. In forested areas the surface soil is usually grayish brown or light brown in color. In places the soil profile consists of grayish-brown or light-brown sand or loamy sand, passing at 2 or 3 inches into yellow or yellowish-brown loamy sand, which grades downward into reddish-yellow sandy loam and then, at about 12 to 15 inches, into reddish-yellow friable sandy clay. In such areas a reddish-yellow loamy sand or loamy coarse sand occurs at 22 to 26 inches.

There are included within this type, as mapped, areas of Sassafras loam, as south of Aserdaten, and also some areas of Sassafras gravelly sandy loam, coarse sandy loam, loamy sand, and sand. Some areas of Scranton sandy loam, consisting of black sandy loam overlying reddish-yellow sandy loam, locally mottled gray and yellow in the lower subsoil, are also included.

The Sassafras sandy loam is an important soil, especially in the northeastern part of the area north of Lakewood. It occurs quite extensively, however, in all parts of the area, except in the central part. It generally occupies the level situations associated with the Sassafras loam, gravelly sandy loam, loamy sand, and sand. In mapping this type some strips of material approximating sand or loamy sand in texture were included, the gradation between the soils being such that arbitrary boundaries were necessary in some places. The topography is level to gently rolling, and the drainage is good.

Much of this type is cleared and farmed, particularly in the northern part of the survey. Here it is a very productive soil. It is handled much the same as the Sassafras gravelly sandy loam. It is especially adapted to potatoes, being excelled for this crop only by the heavier Sassafras loam. It is also extensively used for late truck and general farm crops. Dairying and general farming are practiced upon this type around Camp Dix.

Oaks predominate in forested areas, with a scattering of pine. Much of the virgin forest growth has been destroyed by repeated fires, and the growth is generally stunted. With protection, however, the type produces a fine growth of oak.

Sassafras sandy loam, flat phase.—The flat phase of the Sassafras sandy loam differs from the typical Sassafras sandy loam chiefly in that it occupies flat, nearly level country, and has a higher water table, the subsoil frequently being saturated. It consists of brown sandy loam, underlain at about 8 to 10 inches by yellow rather friable sandy clay, which passes at lower depths into yellow to slightly reddish sandy loam or loamy sand containing gravel. In places the subsoil is a mottled grayish yellow and yellowish brown. Such areas represent inclusions of the Norfolk sandy loam, imperfectly drained phase, with which this phase is closely associated.

This phase of the sandy loam occupies rather low flats where drainage is imperfectly established. It is not extensive or of great agricultural importance, although about half of it is farmed. It occurs chiefly along the bay shore adjoining areas of other Sassafras types. Its agricultural uses and adaptations are very similar to those of the typical Sassafras sandy loam.

Sassafras sandy loam, deep phase.—The deep phase of the Sassafras sandy loam consists of gray to grayish-brown sand or loamy sand, about 3 to 6 inches deep, underlain by yellow or orange-colored sand or loamy sand, which at about 20 to 24 inches passes into reddish-yellow sandy clay, heavy sandy loam, or gravelly sandy loam. The lower subsoil locally contains considerable coarse material; and in places, as at Pasadena, the heavy layer of reddish-yellow sandy loam is underlain within the 3-foot section by lighter material of loamy sand or loamy coarse sand, often gravelly.

South of Cedar Grove there are included within this phase, as mapped, small areas of Sassafras sand and sandy loam, some Lakewood sand, and the shallow phase of the Lakewood sand. In timbered areas it was difficult to separate these types in many places, this resulting in more or less arbitrary soil boundaries.

The Sassafras sandy loam, deep phase, occurs in scattered areas, mainly in the central and eastern parts of the survey. Large areas lie in the vicinity of Lacey, Union Clay Works, and Cedar Crest. The surface ranges from nearly flat or billowy to rolling, most of it being rolling. The drainage is excessive on some of the higher positions.

Practically all this land is still in forest. The native growth consists principally of oak and pine, generally stunted as a result of fires.

When cleared and farmed this soil should be slightly superior to the Sassafras sand, especially for the production of truck crops. The underlying clay or heavy sandy loam layer retains moisture much better than the deeper sand types; at the same time the sandy surface soil warms up early in the spring and in this respect has the desirable qualities of the sand types without the disadvantages of their droughtiness.

If this type is to be successfully cultivated, however, the turning under of humus-supplying crops or manure is essential. Commercial fertilizers increase the yields of all crops, undoubtedly giving the best results in those areas where the soil has not been depleted of organic matter.

SASSAFRAS FINE SANDY LOAM.

The Sassafras fine sandy loam consists of a brown to slightly dark brown loamy fine sand or fine sandy loam, 8 to 10 inches deep, underlain by yellow loamy fine sand or fine sandy loam, which passes quickly into reddish-yellow, friable, heavy fine sandy loam or fine sandy clay, and this passes at about 24 inches into reddish-yellow or orange-colored friable sandy clay. In places, as about 2 miles northwest of Glendola, the lower subsoil is a reddish-yellow fine sand or loamy fine sand.

This soil is less extensive than some of the other Sassafras types, but large bodies of it occur north of Bennetts Mills, west of Farmingdale, southeast of Maxim, near Indian Mills, and south of Tabernacle. The surface is level to rolling and the drainage is good.

Probably 40 per cent of it is cleared and farmed. The native timber consists of various species of oaks, with chestnut, sassafras, birch, hickory, and a scattering of pine. When protected from fire excellent stands of timber are obtained.

The tilled area of this type is utilized principally for the general farm crops of the region in conjunction with late truck crops. Dairying and fruit growing also are of some importance. This is an especially good potato soil, surpassed, probably, only by the Sassafras loam. Yields of 200 bushels per acre are not uncommon.

The type is naturally a good soil, but in order to keep it productive winter cover crops and legumes should be included in the rotations and plowed under as a source of organic matter. Liming has proved beneficial on this soil as well as on the other important types of the Sassafras series through the New Jersey, Delaware, and the Chesapeake Bay region. Manure or commercial fertilizer is necessary for the best yields.

SASSAFRAS LOAM.

The surface soil of the typical Sassafras loam consists of a light-brown to brown loam, 8 or 10 inches deep; the subsurface or upper subsoil consists of reddish-yellow friable loam extending to a depth of about 18 inches, and the middle subsoil of dull-red to yellowish-red friable sandy clay containing some fine gravel and sand. In places, as at Camp Dix, the type consists of brown friable loam, underlain at 6 or 8 inches by reddish-yellow loam which is redder and more sandy in the lower part of the 3-foot section. In other places the subsoil is very gravelly. In forested areas the light-brown

or brown surface is thinner than in cultivated fields, with yellow or yellowish-brown loam in many places occurring within 1 to 3 or 4 inches of the surface.

Typically the surface of this type is flat to very gently undulating. In the vicinity of Allenwood and eastward toward the coast the surface is rolling, but becomes more nearly level as the ocean is approached.

The type is not extensive. It occurs principally north and southeast of Allenwood. Possibly 60 per cent of it is cleared and farmed. It is handled in much the same way as the Sassafras sandy loam and fine sandy loam. Peaches, apples, and a few pears are grown. Dairying is practiced to a considerable extent in conjunction with general farming. Near Allenwood potato culture is important. Potatoes are usually grown in rotation with corn, grass, and grains, and sometimes alfalfa. Yields of 250 bushels per acre are not uncommon, and in many cases higher yields are obtained. Frequently potatoes are grown continuously in the same fields year after year. When this is done a cover crop is seeded in the early fall and plowed under the following spring. Fertilizers or manure are necessary for best yields. Commercial fertilizers are in common use.

The virgin forest growth consists principally of beech, maple, chestnut, red oak, white oak, black oak, and hickory. The stand is large and well developed.

Land of this type can be bought at the present time for about $75 to $150 an acre, although near Allenwood the price is rarely less than $200 an acre and usually much more. Land prices here, however, are inflated owing to the nearness of coast resorts. Farm buildings between Allenwood and Manasquan are of an improved type, and the farms command better prices than elsewhere.

COLLINGTON SAND.

The typical Collington sand consists of a light-brown to brownish-gray sand, 3 to 6 inches deep, overlying reddish-yellow sand containing considerable greensand, which becomes more abundant with increasing depth and imparts a greenish cast to the lower subsoil. The content of greensand varies considerably. Careful examination alone will reveal its presence in the surface soil of this type, but the lower subsoil in places consists of almost pure greensand, which has a characteristic greasy feel. This type grades into adjoining areas of the Sassafras sand, and it is not always possible to locate exact boundaries between the two. This is also true of the heavier soils of the Collington series where they occur associated with the Sassafras.

This type is not extensive. It occurs mainly in the northwestern part of the area in the vicinity of Birmingham, Ewansville, and

Vincentown, where a large proportion of it is cleared and farmed, and in other small areas north of Fort Plains. It occupies level to gently rolling country and is well drained. The native forest growth is chiefly pine and oak, the latter predominating.

When farmed this soil is managed in much the same way as the Sassafras sand and has the same crop adaptations. Truck crops, such as sweet potatoes, tomatoes, muskmelons, watermelons, and peppers are the principal crops. The productiveness of the land could be improved by the addition of stable manure and the growing of clover and cowpeas. It is naturally low in organic matter. Fertilizers are necessary in rather heavy applications for the production of good yields of most crops.

COLLINGTON SANDY LOAM, DEEP PHASE.

The Collington sandy loam as mapped in this area is a deep phase of the type. It consists of light-brown or brownish-gray sand or loamy sand, underlain at 6 to 8 inches by reddish-yellow sand containing some dark-green particles, and grading at about 24 to 30 inches into greenish-yellow sandy clay. Glauconite or greensand marl, which accounts for the greenish tinge, occurs in varying quantities throughout the 3-foot section. It is particularly prominent in the sandy clay subsoil, but generally is not conspicuous above the lower subsoil. In places the heavy sandy clay layer is encountered at about 14 inches; in other places below 30 inches, the average depth being about 18 to 20 inches. Some small, unimportant areas, in which the material is fine in texture—in reality the Collington fine sandy loam, deep phase—are included with this soil.

This is not an extensive soil. It occurs chiefly in the northwestern and northeastern parts of the area, in the vicinity of Pemberton, south of Smithville, 1½ miles north of Fort Plains, and northwest of West Farms. The surface is gently rolling, and the drainage is good.

Practically all this soil is cleared and farmed. It is especially adapted to truck crops, such as tomatoes, sweet potatoes, muskmelons, peppers, and watermelons, and to potatoes to some extent. In farm practice it receives much the same treatment as the Collington fine sandy loam with which it is associated.

The plowing under of more vegetable matter, which may be supplied by crops of cowpeas, clover, or rye, would improve the productivity of this soil. Manure or fertilizer is necessary for good yields.

COLLINGTON FINE SANDY LOAM.

To a depth of about 8 or 10 inches the Collington fine sandy loam consists of a brown loamy fine sand to fine sandy loam with a greenish cast. This is underlain by reddish-yellow fine sandy loam to

sandy loam, which passes at about 18 to 20 inches into reddish-yellow sandy clay containing considerable greensand. In places at about 24 to 30 inches a green sandy clay mottled with bluish green and dark reddish brown is encountered.

Included with this type are unimportant small bodies of Collington sandy loam and Collington sandy loam, deep phase. In both of these included types most of the sandy material consists of a medium rather than fine sand. This soil grades into the associated Sassafras soils so gradually that the boundary between the types can not everywhere be accurately determined. In places, as, for example, about one-half mile northwest of Birmingham, the type consists of brown loamy sand with a greenish cast, underlain at about 8 to 10 inches by green or greenish yellowish-brown loamy fine sand, passing beneath into greenish-yellow fine sandy loam and at 24 to 30 inches into green sandy clay mottled with bluish-green and reddish-brown colors.

This type is important only in the northwestern part or the area. It occurs in large bodies in the vicinity of Smithville, at Pemberton, and north of Vincentown. Small developments are also found northwest of Georgia, in the northeastern part of the area. The topography is level to undulating and drainage is good.

Practically all of this soil is cleared and farmed. The general farm crops are grown in conjunction with potatoes and late vegetables. Fruit growing is not important. Good crops of corn, timothy and clover hay, and small grains are obtained. Late tomatoes, potatoes, cabbage, and peppers are the chief truck crops. North of Vincentown and around Pemberton some dairying is practiced in connection with general farming and trucking. The herds, composed for the most part of grade Holsteins, are small, probably averaging about 10 head. Milk is shipped to Philadelphia or to near-by creameries at Vincentown and Pemberton.

Modern farm methods are practiced in farming the type, and rotations are in general use. Liberal applications of lime and the more extensive use of cover crops probably would prove beneficial to the soil. Commercial fertilizer or manure is essential for the production of the best yields.

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

Mechanical analyses of Collington fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
170869	Soil	1.1	5.2	6.7	48.6	14.3	15.2	8.8
170870	Subsoil	.0	3.7	4.4	34.7	17.6	21.1	18.5

COLLINGTON LOAM.

Typically the Collington loam consists of a brown to rather dark brown mellow loam, about 8 to 10 inches deep, underlain by reddish-brown heavy loam to clay loam containing enough greensand material to impart in places a greenish color.

This type is mapped only at Smithville and southwest of Ewansville. It occupies flat level positions, but the drainage is good. All the type is cleared and farmed. It is handled in much the same manner as the Collington fine sandy loam, with which it is closely associated. Yields are somewhat larger on this type than on the lighter sandy loam of the series. The general farm crops, such as corn, small grain, timothy and clover, and potatoes, are grown.

SHREWSBURY SANDY LOAM.

The Shrewsbury sandy loam consists of a brown or grayish-brown sandy loam, about 8 to 10 inches deep, underlain by mottled greenish, yellow, bluish-gray, and reddish-yellow sandy clay, which at about 20 to 24 inches passes into heavier sandy clay of mottled greenish, yellowish, and reddish colors. In places the surface soil is a dark-brown to black loam, representing inclusions of Keansburg loam. There are also included within this type areas of Shrewsbury loam and fine sandy loam.

An area 1 mile northeast of Vincentown consists of brownish-gray to gray heavy sandy loam to loam, underlain at about 8 inches by mottled bluish-gray and yellow silty clay loam to sandy clay loam, and at about 15 inches by mottled bluish-green and yellow sandy clay loam to silty clay, which passes at about 20 to 24 inches into a green sand, loamy sand, or sandy loam showing some reddish mottling. An area one-half mile southeast of Vincentown consists of brown sandy loam about 10 inches deep, overlying yellow sandy clay to about 15 inches, with mottlings of bluish gray below this, the lower subsoil consisting of mottled reddish-brown and bluish-gray sandy clay which passes at about 30 inches into a reddish-yellow, yellow, and gray sand.

This type is not extensive, occurring only in the northwestern part of the area. Most of it is under cultivation. There are large developments in the vicinity of Vincentown and Pemberton, south of Birmingham, and near Beaverville. This soil occupies low-lying flat areas adjoining the Collington soils on the higher level and the Keansburg soils in the lower depressions. The drainage is imperfect but not so poor as on the Keansburg loam.

When artificially drained, this type produces especially heavy yields of corn, timothy and clover hay, wheat, rye, and late truck, particularly tomatoes. Farmers report yields of 80 bushels of corn per acre,

and 1½ to 2 tons of timothy and clover hay. Dairying is quite extensively practiced on this type east of Vincentown. The herds are mostly grade Holstein cattle, and average from 15 to 20 head. This soil does not seem especially well adapted to potatoes. It is late in warming up in the spring, and the drainage at this season is imperfect. Fair yields are obtained, however, especially during dry seasons.

Land of this type sells at the present time for about $75 to $150 an acre when drained and cultivated.

This soil requires occasional applications of lime, and also artificial drainage, either with open ditches or underground drain tile, for best results. Tile drains give the most satisfactory results.

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

Mechanical analyses of Shrewsbury sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
170833	Soil	6.1	18.9	7.8	23.2	13.7	19.2	11.0
170834	Subsoil	1.0	2.2	.1	24.2	37.5	22.6	10.4

KEANSBURG LOAM.

The Keansburg loam has a very dark brown to black loam surface soil, 8 to 10 inches deep and rich in organic matter. This is underlain by gray silty clay to sandy clay, which grades below into greenish or bluish-gray silty clay to sandy clay showing some yellow mottling. At about 20 inches this overlies green silty clay to sandy clay with yellow and reddish-brown mottling. In places, as mapped, the type approaches a sandy loam, but such areas are not extensive.

One mile north of Fort Plains there is an included area of Keansburg sandy loam, the type here consisting of black sandy loam, underlain at 10 inches by black clay, which passes at about 16 inches into white or light-gray clay, mottled with green and reddish-yellow, and then into sandy clay.

This type is extensive only in the northwestern part of the area. Small bodies occur around Fort Plains. The more important tracts are in the vicinity of Ewansville, Beaverville, Pemberton, and Buddtown. It occupies low flat areas where drainage is imperfectly developed.

Most of this type has been cleared and drained, and put into cultivation. Both open ditches and underground tile systems are used in draining the soil. The general farm crops, such as corn, wheat, timothy, and clover, are grown, along with some late truck crops, especially tomatoes, and some strawberries. This soil is rather late in warming up in the spring, because of its imperfect drainage, and

for this reason it is better adapted to the production of the general farm crops than to trucking. Vegetables are said to mature 10 days to 2 weeks later than on the better drained soils. This type when drained is well suited to corn. Yields of 80 to 100 bushels per acre are obtained. Timothy and clover hay yields range from 1 to 1¾ tons per acre.

The tillage methods practiced are practically the same as those employed on the Sassafras loam, although the Keansburg loam is rather restricted in the range of moisture conditions under which it can be plowed satisfactorily. Crops on this type do not receive as much manure or commercial fertilizer as on many of the other soils.

When drained, the Keansburg loam is one of the most productive general farming soils of the area, and under proper management it is unsurpassed for the production of hay and corn. Liberal applications of lime would probably give favorable results. Artificial drainage is essential, and tile drains should be used instead of open ditches. The lower, wetter areas, where drainage is impracticable, can be utilized to the best advantage as pasture land.

NORFOLK FINE SAND.

The Norfolk fine sand is a grayish-brown or brownish-gray loose fine sand, 3 or 4 inches deep, underlain by yellow or pale-yellow fine sand. In places, especially in the lower situations, the subsoil is slightly reddish or orange colored, approaching in color the characteristic Sassafras subsoil, but such areas are not typical. In low, flat areas the lower subsoil shows some gray mottling and is quite moist.

The Norfolk fine sand is not an extensive type, nor is it of great agricultural importance. It is developed chiefly in a narrow belt lying south of the outcropping marl formations, although areas of it occur elsewhere in the survey. The largest tracts lie near Flyat and Fox Chase. This type occupies well-drained areas having a somewhat hillocky or ridgy surface. The drainage is excessive in places, especially in the higher situations. Only a small part of this type is cleared.

The virgin forest consists chiefly of scrub oak and pine. Holly, mountain laurel, and huckleberry form the principal undergrowth, with considerable wintergreen in lower situations. This soil is too light for best results with the general farm crops, but under careful management good results are obtained with vegetables. Sweet potatoes, peppers, early tomatoes, and muskmelons are the principal crops. Corn is grown to some extent, but it does not give as satisfactory results on this type as on the heavier soils.

This soil is naturally low in organic matter, and the plowing under of leguminous crops, such as peas or clover, together with the addition of stable manure, will increase its productiveness. Com-

mercial fertilizer or manure is necessary in liberal amounts if good crops are to be obtained.

NORFOLK SANDY LOAM, IMPERFECTLY DRAINED PHASE.

The Norfolk sandy loam is developed in the Chatsworth area as an imperfectly drained phase. It consists of gray to brownish-gray sandy loam, about 6 inches deep, underlain by yellow friable sandy clay, which is slightly reddish at about 30 inches, passing down into yellow sandy clay. Yellow and gray mottlings are present locally in the lower part of the 3-foot section, and the lower subsoil is usually moist. Yellow, however, is the predominant color in the subsoil. In the typical Norfolk sandy loam, which occurs so extensively in the Middle Coastal Plain of the South Atlantic States, the subsoil is yellow without any mottling of importance.

This soil is extremely variable both in texture and color. In places where the drainage is better the lower subsoil locally is reddish-yellow and here and there grades into rather stiff sandy clay, representing an approach toward the Sassafras soils. There are included areas of sand, in fact, about half of the total area, is really a poorly drained phase of Norfolk sand, but separation of the two soils seemed of little importance owing to the small extent of both. This sand consists of grayish sand or loamy sand, about 4 to 5 inches deep, underlain by yellow sand, which at about 20 inches becomes pale yellow in color. The lower subsoil is mottled in places with yellow and gray, and is usually quite moist.

This phase of the Norfolk sandy loam is not extensive, and is unimportant agriculturally. It occupies low flats adjoining still lower areas of Portsmouth, Scranton, or St. Johns soils. As the name implies, the drainage is not well established, especially in the subsoil. The principal areas occur near Elwood and bordering the shores of Barnegat Bay.

In farm practice this soil receives about the same treatment as the Sassafras sandy loam and gravelly sandy loam. It is not so productive as these types, but strawberries appear to do especially well.

The forest consists chiefly of oaks, many water-loving species appearing. About one-fourth of this type is cleared and under cultivation.

Tile drainage and liberal applications of lime would increase the productiveness of this soil. Commercial fertilizer and manure are essential to the production of good crops.

LAKEWOOD SAND.

The typical Lakewood sand consists of white, loose, clean sand, underlain at depths ranging from 6 to 20 inches by orange-colored sand of comparatively open structure, extending to a depth of 36 inches

or more. Locally the orange-yellow color of the subsoil passes into yellow in the lower subsoil. In some places there is a faint reddish cast to the yellowish subsoil. The subsoil in general is uniform in texture; in places it contains some gravel and coarse sand.

In some of the low, flat situations adjoining areas of St. Johns sand a thin layer of dark-brown to coffee-brown incipient hardpan is encountered at depths of 10 or 12 inches. This passes at 14 to 16 inches into orange or reddish-yellow sand. Such areas as the latter represent a transition soil between the low, imperfectly drained St. Johns sand and the typical Lakewood sand on the higher situations. The soil with the hardpan, such as is found about 2½ miles southeast of Browns Mills, represents an inclusion of Leon sand.

As this type has been mapped there are small included areas of Leon sand, Lakewood sand, shallow phase, Norfolk sand, and St. Lucie sand. The last-named type consists of clean white sand to a depth of 36 inches or more.

The Lakewood sand is the most extensive upland soil in the area. With Swamp and St. Johns sand it occupies most of the central part of the area. It occurs in large bodies extending in every direction from the vicinity of Chatsworth to the coast, south to the Mullica River, and north to Lakehurst. There are large bodies also at Browns Mills, north of Batsto, and southwest of Toms River. The surface is typically rolling or slighty hummocky, but in places it is flat or nearly so. The drainage is usually excessive.

Very little of the type is cultivated, by far the greater part being covered with a forest growth, in which the trees are small and in places scattered. This forest consists chiefly of pitch pine and scrub oak, with an undergrowth of huckleberry and other shrubs. In many places the growth consists of a thick bushy growth, with but few trees of any size.

The agricultural value of this soil is low, and much of it is owned by the townships, the original owners having failed to pay taxes. Sales of large tracts have been recorded at prices ranging between $3 and $4 an acre, the tracts including, usually, one or more areas of swamp supporting a valuable growth of white cedar. In some parts of the State small fields and patches of Lakewood sand are being used in the production of dewberries and blackberries and of asparagus and other vegetables. Manures or fertilizers are necessary, and heavy applications must be used in order to obtain good yields. The soil is exceptionally low in organic matter, and this should be supplied where areas of this soil are brought under cultivation.

Lakewood sand, shallow phase.—The Lakewood sand, shallow phase, consists of loose, white sand to a depth of about 4 to 6 inches, overlying orange-colored or yellow sand. In places the surface soil is grayish. Included within this phase are small areas of typical Lake-

wood sand and an occasional patch of St. Lucie sand—that is, white sand 3 feet deep, without the yellow or orange-yellow subsoil. Patches of Sassafras sand, Norfolk sand, Sassafras gravelly sandy loam, and Lakewood gravelly sandy loam likewise have been included, owing to the small size of the individual areas of the included soils.

The topography is level to gently undulating, and the drainage is good to excessive.

The Lakewood sand, shallow phase, is distributed throughout the area and is prominent in the southwestern part, in the vicinity of Elwood and Magnolia. Very little of it is cleared. The forest consists chiefly of oak and pine. The virgin growth is considerably better than that on the typical Lakewood sand, including more large-sized trees.

The soil is considered better farm land than the Lakewood sand, but not as productive as the Sassafras sand. Vegetables, peaches, and berries are the crops that may be expected to succeed best. This soil, like the typical Lakewood sand, is exceptionally low in organic matter, especially in the first 6 inches. It is also highly quartzose and low in plant nutrients, as the very light colored, loose quartz sands of the humid region characteristically are. With the aid of stable manure or fertilizers, or both, the yields can be increased. By plowing under green vegetation, such as rye and peas, the humus content can be built up, but some manure or fertilizer will be required for the production of good yields of these soil-improving crops, or of any other crops for that matter, and even after the soil has thus been improved, manure or fertilizer still will be needed. Improvement must not be expected to be as lasting as on the heavier textured soils.

LAKEWOOD FINE SAND.

The Lakewood fine sand consists of 8 to 12 inches of fine white sand overlying orange-colored, loose fine sand, which passes beneath into yellow or pale-yellow fine sand. In some places, particularly in low-lying areas, a rather compact layer of brownish sand forming an incipient hardpan is encountered at various depths. These areas represent inclusions of Leon fine sand where the soil is whitish, and of St. Johns fine sand where the soil is black. Small areas of Sassafras fine sand are also included with the type, as mapped.

The Lakewood fine sand is confined to the northeastern part of the area. It is typically developed in the vicinity of Jacksons Mills, Fort Plains, and in the sections to the northwest and southwest of Maxim. The topography is level to gently undulating. The drainage is good to excessive, except in the lower situations, in which the subsoil may remain saturated for a considerable time after periods of rainy weather.

Much of the Lakewood fine sand is cleared and under cultivation. The open nature of this soil allows cultivation at any time. The soil is used mainly for truck crops, though to some extent for corn. The successful truck crops include lima beans, tomatoes, peppers, cabbage, watermelons, muskmelons, beans, peas, and sweet corn. A few potatoes also are grown. Ready markets for these products are found in near-by coast resorts.

This type is of considerably greater agricultural value than the Lakewood sand, approaching that of the Sassafras sand and fine sand. The fine texture causes it to hold moisture better, and applications of commercial mixtures do not leach out quite so readily as from the coarser textured Lakewood sand. This soil, like the Lakewood sand, however, requires the addition of stable manure or other vegetable matter to maintain the proper supply of humus, and manure or fertilizer in liberal quantities is required for good yields. Overhead irrigation probably would prove profitable in the production of truck crops.

LAKEWOOD SANDY LOAM, DEEP PHASE.

The Lakewood sandy loam, deep phase, consists of about 4 to 8 inches of white sand, frequently a little grayish in the surface inch, owing to the organic matter present, underlain by yellow or orange-yellow loamy sand passing at depths ranging from about 12 to 24 inches into reddish-yellow, orange-yellow, or yellow sandy loam to sandy clay, which, in turn, passes abruptly into yellow friable sandy clay at depths of about 30 inches.

In some of the lower situations a thin layer 2 or 3 inches thick of brownish sand of the nature of incipient hardpan is found here and there at depths of 12 to 14 inches. This layer passes abruptly into orange-colored to yellow loamy sand, sandy loam, or gravelly sandy loam below. Such areas constitute Leon soil or a close approach to that soil, but the areas are small and unimportant and for that reason were not mapped separately. In many places the surface soil consists of 12 to 14 inches of white sand containing considerable gravel, with orange or reddish-yellow heavy sandy loam beneath.

In many places, also, there are included areas of Lakewood gravelly sandy loam. These are shown by gravel symbol. They consist of practically the same kind of soil and subsoil as the Lakewood sandy loam, deep phase, except for the presence of considerable quantities of quartz pebbles an inch or less in diameter. This gravel is almost pure white, differing in this respect from the gravel of the Sassafras gravelly sandy loam, much of which has a distinct yellowish tinge.

An excavation was made on this type in the plains about 3½ miles northeast of Cedar Bridge. This showed the following characteristics

through the vertical section: Light-gray sand to about 2 inches, white sand to about 5 inches, yellow loamy sand passing at about 8 inches into yellow sandy loam and at about 10 inches into yellow friable sandy clay showing a higher content of sand and some gravel at about 22 inches, this lower part being a gravelly sandy loam, the gravel increasing with depth until gravelly sand or gravelly loamy sand was reached at about 36 to 40 inches. Below this a layer of white and yellow sand with gravel extended to about 5 feet, and beneath this there was a layer of yellow clay or sandy clay passing within about 3 inches into orange-colored sandy loam, which was underlain at a depth of about 66 inches by yellow to orange-colored sand containing a little gravel, this extending to about 7½ feet. Some of the quartz gravel in the subsoil was fully 2 inches in diameter, being larger than that commonly seen on or near the surface.

The Lakewood sandy loam, deep phase, occurs in large areas northwest of Munion Field and Cedar Bridge. It is the typical soil in the sections locally called the Plains or Pine Barrens. Smaller areas also lie in the vicinity of Lacey, Double Trouble, Union Clay Works, and Chicken Bone.

This type occupies high, well-drained areas with rolling topography. Many of the higher knolls are capped with the gravelly variation. The drainage is thorough to excessive.

Practically none of the soil is cleared. The virgin forest consists of scrub oak and pine with an undergrowth of bracken and huckleberry. On the plains the growth consists chiefly of stunted and prostrate pitch pine and scrub oak rarely exceeding 4 feet in height. Some laurel, bearberry, and the small plants of the heath family are also abundant. In other places the surface is quite bare of vegetation. The trees of the plains are very inferior to those found elsewhere.[9]

[9] The growth over the plains area consists of very scrubby pine, seldom more than 6 or 8 feet high, probably averaging less than 4 feet, and of scrub oak of even shorter growth, alone or with some mountain laurel in places. The country apparently has been repeatedly burned over, and this, it is believed, has had much to do with the stunted character of the vegetation. This year (1919) a large area was burned over, and in it nearly every little pine was killed down to the ground but not below the surface of the ground. All or practically all of the pines consist of a cluster of sprouts growing from a single rootstock. At the base of one tree which had been killed down to the ground by fire 74 young sprouts were counted. These sprouts grow in sprawling or prostrate fashion, so crowded together as to have no chance to develop into trees of any size, unless it should be by long-continued growth unchecked by fire.

With liberal additions of manure or fertilizer this soil could be used for some of the vegetables grown in the region, such as asparagus and sweet potatoes. Probably blackberries and dewberries would be the most successful crops. The soil is naturally thin, it must be understood, and where much expense is required for clearing, it is doubtful whether farming could be carried on profitably under present economic conditions, especially in localities off good roads. The fertilizer and manure needs would be expensive to meet. By increasing the humus content by growing and occasionally plowing under crops like peas and rye, the fertility could be increased somewhat, but still manure or fertilizer would be needed in liberal amounts for good yields. With available areas of better soil more favorably situated with respect to roads and markets, such as the Sassafras gravelly loam, of which there are many unused areas in the State, it would probably not be economical to undertake extensively the clearing and utilization of the plains areas of this soil.

With its humus-free white soil, land of this type in general can possess only a low degree of inherent productivity, but with some manurial treatment, as applications of manure or fertilizer, as an initial stimulant to plant growth, it can be made to grow soil-improving crops, as rye or cowpeas, or possibly clover if heavily limed with burnt lime, and in this manner the humus content of the soil can be increased and the land eventually brought up to a productive condition suitable to the production of some of the farm crops. Care probably should be taken not to plow up too much of the raw subsurface material in any single year—not more than about 1 inch of the material lying below the plow depth of the preceding year. Fertilizers or manure will be required for good yields.

ST. JOHNS SAND.

The typical St. Johns sand is a black sand about 7 inches deep, overlying white sand to a depth of about 16 inches. At this depth a dark-brown, compact layer of sand about 4 inches thick, having the character of incipient hardpan, is encountered, below which is found dingy orange-yellow sand to a depth of 36 inches or more. The hardpan layer contains considerable organic matter and some iron. A sample of this layer analyzed 1.43 per cent organic matter and 0.20 per cent iron. The lower sand stratum is usually saturated with water and flows slowly into excavations, resembling "quicksand" in this respect. A considerable proportion of coarse quartz fragments appears in the lower subsoil of some areas. The material from the surface down is decidedly acid in reaction.

As mapped, the type shows some variation. In places the surface soil is loamy, owing to the presence of organic matter, and is underlain at about 5 to 10 inches by brownish to grayish sand passing abruptly into white sand, below which the dark coffee-brown to nearly black, rather compact sand is found at depths varying from 10 to 36 inches. In the lower depths of the compact stratum the soil is somewhat looser and passes into yellow or orange-colored sand, with gray to white sand or fine gravel and sand beneath. In places no whitish material is present between the black surface soil and the brown hardpan layer.

There are included with the St. Johns sand, as mapped, small areas of Scranton sandy loam and Portsmouth sand. In the former no hardpan layer is encountered, and the subsoil is a yellow sandy clay. The Portsmouth sand consists of black sand or black mucky sand overlying whitish to gray sand, which is normally saturated with water. There are also small areas of Leon sand and Swamp, which have been included within this type on account of their small extent.

The St. Johns sand is an extensive soil. It occurs in large areas in the vicinity of Retreat, Magnolia, Hampton Park, Rockwood, and

Atsion. It is developed in depressions and in areas adjacent to or at the heads of swamps. The drainage is poor, and much of this type is under water during periods of excessive rainfall.

The type is important agriculturally only in the production of cranberries. Large areas favorably situated near swamps have been cleared and bogs laid out. About 25 per cent of this soil is utilized in this manner, the remainder being uncleared. The forest consists of pine and maple, with a thick undergrowth of huckleberries, azalea, and other shrubs.

Artificial drainage will be neccessary for any satisfactory cultivation of this soil, and liberal additions of manure or complete fertilizer mixtures will be required, if good yields are to be expected. Heavy liming, probably from 1 to 2 tons of burnt lime or twice this amount of ground limestone per acre, also may be required for best results with land of this kind. Crops which may be expected to succeed best, according to observations here and elsewhere on the same or similar soil, are cabbage, lettuce, onions, cauliflower, and strawberries. It is doubtful, however, whether it would prove profitable to go to a great deal of expense to drain this soil on any extensive scale for use for farming under present economic conditions. There is much land still unused in the State, which could be farmed with perhaps as good or better returns, and which would not require extensive canaling and ditching, as would this type.

PORTSMOUTH SANDY LOAM.

The Portsmouth sandy loam is a black mucky sandy loam, underlain at 8 to 10 inches by whitish sandy loam to sandy clay, with gravel and a higher sand content in the lower subsoil. This type, as mapped, is highly variable both in the soil and subsoil. In places the surface soil is gray, approaching the characteristics of the soils of the Elkton series, mapped in the Camden area on the west. In places the subsoil at about 15 inches is a mottled gray and yellow sandy loam to sandy clay. In other places the surface soil is a heavy black, mucky, loamy sand with whitish or mottled gray and yellow sandy loam beneath. In some areas, as at Tabernacle, a rather compact coffee-brown layer of sand of a hardpan nature is encountered at about 8 to 10 inches, this passing at about 16 or 18 inches into yellow or whitish sand or light sandy loam. These areas represent inclusions of St. Johns sand or sandy loam. Some Portsmouth sand, Scranton sandy loam, and Leon sand on hummocks are also included with this type, as mapped.

Only a very small part of the Portsmouth sandy loam is cleared. It is probably best suited to strawberries, cabbage, and lettuce. When limed and manured or fertilized good crops of corn and grass

are obtained. Some small areas have been diked and are utilized as cranberry bogs.

The forest growth is thick and includes oaks of several species, maple, gum, birch, and a few scattering pines. Wintergreen or teaberry is abundant, and in places there is considerable holly and laurel. Azalea, ferns, high-bush huckleberry, and a variety of moisture-loving shrubs are common plants on the Portsmouth soils of New Jersey.

When drained this soil has considerable agricultural possibilities. Tile drains probably will give better all-round drainage results than open ditches, but the latter have frequently been employed effectively in draining this kind of land.

In reclaiming this land liberal additions of lime, probably from 1 to 2 tons per acre of burnt lime or twice as much ground limestone should be applied. Manure or commercial fertilizer also will be needed in moderate to fairly heavy additions in order to get best results with any of the crops to which the soil is adapted.

PORTSMOUTH LOAM.

The Portsmouth loam is a black mucky loam, about 10 to 12 inches deep, overlying whitish sandy loam to sandy clay, with some pale-yellow mottling in the deep subsoil. In some parts of the type, as it has been mapped, the soil is a black mucky loam with considerable sand 10 or 12 inches deep, while the subsoil is a white saturated sand, which in exposed sections, as in ditch banks, caves and flows in the manner of quicksand. There are some included small patches of St. Johns loam, such as those about a mile northwest of Whitesville. Here the soil consists of a black loam, 6 to 10 inches deep, overlying whitish or light-gray loamy sand to sandy loam, with a brown sandy hardpan layer at about 20 inches. In places the hardpan layer occurs much nearer the surface and grades down into yellowish or orange-colored sandy material.

This type is not extensive, and therefore of little agricultural importance. It occupies low, depressed areas, frequently about the heads of streams where drainage is imperfect. Most of it is still forested with scrub pine and oak and a variety of moist-land shrubs. When drained and farmed good yields of timothy hay and corn are obtained. Cabbage is also grown to some extent on this soil.

This soil is naturally rich in organic matter, and when drained and heavily limed it is likely to prove a good soil for strawberries, corn, grass, and late truck crops. It is said not to be particularly adapted to potatoes. Strawberries, lettuce, and onions are successfully grown on this type of soil in other regions.

SCRANTON SANDY LOAM.

The Scranton sandy loam consists of a black mucky loamy sand or sandy loam, having a depth of 8 or 10 inches, underlain by yellow or orange-yellow sandy loam or friable sandy clay, becoming more sandy with depth. The surface soil of this type is similar to that of the Portsmouth and St. Johns soils, while the subsoil closely resembles the subsoil of the imperfectly drained phases of the Norfolk soils. In places there is some gray and orange-yellow mottling in the lower subsoil, which is usually moist.

This soil occupies flat, rather low situations having imperfect drainage, as in the section near the shore of Barnegat Bay. It is not important either in extent or agricultural use. Except along the bay shore, most of it is in forest. The native growth consists principally of oaks, pine, cedar, maple, black gum, birch, smilax, and holly.

This type could be greatly improved by underdrainage and by liberal applications of lime. It seems to be well adapted to strawberries, and good grass and corn crops are also obtained. Cabbage, lettuce, cauliflower, and a number of other vegetables are grown on similar soil in some of the southern trucking districts. Liberal applications of manure or commercial fertilizer may be expected to increase the yields markedly.

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

Mechanical analyses of Scranton sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
170857	Soil	4.3	22.2	13.5	23.8	8.6	16.4	11.2
170858	Subsoil	1.8	20.2	14.9	27.1	9.5	17.6	8.9

LEON SAND.

The typical Leon sand consists of a light-gray loose sand, 3 to 5 inches deep, underlain by white loose sand which, at depths ranging from 10 to 16 inches, is underlain by a compact hardpan layer, 8 to 10 inches thick, of dark-brown or coffee-brown sand. Below this layer the material is an orange or yellow sand or loamy sand to 36 inches or more. The hardpan in places is found at depths below 16 inches. Some areas of St. Johns sand are included with the Leon sand.

The surface of this type is characteristically flat, but in places it is slightly hummocky. This soil lies at a somewhat lower level than the Lakewood sand, and in somewhat higher and better drained positions than the St. Johns sand. The drainage is, however, poor.

None of this type is cleared. The virgin forest is chiefly scrub pine and oak, with considerable huckleberry and bracken. The trees are stunted, owing, it is believed, to recurring fires. Soil of this kind is generally highly acid, and requires liming for crops other than the acid-tolerant crops, such as potatoes, strawberries, and tomatoes. It may have about the same value as the Lakewood soils, but it is not known just how the hardpan layer affects the growth of crops here. For successful production of any crop much manure or fertilizer will be needed.

FRENEAU LOAM.

The Freneau loam is a brown to dark-brown loam, about 8 to 10 inches deep, overlying mottled rusty-brown, brown, and black loam, which at depths of about 20 to 24 inches is underlain by black or mottled black, bluish, and greenish loam which is underlain at about 30 inches by dark bluish green and black sandy loam or by mottled bluish, greenish, and rusty-brown loam, sandy loam, or silt loam. There are many variations in color and texture in this soil. Some of the areas mapped consist of Freneau sandy loam and clay loam. In other places the surface soil is a black muck overlying heavy sandy loam, loam, or material of other texture containing varying quantities of glauconitic sand.

This is not an extensive type, and it is unimportant agriculturally. It occupies first bottoms of streams, and the material consists of alluvium which has been washed mainly from near-by areas of Sassafras and Collington soils. The drainage is imperfect, and during heavy rains much of the type is under water. The subsoil is always saturated.

Only a small part of this type is cleared, and very little of this is farmed. It is used chiefly as pasture. The native timber growth is heavy with considerable undergrowth. When drained and limed this type would probably prove a strong soil especially adapted to corn, timothy, and clover.

SWAMP.

The areas classed as Swamp represent various soil materials almost if not quite continuously in a state of saturation. The material predominating consists of black muck, underlain at depths ranging from about 15 to 30 inches by whitish sand. Some areas included consist of muck to depths of 2 to 3 feet, and the surface material is brownish peat, as south of the Butler farm on Popes Branch. In the mapping of large areas of this type, especially about the heads of streams and in broad stream bottoms, there are included islandlike areas of Portsmouth sandy loam, St. Johns sand, and Leon sand.

Swamp occupies a considerable area in all parts of the survey, being especially important in the western half. It occupies large, broad,

flat areas adjoining and about the heads of streams. Where cleared, drained, and diked, it is used extensively for cranberry bogs, probably 25 per cent of the total area being in bogs at the present time.

Much of the swamp is still forested, chiefly with white cedar, black gum, maple, bay, birch, and some pine. Holly, azalea, smilax, blueberries, numerous other shrubs, and vines form a very dense undergrowth. Ferns, grasses, sedges, and sphagnum moss flourish in some areas.

Swamp with a good stand of cedar sells at the present time for $200 to $400 an acre and even higher. Cranberry bogs bring from $300 to $500 an acre, and some have sold as high as $1,000. When the timber is poor and the land uncleared, $20 to $50 an acre is the average value.

Where the land can be economically drained, corn, cabbage, lettuce, strawberries, and timothy should prove successful crops.

TIDAL MARSH.

A continuous strip of Tidal marsh, ranging from about one-half mile to 5 miles in width, extends along Barnegat Bay from Bay Head to Tuckerton on the east, and for many miles up the Mullica River and other streams. Typically developed, this marsh consists of a dark-colored, oozy material of silty clay containing in places much vegetable matter. In the northern part of the area, especially where this salt marsh adjoins areas of Coastal beach, a sandy phase of marsh is found consisting of black sand overlying white sand, and supporting a rather short growth of marsh grasses.

Tidal marsh is very extensive, but without value except for the production of salt hay. The marsh grasses are cut and removed in the summer season during periods of low tide or in the winter when the ground is frozen. Cut before frost they make a better quality of hay, which may be fed to horses. The hay harvested in winter is of poorer quality and used as packing material, as in the crating of glass.

Costly diking and drainage operations, probably including pumping, would be necessary to put this character of land in shape for farming, and until the area of available well-drained land has been brought more completely under cultivation, it would appear unwise to attempt the extensive reclamation of these marshes for agriculture.

Land similar to that with silty clay texture has been reclaimed, however, elsewhere in the State of New Jersey, and successfully used for timothy, strawberries, corn, and potatoes. The variation with a sand subsoil, found in the northern part of the area, would not be expected to prove as productive as the typical heavy soil. The strips along the streams probably could be most effectively handled, if at any time reclamation should be undertaken.

COASTAL BEACH.

Along the seacoast there is a strip of Coastal beach averaging about one-fourth mile in width and lying between the open sea and the bays and sounds. The material consists mainly of white sand of varying texture, with a small admixture of black and yellow particles. This land consists of a sloping wave-beaten beach, at the back of which is a narrow strip of hillocky dune sand that in places has been partly fixed by grass and other vegetation. The dunes slope toward the mainland into a flat, wet, whitish sand, in places grading into the sandy variation of Tidal marsh.

Coastal beach is not considered agricultural land. The native vegetation consists of sea-beach sandwort and sea-sand reed.

SUMMARY.

The Chatsworth area is situated in the southeastern part of New Jersey. It includes all of Ocean County, about half of Burlington County, one-third of Atlantic County, and small parts of Monmouth and Camden Counties.

The topography is mainly flat and level to gently rolling, with a range in elevation from sea level to 200 feet above. The general slope is to the east and southeast to the Atlantic Ocean and to the northwest to the Delaware River. Most of the area has adequate drainage, but there are swamps and many depressions and flats that have imperfect drainage.

Early settlers first established trading posts in the Chatsworth area early in the seventeenth century, but counties were not definitely formed until a hundred years later. The present population consists chiefly of native stock. The density of population is greatest in Burlington County and least in Atlantic County. The towns are mostly along the seacoast and railroads, and in the large river valleys. Few persons inhabit the central part of the area.

Tuckerton, Pemberton, Manasquan, and Egg Harbor City are towns of importance. The principal resort towns are Lakewood, Toms River, Spring Lake, Belmar, Point Pleasant, Island Heights, Seaside Park, and Beach Haven.

The area, as compared with other parts of New Jersey, is poorly supplied with railroads. The wagon roads in the agricultural sections and the three main trunk line highways are good, but the rest of the roads are poor and unimproved. Telephone service is available to all the developed sections.

New York City and Philadelphia are the chief metropolitan markets. The seashore resorts and local markets also absorb considerable quantities of the farm products. Cranberries are shipped to markets in all parts of the United States.

The climate is unusually mild considering the latitude. Winters are rarely severe, and the snowfall is usually light. The heat and humidity of summer is tempered by the prevailing ocean breezes. Rainfall is everywhere sufficient for successful farming.

About 20 per cent of the Chatsworth area is cleared and in farms; the rest is still in forest. Agriculture is restricted to certain parts of the area where soils and conditions are most favorable. Corn, grasses, potatoes, and truck crops are among the more important agricultural products. Strawberries, blackberries, and some peaches, apples, and pears are also cash crops, and the production of cranberries is an extensive industry.

Poultry raising is important in the vicinity of Lakewood and Toms River.

Dairying is carried on extensively in the northeastern and northwestern parts of the area.

Farms of the Chatsworth area are in general only moderately well equipped. Farm practice, however, is modern, and includes crop rotation, the use of manures and fertilizers, and spraying to control insects and fungous diseases.

The Chatsworth area lies wholly within the Coastal Plain province, and the soils are predominantly sandy and derived from unconsolidated beds of clay, marl, sand, and gravel. There are represented 11 soil series, including 25 types and 5 phases, and 3 miscellaneous types.

The Sassafras soils are well drained and very productive. Eight types, ranging from loam to coarse sand, and 4 phases are mapped. The loam and sandy loam types are especially strong potato soils. The sandy types are utilized chiefly in the production of truck crops.

The Collington soils occur only in the northern part of the survey and particularly in the northwestern part. The sand, fine sandy loam, loam, and a deep phase of the sandy loam are the types mapped. Practically all these soils are cleared and under cultivation, the heavier types being used for general farm and late truck crops, and the sandier types more exclusively for trucking.

The Shrewsbury sandy loam is closely associated with the Collington soils. Practically all the type is cleared and being farmed. It is an especially strong corn soil and well adapted to other general farm crops.

The Keansburg loam, when drained, is well suited to grass and corn. Much of this type is at present used for pasture.

The Norfolk fine sand is a good trucking soil. The imperfectly drained phase of the sandy loam is used principally in growing strawberries, and cabbage and other late truck crops.

The soils of the Lakewood series are among the least productive of the survey. They occupy more than 30 per cent of the Chats-

worth area. Excepting the fine sand, practically no land composed of the Lakewood soils is under cultivation. An inferior forest growth of pitch pine and scrub oak covers most of this land.

The St. Johns sand is the most important of the imperfectly drained soils. About one-fourth of this type has been drained and diked and is used in the production of cranberries; the rest is undeveloped.

The Portsmouth loam and sandy loam are also imperfectly drained. They occupy depressions and low flat areas and have little agricultural importance. When drained, however, they are especially adapted to cabbage and strawberries. Grass and corn also do well on these soils when reclaimed.

The Scranton sandy loam is a black, mucky, imperfectly drained soil. It occupies flats, principally along Barnegat Bay. Some of this type is cleared and used in producing truck crops. It is especially adapted to strawberries.

The Leon sand is low in organic matter and unproductive. Practically all of it is in forest consisting of pitch pine and scrub oak, much of which is stunted.

The Freneau loam occupies first bottoms of streams and consists of material washed from near-by Sassafras and Collington soils. It is used chiefly as pasture land.

Swamp is an extensive type. It occupies large, broad, flat areas adjoining and at the heads of streams. Where cleared, diked and drained, it is very extensively used for the production of cranberries. Valuable stands of white cedar are found on parts of this type.

There are large areas of Tidal marsh in the area. It produces a coarse salt hay, used largely as material for packing.

Coastal beach consists of a narrow strip of sand bordering the Atlantic Ocean and the bays. Most of the ocean shore resorts are situated on this type. It has no agricultural value.

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Areas surveyed in New Jersey, shown by shading.

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