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DEPARTMENT OF CONSERVATION AND DEVELOPMENT  
STATE OF NEW JERSEY

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DIVISION OF GEOLOGY AND WATERS

HENRY B. KUMMEL, *State Geologist*

In cooperation with the United States Department of Agriculture—  
Bureau of Soils—MILTON WHITNEY, *Chief*

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**BULLETIN 22**  
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SOIL SURVEY OF THE MILLVILLE AREA,  
NEW JERSEY

BY

C. C. ENGLE, in Charge, L. L. LEE, and H. A. MILLER, of the  
Department of Conservation and Development of New Jersey,  
and AUSTIN L. PATRICK, J. M. SNYDER, and HOWARD C.  
SMITH, of the U. S. Department of Agriculture.  
H. H. BENNETT, Inspector.

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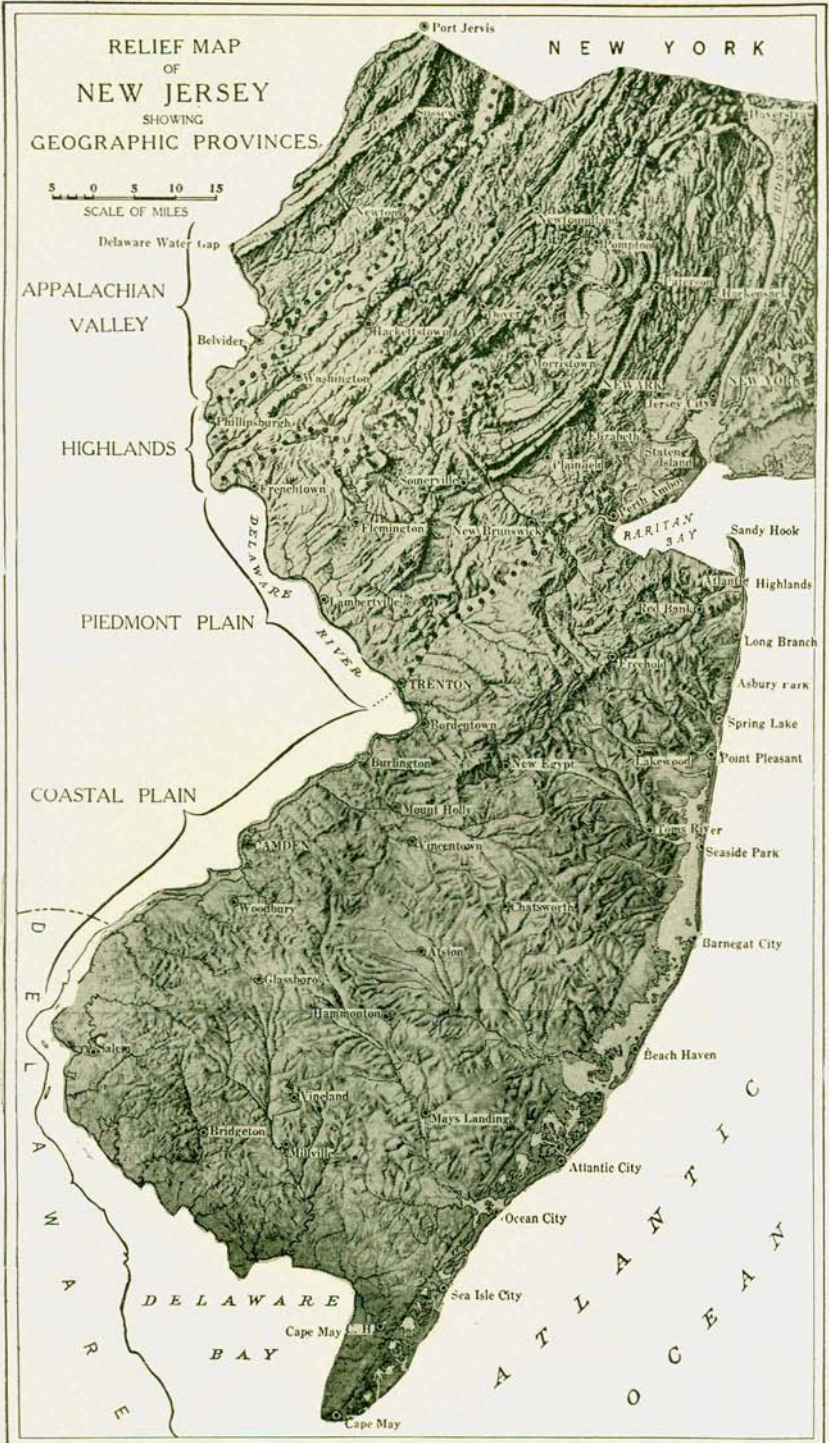
## FOREWORD.

For a number of years the Department of Conservation and Development, in cooperation with the Bureau of Soils of the United States Department of Agriculture, has been engaged in classifying and mapping the soil types of the State. The progress of the work, and the areas included in the published reports, are shown by the diagram on the back cover.

Both organizations share equally in the expense of the field work. The reports and maps are printed by the Bureau of Soils, the State Department being privileged to purchase a small edition at cost. This Department has a limited number of the reports already published for distribution to those who may have particular use for them.

HENRY B. KÜMMEL,

*State Geologist.*



GEOGRAPHIC PROVINCES OF NEW JERSEY.  
NEW JERSEY GEOLOGICAL SURVEY

U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE DEPARTMENT OF CONSERVATION AND DEVELOPMENT OF NEW JERSEY, HENRY B. KUMMEL, STATE GEOLOGIST;  
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LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., December 11, 1919.*

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of the Millville area, New Jersey, and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1917, as authorized by law. This work was done in cooperation with the Department of Conservation and Development of New Jersey.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

Hon. D. F. HOUSTON,  
*Secretary of Agriculture.*

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## MAP.

Soil map, Millville sheet, New Jersey.

## SOIL SURVEY OF MILLVILLE AREA, NEW JERSEY.

By C. C. ENGLE, In Charge, L. L. LEE and H. A. MILLER, of the Department of Conservation and Development of New Jersey, and AUSTIN L. PATRICK, J. M. SNYDER, and HOWARD C. SMITH, of the U. S. Department of Agriculture.—Area Inspected by HUGH H. BENNETT.

### DESCRIPTION OF THE AREA.

The Millville area comprises the extreme southern part of New Jersey. It includes all of Cape May County, two-thirds of Atlantic County, about three-fourths of Cumberland County, and small parts of Gloucester and Salem Counties. It is bounded on the north by parallel  $39^{\circ} 32'$  north latitude, on the west by meridian  $75^{\circ} 12'$  west longitude, and on the other sides by Delaware Bay and the Atlantic Ocean. Excluding the Cape May Peninsula, it has an average length from east to west of 38 miles and an average width from north to south of 25 miles. The distance from the north boundary to the tip of the Cape May Peninsula is about 42 miles. The survey comprises all of atlas sheets No. 35, 36, and 37 of the New Jersey Geological Survey, and has an extent of 1,002 square miles, or 641,280 acres.

The Millville area as a whole is flat to gently undulating, and characterized by a lack of relief. The northwestern part and the section along the Maurice River show the most relief. They merge gradually into a flat belt, 3 to 8 miles wide, bordering Delaware Bay. The eastern half of the area, including the Cape May Peninsula, is more nearly level, but there is no such distinct belt of low, flat upland along the Atlantic shore as along the north side of Delaware Bay. There are many large, swampy depressions throughout the area, the most notable lying near Dividing Creek, Dennisville, and Weymouth.

The range in elevation is from sea level to a maximum of 141 feet, which is the elevation of a knob  $2\frac{1}{2}$  miles south of Husted, in the northwestern corner of the area. The general slope is to the south, toward Delaware Bay, and to the east toward the Atlantic Ocean.

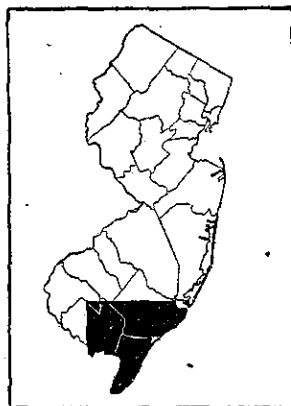


FIG. 1.—Sketch map showing location of the Millville area, New Jersey.



(See Pl. I.) The drainage is separated by a divide which extends in a general southerly direction from Landisville through Halberton, Woodbine, Sea Isle Junction, and Cape May Court House to West Cape May. This divide is not a distinct ridge at any point. It is generally a broad, smooth belt, varying in width from about 4 miles in the northern part of the area to 1 mile or less on the lower end of the Cape May Peninsula, and only slightly elevated above the surrounding country.

Three important rivers—the Tuckahoe, the Great Egg, and the Mullica—receive most of the Atlantic drainage. They have cut their way to tide level for a distance of 15 to 20 miles back from the ocean, and are sluggish and meandering. They and their tributaries are bordered by, and have their sources in, flat, swampy areas. The Tuckahoe and Great Egg Rivers empty into Great Egg Bay just west of Ocean City. The Mullica River, lying outside the area surveyed, empties into Great Bay just north of the area surveyed. The Maurice River collects most of the drainage to the west of the divide, and empties into Maurice River Cove, a part of Delaware Bay. It is a tidewater stream 15 miles inland to Millville, where it forms the outlet of Union Lake. Dividing Creek and Dennis Creek also receive drainage from the Delaware Bay basin.

Nearly all parts of the Millville area have adequate drainage except certain flat regions on the main divide, such as those in the vicinity of Woodbine and Richland and west of Burleigh, and the flat belt bordering Delaware Bay. Much of the flat region about Tuckahoe and Marshallville can also be described as imperfectly drained.

There are a number of small lakes (mill ponds) throughout the area. The outlets of two of the larger ones, Union Lake at Millville and the one at Mays Landing, supply a small amount of power which is used for local industries.

The Atlantic shore is indented by numerous bays and inlets which provide harbor facilities for the resorts which occupy nearly the entire coast line. The most important of these are Cold Spring Inlet north of Cape May City, Great Egg Bay at Ocean City, Absecon Inlet and Bay at Atlantic City, and Great Bay in the extreme north-eastern part of the area.

In the forested areas the growth<sup>1</sup> consists mainly of pine and oak. Pitch pine (*Pinus rigida*) is the most abundant of the pines. Short-leaf or yellow pine (*Pinus echinata* Mill) is important locally, as in the western and southwestern parts of the area. The common oaks are the blackjack oak (*Quercus Marylandica* Muench), scrub oak

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<sup>1</sup> Botanical data from 177th Review of N. J. State Museum, 1910, and specimens identified by Bureau of Plant Industry, U. S. Dept. of Agr.

(*Q. ilicifolia* Wang.), post oak (*Q. stellata* Wang.), rock chestnut oak, (*Q. prinus* L.) black oak (*Q. velutina* L.), and white oak (*Q. alba* L.). Much of the growth is bushy or scrubby, but some of the trees reach a diameter of 6 to 8 inches and are 30 to 35 feet in height. There are several kinds of forest growth in the upland. The first consists of medium to tall pine with a thick undergrowth of scrub oak and an abundance of huckleberry. The second consists of a more open growth in which fairly tall oaks and pines are nearly equal in number. Other areas are covered with a dense growth of oak alone, both a bushy or scrubby sort and many of larger size, averaging perhaps 30 feet in height. Plate II shows a quite typical woods scene, and illustrates well the character of the underbrush. There is much sassafras and some hickory, and in the southern part of the area holly is plentiful. Huckleberry covers the ground more or less thickly nearly everywhere. Other species of greater or less importance are bracken (*Pteridium aquilinum* L.), greenbrier (*Smilax glauca* Walt.), sweet fern (*Comptonia asplenifolia* L.), sheep laurel or mountain laurel (*Kalmia angustifolia* L.), staggerbush (*Pieris marina* L.), arbutus (*Epigaea repens* L.), and wild indigo (*Baptisia tinctoria* L.). There are also many grasses, sedges, and rushes. There is little difference in the natural vegetation on the several upland soils.

Nothing definite is known in regard to the settlement of Cape May County prior to 1691, but about this time a number of settlers came from Long Island, having been attracted chiefly by the excellent whale fishing in Delaware Bay. The population has steadily increased from 1,004 in 1738 to 5,324 in 1840, and 19,745 in 1910. Seventy-nine per cent of the population consists of native-born white persons, 13.7 per cent of foreign-born white persons, and 7.3 per cent of Negroes. The foreigners are mainly of Russian, Italian, German, Irish, or English stock. The county is most thickly settled on the peninsula, along the Atlantic border, along the north shore of Delaware Bay, and along the northern border. The northwestern part is sparsely settled. The population averaged 74.5 persons to the square mile in 1910. There are no towns in the county with a normal population of more than 2,500, hence the entire population is classed as rural by the census. There are, however, a number of resorts which have a large summer population, notably Cape May City and Wildwood. Cape May City, with a normal population of 2,471, and Cape May Court House, with a population of about 900, are of local importance as agricultural centers. Other towns of more or less importance as seaside resorts are Ocean City, Sea Isle City, and Stone Harbor.

Atlantic County was formed from the eastern part of Gloucester County in 1837. The early settlers were attracted by the large tracts

of cedar, oak, and pine, and by the abundance of fish, oysters, and clams in the adjacent waters. The population of the county in 1910 was 71,894. Sixty-nine per cent of the inhabitants were native-born white persons, 15.9 per cent foreign-born white persons, and 15 per cent colored. The foreign nationalities represented are mainly Italian, German, Irish, Russian, and English. Only 22.6 per cent of the population of Atlantic County is rural, and on the whole it is sparsely populated, especially in the central portion. The average number of rural inhabitants per square mile is only 28.6, and the farming communities are concentrated along the railroads and along the eastern and southern borders. The large proportion of foreigners is partly explained by the cosmopolitan character of the large resort towns, but there are many farming communities made up largely of nonnative stock. Atlantic City, with a resident population of 46,150, is the largest city in the Millville area. It is the largest summer resort in the eastern part of the United States and has a large patronage in the winter as well. Mays Landing, the county seat of Atlantic County, is one of the oldest towns in the area, having been founded in 1710. It has a large cotton mill but is not important as an agricultural center. Its population in 1910 was 1,389. Pleasantville, with a population of 4,390, and Egg Harbor, with 2,181 inhabitants, are of some importance as farming centers and also industrially.

Cumberland County was formed from part of Salem County in 1747. Its population in 1840 was 14,363, and in 1910, 55,153. The early settlers in this county were attracted by the forests and the maritime and agricultural opportunities. They came largely from New England and Long Island. The Swedes formed settlements at Dorchester and Leesburg between 1637 and 1654. In 1910 85.7 per cent of the population of Cumberland County consisted of native-born white persons, 9.5 per cent of foreign-born white persons, and 4.8 per cent of colored persons. The principal foreign nationalities represented are Italian, German, Russian, Irish, and English. The rural population comprises 42.1 per cent of the total, and averages 46.4 persons per square mile. These figures would be less for the eastern two-thirds of the county which is included in the present survey. This eastern two-thirds is most thickly populated in the southern, northern, and western portions. The east-central part and much of the region east, south, and southeast of Millville are very thinly settled, and a large part of the land has not been cleared. Millville is one of the largest inland towns in southern New Jersey, with a population of 12,451 in 1910. It is chiefly an industrial center. Bridgeton, just west of the area, the county seat of Cumberland County, is an important agricultural and manufacturing town, with a population in 1910 of 14,209. Vineland is a thriving manu-

facturing and agricultural center, with a population in 1910 of 5,282. Other small towns of more or less importance agriculturally are Port Norris, which is near the important oyster-shipping point of Bivalve; Cedarville; Newport; Dorchester; and Leesburg.<sup>1</sup>

The transportation facilities of the area are very good. The area is served by seven railroads. A line of the Central Railroad of New Jersey running through Landisville and Vineland from Bridgeton hauls much fruit, truck, poultry, and eggs to New York from the Vineland district and elsewhere. A branch extends to Bivalve, an important oyster-shipping point at the mouth of the Maurice River. There are four lines of the West Jersey & Seashore Railroad, one crossing the northwestern corner of the area and ending at Bridgeton; a second, extending to Millville and Cape May, and connecting at Manumuskin Station with Bivalve and at other places with various shore resorts; a third, electrified, reaching to Richland, Mays Landing, and Atlantic City; and a fourth serving Egg Harbor and Atlantic City. The Atlantic City Railroad has two lines in this area. One runs south through Richland to various Atlantic shore resorts, and terminates at Cape May. A second touches Egg Harbor and terminates at Atlantic City. There are several trolley lines, one connecting Vineland, Millville, Bridgeton, and Port Norris, and another connecting Atlantic City and Pleasantville with shore points to the south.

The public highways of the area as a whole are in excellent condition. Nearly all the main roads are improved, largely with gravel, and they are wide and well graded. They are free from stones and are kept well scraped during the wet months of the year. These roads have one disadvantage; they become soft and easily rutted in thawing weather.

All the settled parts of the area are supplied with telephone service.

The larger streams are navigable for small craft and barges 5 to 15 miles up their courses. Prior to the railroad building, which took place about the middle of the nineteenth century, nearly all the transportation from the inland region to the cities was by water.

<sup>1</sup> Since this report was written the preliminary announcement of the population of Cape May, Atlantic, and Cumberland counties and their civil divisions in 1920 has been issued by the Bureau of the Census, as follows: Cape May County, 19,460; urban, 8,301; rural, 11,159; Cape May City, 2,999; Wildwood, 2,790; Ocean City, 2,512; Woodbine, 1,406; West Cape May, 967; North Wildwood, 807; Sea Isle City, 564; Avalon, 197; Wildwood Crest, 161; Stone Harbor, 159; Cape May Point, 121; South Cape May, 10.

Atlantic County, 83,883; urban 65,608; rural, 18,275; Atlantic City, 50,682; Hammononton, 6,417; Pleasantville, 5,887; Egg Harbor, 2,622; Ventnor, 2,203; Absecon, 702; Folsom, 217; Linwood, 681; Longport, 84; Margate City, 249; Northfield, 1,127; Port Republic, 340; Somers Point, 800.

Cumberland County, 61,348; urban, 35,813; rural, 25,535; Bridgeton, 14,323; Millville, 14,691; Vineland, 6,799.

The chief markets within the area are the many shore resorts such as Atlantic City, Ocean City, Wildwood, and Cape May. A large amount of food products is hauled to these places by motor truck and railroad. Much produce is consumed also by such towns as Vineland, Millville, Bridgeton, Pleasantville, Egg Harbor, and Cape May Court House, and the smaller towns afford local markets. Outside the area New York City, 190 miles away, is the chief market, with Philadelphia second.

Most of the agricultural communities are provided with canning plants. Bridgeton, just outside of the area, has nine such plants. All of them can tomatoes, and five in addition can one or more of the following: Kieffer pears, pumpkins, beans, squash, beets, and rhubarb. In Cedarville there are two canning houses, one of which puts up tomatoes and peas, and the other tomatoes, peas, and beets. Newport has a tomato-canning plant. Vineland has one plant, canning tomatoes, peaches, and berries. A plant in Fairton, just outside the area surveyed, on the west, cans tomatoes and cherries. In Cape May there are six canning factories, the principal products being tomatoes, peas, and lima beans. A plant at Rio Grande cans tomatoes. There are two canneries at Goshen and two at Eldora, handling tomatoes, pumpkins, and lima beans. At Egg Harbor, in Atlantic County, a plant cans tomatoes and pears. There are two tomato-canning plants at Landisville, and one of these in addition cans small fruits and peaches.

#### CLIMATE.

The Millville area has a milder climate, with a longer growing season, than inland regions of similar latitude. The winters are much milder than in northern New Jersey, although the high humidity often renders the cold of the fall and winter very penetrating. The heat of summer is for a similar reason often oppressive. The snowfalls are usually light, and the snow generally melts soon. Along the shore and for several miles inland the modifying influence of the ocean breezes is felt, and their prevalence has contributed to giving the many shore resorts their wide popularity. During periods of high temperature, however, the land breezes are oppressive even in the shore region.

There is considerable variation in the length of growing season in different parts of the area, as can be seen from the table below, showing records from four weather bureau stations. At Vineland the average length is only 185 days, while at Cape May the average is 231 days. This long season enables the farmers to make very early plantings in the spring, and to rely on maturing crops late in the fall.

*Average and extreme dates of killing frosts, Millville area.*

Average length of growing season (days).	Weather Bureau station.	Average date of last in spring.	Average date of first in fall.	Latest recorded in spring.	Earliest recorded in fall.
208	Atlantic City.....	Apr. 10	Nov. 4	Apr. 25	Oct. 1
187	Bridgeton <sup>1</sup> .....	Apr. 19	Oct. 23	May 12	Oct. 1
231	Cape May.....	Mar. 30	Nov. 16	Apr. 11	Nov. 1
185	Vineland.....	Apr. 18	Oct. 20	May 22	Sept. 22

<sup>1</sup> Just west of the area.

Complete climatic data for two stations within the area, Vineland in the north and Cape May in the south, are given in the following tables:

*Normal monthly, seasonal, and annual temperature and precipitation at Vineland.*

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1914).	Total amount for the wettest year (1902).
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December.....	34.4	68	-5	3.84	6.26	6.85
January.....	32.0	71	-11	3.77	4.17	3.81
February.....	32.5	71	-13	4.05	2.47	7.37
Winter.....	33.0	71	-13	11.66	12.90	18.03
March.....	40.3	87	-6	4.16	2.02	4.45
April.....	50.7	97	21	3.34	3.23	3.61
May.....	62.2	98	29	3.77	1.44	1.35
Spring.....	51.1	98	-6	11.27	6.69	9.41
June.....	71.6	102	41	3.53	1.46	8.16
July.....	78.4	105	47	4.51	4.22	3.68
August.....	73.6	104	46	4.97	5.20	2.10
Summer.....	73.9	105	41	13.06	10.98	13.94
September.....	66.9	101	32	3.85	.28	5.44
October.....	55.4	92	22	3.46	1.66	5.37
November.....	43.9	80	12	3.30	1.88	3.72
Fall.....	55.4	101	12	10.60	3.82	14.53
Year.....	53.3	105	-13	46.59	34.39	55.91

*Normal monthly, seasonal, and annual temperature and precipitation at Cape May.*

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1895).	Total amount for the wettest year (1903).	Snow, average depth. <sup>1</sup>
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	38.0	64	10	3.78	2.33	3.52	3.4
January.....	34.1	65	2	3.37	3.51	4.45	8.5
February.....	34.1	64	5	3.39	1.68	5.65	8.6
Winter.....	35.4	65	2	10.54	7.52	3.62	20.5
March.....	40.8	68	12	3.91	3.34	6.25	2.9
April.....	48.4	83	28	2.99	3.68	2.40	0.1
May.....	58.6	91	41	2.99	2.85	1.13	.....
Spring.....	49.3	91	12	9.80	9.87	9.78	3.0
June.....	67.7	95	46	3.04	0.93	4.48	.....
July.....	73.4	94	55	3.78	2.84	6.49	.....
August.....	73.4	95	53	4.26	0.86	6.70	.....
Summer.....	71.5	95	46	11.08	4.63	17.67	.....
September.....	69.0	92	42	3.00	0.49	4.66	.....
October.....	59.6	82	34	3.30	2.41	4.67	.....
November.....	48.2	74	24	3.22	2.31	1.93	0.6
Fall.....	58.9	92	24	9.52	5.21	12.26	0.6
Year.....	53.7	95	2	41.03	27.23	53.33	24.1

<sup>1</sup> Record for 16 years at Cape May Court House.

The mean seasonal temperatures at these two stations vary from 1.8° to 3.5°. However, the mean spring and summer temperatures are highest at Vineland, while the mean fall and winter temperatures are highest at Cape May City. The lowest temperature recorded at Vineland is 13 degrees below zero, while the lowest at Cape May City is 2 degrees above. The highest temperature recorded at Vineland is 105° F., and at Cape May, 95°. The difference illustrates the tempering influence of the ocean on both the summer and winter temperatures.

The precipitation is always adequate for maturing crops if not unfavorably distributed. Occasionally there are periods of drought, during which crops suffer, especially on the sandy soils. In all parts of the area the three months of greatest rainfall are June, July, and August. The mean annual precipitation at Vineland is 46.59 inches, and at Cape May, 41 inches.

The driest year on record in the whole area was that recorded at Cape May in 1895, when only 27.23 inches of rain fell, while the wettest was recorded at Atlantic City in 1903, when the precipitation amounted to 61.11 inches.

#### AGRICULTURE.

The early settlers in this region were probably attracted more by the fine fishing and whaling in the near-by waters and by the timber resources and the opportunities for shipbuilding than by the agricultural possibilities of the region. The first crops grown were vegetables, corn, wheat, oats, and rye. The settlements were confined mainly to points easily reached by water, but with the establishing of glass factories, iron foundries, and other industries, wagon roads and later railroads were extended into the inland sections.

The agriculture of the area has followed the development of markets, and with the growth of large centers of population in the east and the large resorts along the Atlantic shore there has been a falling off in the production of general farm crops and an increase in trucking. The change between 1880 and 1910 is illustrated in the census data for Cape May County. This county lies wholly within the area surveyed and fairly represents the included portions of Atlantic and Cumberland Counties.

From 1880 to 1910 corn decreased in acreage from 4,996 to 4,090 acres, hay from 4,302 to 3,587 acres, wheat from 1,543 acres to zero and oats from 335 to 24 acres, while Irish potatoes increased from 442 to 847 acres, and sweet potatoes from 301 to 445 acres. In 1880 about 94 per cent of the cultivated acreage was devoted to corn, hay, wheat, and oats, while by 1910 the percentage was reduced to 72. The acreage formerly devoted to wheat has been entirely supplanted by truck crops, and the acreage withdrawn from the other general farm crops has been similarly absorbed. When wheat growing was important there were a number of local grist mills in operation. In Atlantic County<sup>1</sup> cereal production never was as important as in Cape May and Cumberland Counties. The corn acreage in 1910 was practically the same as in 1880, while the acreage in hay was larger. The other cereals have given way to an increased acreage in sweet potatoes, Irish potatoes, peaches, small fruits, and vegetables. Much more attention is also given to poultry raising. In Cumberland County a similar change toward trucking has taken place, though in a smaller degree.

<sup>1</sup> Reference to Atlantic and Cumberland Counties, hereafter will mean those portions lying within the area except when census data are quoted.



There has been a gradual increase in the value of farm property in this area, except between 1890 and 1900, when farm values were low. The value of farm animals and implements also shows a gradual increase, and land values nearly doubled between 1900 and 1910. In Atlantic County the total value of farm animals has fallen off greatly since 1880. The census of that year reports domestic animals as representing 20.6 per cent of the total farm value, while by 1910 the figure had been reduced to 6 per cent. The next census will no doubt show a great increase in the value of farm property, judging from present conditions.

One of the most significant changes since 1880 has been a reduction in the average size of the farms. In Cape May County the average size decreased from 95 to 66.6 acres. This has been brought about in large measure by the change to an intensive type of farming. There has been a corresponding increase in the total number of farms from 547 to 632.

The Millville area is essentially a trucking, fruit, and poultry district. According to the census for Cape May County, grains and hay constituted 22.6 per cent of the value of all agricultural products in 1909, animal and dairy products 14.6 per cent, vegetables 29.5 per cent, poultry and eggs 18.8 per cent, and fruits and nuts and other crops 14.5 per cent. In the other counties the percentages are very similar, except that in Atlantic County the proportion of fruits and nuts is much higher.

Corn is the only cereal which occupies a large acreage. The crop is fed to farm animals or sold locally. Nearly every farmer devotes 5 to 15 acres to corn. A small acreage of wheat is grown at the present time in the northwestern part of the area. Hay is grown mainly for use on the farm, little except salt hay cut from the tidal meadows being sold. The summer crop of salt-marsh hay is used for feeding horses, while the winter cutting is sold for bedding, packing, or for making foundry rope.

The most important vegetable crops in Cape May County in 1909 were, in the order of their value, Irish potatoes, tomatoes, sweet potatoes, sweet corn, cantaloupes, and watermelons. Crops of less importance were green peas and beans, onions, cabbage, and many other vegetables grown for the near-by shore trade. Large quantities of Irish potatoes and sweet potatoes are shipped out of the county each year. The most important fruit and berry crops, named in the order of their value, are cranberries, strawberries, grapes, apples, peaches, and pears. Poultry and eggs are sold quite largely to the near-by shore resorts.

The leading fruit crops of Atlantic County are blackberries, dewberries, grapes, strawberries, cranberries, peaches, pears, apples, cherries, and plums. The peach industry has increased greatly in

this county in recent years. The most important vegetable crops of Atlantic County are sweet potatoes, Irish potatoes, sweet corn, tomatoes, and peppers, with cabbage, cantaloupes, watermelons, green peas, beans, asparagus, cucumbers, onions, turnips, and rhubarb of less importance. In Cumberland County much the same type of farming is followed as in Cape May County. The chief vegetables grown for sale are Irish potatoes, sweet potatoes, tomatoes, peppers, green beans, and lima beans, with sweet corn, asparagus, watermelons, cantaloupes, rhubarb, lettuce, cabbage, horse beans, and okra of some importance. Strawberries, peaches, blackberries, dewberries, grapes, apples, and cranberries are the principal fruits.

Dairying and hog raising are not carried on to any important extent. There are practically no dairy herds in Atlantic County, only three in Cape May County, and but few in Cumberland County. These dairy farms are located mainly along the Maurice River, and the stock is pastured on Reclaimed tidal marsh. High-grade Holstein cows, with a few Guernseys, make up the herds, each of which is headed by a purebred bull. Most farmers keep one cow or goat, and a few hogs, which are rarely of purebred stock. There are, however, a few purebred Berkshire hogs in Cape May County.

The poultry industry is highly developed throughout the area. The chief breed is the White Leghorn, but fowls of heavier breeds are kept for table use. In the vicinity of Vineland poultry raising is the chief industry. The average flock includes 600 to 700 laying hens, and there is an average return of about 100<sup>1</sup> eggs per hen per year. The eggs are shipped by express to New York City, and bring top prices. The green feed needed is grown in the runs, which average 8.4 acres. Other feeds are purchased. Green foods grown for winter use are *mangelwurzels*, *cabbage*, and *kale*.

Topographic variations have little influence upon crop production in this area except as they have influenced soil formation. The topography is considered to some extent in the selection of the more rolling areas for orchard sites, and it ought perhaps to be given more consideration than it receives. For example, areas well elevated above the general water level should be selected for crops which will suffer least from drought. Nearly all the crops are grown on every important upland soil, but well-defined crop adaptations are generally recognized. The sandy loams are used for corn, hay, and medium to late truck crops, as well as Irish potatoes, apples, and peaches. The sands are used for early truck, small fruits, sweet potatoes, and peaches. The swamp lands when drained are used for cranberries. In sections away from shipping points the farmers do not grow early truck crops or small fruits, even on soils

<sup>1</sup> See N. J. Agr. Expt. Sta. Poultry Survey, 1917.

adapted to them, but keep to Irish potatoes, sweet potatoes, peppers, beans, and other crops which can be hauled more or less at leisure and in large quantities.

Cereal production in the Millville area is largely confined to the growing of yellow dent corn, though some rye is grown. (Plate III, fig. 1.) Corn is planted by hand, in hills 4 feet apart each way. Planting lasts from May 20 to June 10. In many sections corn is fertilized lightly or not at all. When it is grown on sod 10 to 12 tons of manure per acre is sometimes used, and where it does not follow grass 600 to 1,000 pounds of a 3-8-10<sup>1</sup> fertilizer. The fertilizer is generally put in the hill after a little earth is thrown over the seed, and it is very seldom broadcasted. Plate III, figure 2, shows a good stand of corn on the Sassafras gravelly sandy loam.

The hay crop consists of red and alsike clover, timothy, and alfalfa. Mixed hay is commonly cut in June and October. Salt hay is cut in summer if the meadows are dry, otherwise in winter. Alfalfa is cut three and occasionally four times a year. The crop is commonly seeded about August 20, after potatoes or beans, at the rate of 25 to 35 pounds per acre. It is left down eight years or longer when the stand is good.

Early and midseason Irish potatoes are planted as soon as danger of frost is past. Two-horse planters are used in large fields, but much of the planting is done by hand. The crop is given level cultivation until about June, when it is ridged. Irish Cobbler, Rural New Yorker, Green Mountain, Mills Pride, Early Rose, Burbank, and True Fortune are the principal varieties planted for the early crop, but at least one-half of the crop is of late planting. Dakota Red Skin is the only late variety of importance. Late potatoes are planted the first week in July. Potatoes are commonly fertilized in the row, 400 to 1,600 pounds per acre of a 2-8-10 to 4-8-10 mixture being applied. Harvesting is done mainly with horse-drawn diggers.

Sweet potatoes are bedded the first week in April, the beds in many cases being warmed by artificial heat. The slips are set out the last week in May or the first in June, generally on ridges 36 to 40 inches apart and 5 to 8 inches high, the plants being placed 18 to 20 inches apart. Large fields are planted with 2-horse planters, which supply water to each plant. Other areas are planted by hand. The crop is fertilized at the rate of 1,000 to 1,400 pounds per acre, generally with a 2-8-10 mixture. One to 10 tons of manure also is added when available. Very often the manure is placed in a furrow, over which the ridge is made. Harvesting is done with special

<sup>1</sup> Three per cent nitrogen, 8 per cent phosphoric acid, 10 per cent potash. The fertilizers mentioned are those used in normal times.



FIG. 1.—RYE ON SASSAFRAS GRAVELLY SANDY LOAM.

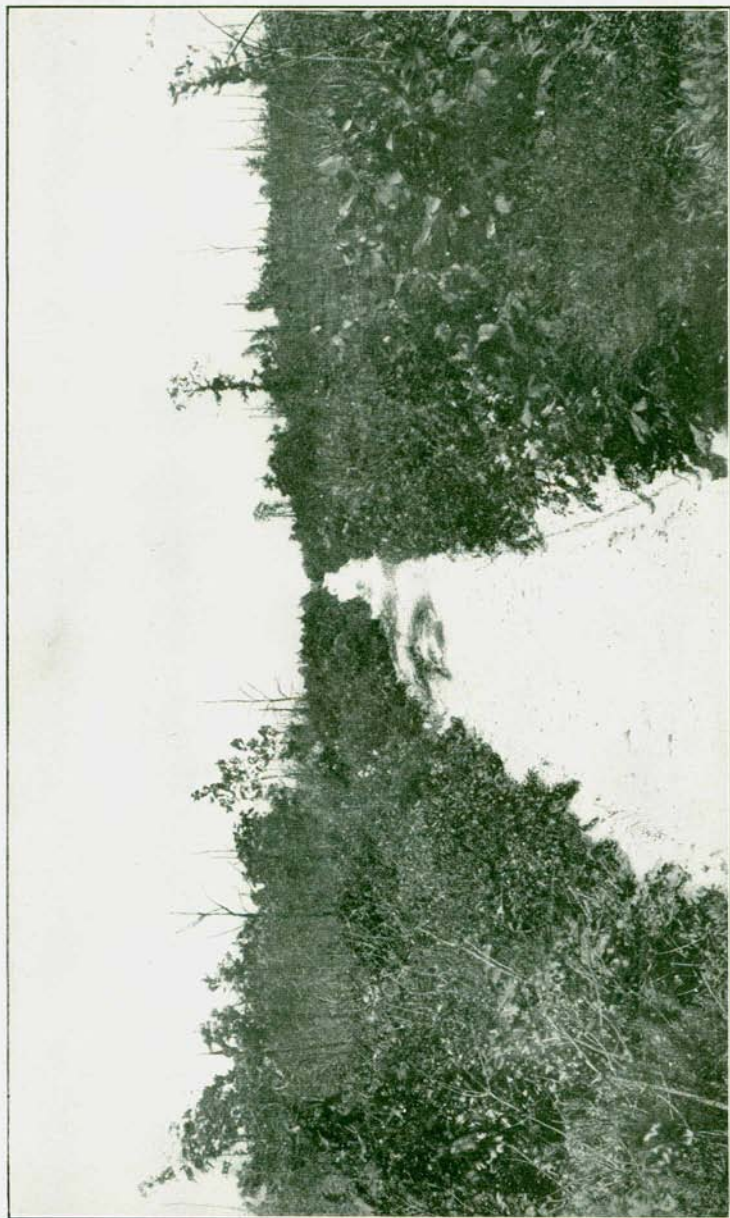


FIG. 2.—CORN ON SASSAFRAS GRAVELLY SANDY LOAM.



FIG. 3.—SWEET POTATOES ON SASSAFRAS SAND IN FOREGROUND.

Areas of Sassafras sandy loam in background.  
NEW JERSEY GEOLOGICAL SURVEY



SHOWING CHARACTER OF THE "BUSH" OR WOODS.

The undergrowth is typical, but usually there is more pine or oak of small size. Much of the wooded area is burned over annually. Some trees killed by fire are shown in this illustration.



FIG. 1.—PEPPERS ON SASSAFRAS LOAMY SAND.



FIG. 2.—POLE LIMA BEANS ON SASSAFRAS GRAVELLY SANDY LOAM, FLAT PHASE.

plows, the vines first being removed. Yellow and red skin potatoes both are grown. They are graded into primes and culls and either shipped in bushel hampers (as shown in Plate III, fig. 3) and barrels, or stored and held for winter sale.

Tomato seed is sown in hotbeds about April 15, and the plants are set out about June 1 for the late crop and May 10 for the early crop. They are set about 4 feet apart each way. Some planting is done by machine. Manure is generally used for tomatoes, at the rate of 6 to 8 tons or more per acre. The brand of fertilizer used varies considerably, but in normal times averages about 2-8-10. The acreage applications vary from 200 to 600 pounds. Most farmers place the fertilizer in the hills, although some is broadcasted. It is usually supplemented with about 100 pounds of nitrate of soda, applied to the hills when the fruit is setting. On the poultry farms a mixture of 400 pounds of acid phosphate and 1 ton of poultry manure is often applied, at the rate of 400 to 1,000 pounds per acre. In some parts of the area one-half ton of fish guano is used with the manure. The crop is first given frequent level cultivation, which is deep at first and shallow later. The great bulk of the tomatoes is of late varieties, and are sold to local canners or shipped to those in Camden or Baltimore. Many are shipped by water from such points as Port Norris and Bridgeton. The most common varieties of late tomatoes are the Greater Baltimore, Cumberland Red (local in Cape May and Cumberland Counties), Stone, Ponderosa (or Beefsteak), and Matchless. The early varieties are chiefly the Earliana, Chalks Early Jewel, and Bonny Best.

Sweet corn is grown to a considerable extent for the shore markets. The earliest variety is Crosbys Early, which is really not sweet corn but a variety of flint. Other common varieties grown are Country Gentleman, Stowells Evergreen, and Golden Bantam.

Pepper seed is planted in hotbeds in late February or in March, and the plants are set out, in rows about 3 feet apart, as early as May 10 and as late as July 1. They are spaced 12 to 24 inches apart, depending upon the variety and soil. Plate IV, figure 1, shows a good field of peppers on a Sassafras soil. The fertilization and cultivation is similar to that given tomatoes, and depends upon the soil. Peppers are sometimes grown as an intercultivated crop in orchards, as shown in Plate V, figure 2. Harvesting begins about July 1 and continues until November or until frost. Peppers are an excellent crop to grow where labor is short, as picking can be delayed a considerable time. The crop is shipped in hampers or in barrels. Half-barrel boxes or southern pepper crates are used to a large extent, as they have a more attractive appearance than the barrel. Sweet peppers are grown most extensively. The chief variety is the Ruby

King. Others are Bull Nose, Cheese, Cuban, Italian White Cap, Chinese, and Long Sweet. The Cherry, Long Hot, Chinese Hot, and Finger varieties are the principal varieties of hot peppers grown.

Onion growing is most highly developed in the southwestern part of the area. About 20,000 bushels are annually produced in the Millville area. The lighter soils are preferred for onions because the careful cultivation necessary is easier. The crop is grown largely from sets, since in order to get a good price it must reach the market by June 20 or July 1, ahead of the Long Island and New York State crops, and when seed is used it does not mature until about August 1. The field intended for onions is plowed in March to a depth of 6 to 9 inches. The sets are put in rows 2 feet apart in the latter part of March. The sets heretofore used have come mainly from Ohio and New York, but many farmers are now growing their own. The seed for sets is sown at the rate of 60 to 70 pounds per acre and yields as much as 400 bushels per acre. The sets are harvested in July and stored in a dry place for use the following year. The onion crop is weeded by hand until 3 or 4 weeks after setting, when 1-horse, shallow-toothed cultivators are used. Onion fields are often limed at the rate of one-half ton to the acre, and two applications of fertilizer are usually made, the first one consisting of about 400 pounds of a 4-8-10 mixture and the later one of 300 pounds of a 2-8-10 mixture broadcasted. Another preparation in common use analyzes 3 per cent nitrogen, 7 per cent phosphoric acid, and 7 per cent potash. In the Cedarville and Newport district onions are often grown in the same field for seven or eight years continuously, but cover crops are usually sown after the crop is removed. Plate VIII shows a crop of onions being harvested on a Sassafras soil. Yellow onions are grown largely for summer use and white onions for winter use. The leading yellow varieties are the Yellow Globe, Yellow Danvers, and Yellow Dutch or Strasburg. The principal white varieties are the White Portugal and White Southport.

Two types of beans are of commercial importance, the cranberry and lima, both pole and bush varieties. The cranberry beans are mainly of the French variety, while the bush limas are chiefly the Fordhook. The former are planted at the rate of 5 pecks to the acre, in rows 3 feet apart, at intervals from May 1 to July 1, and need about 12 weeks to mature. About 500 pounds of a 2-8-10 fertilizer is generally applied, and manure is used if on hand. Two crops of these beans can be grown if they are put in early, but they are usually followed by red-skin potatoes or navy beans. The crop is sold in the pod for winter use. The bush lima beans are handled very much like the French cranberry bean, but are sold largely to canners. Pole lima beans are planted about April 10, the field having been first marked out and hilled and poles placed 4 feet apart



each way. Two vines are allowed to the hill. The crop is heavily fertilized with both manure and commercial goods, the latter being placed in the hill. A common method is to make a very early planting and two plantings later, to insure a good stand. A first-class field of pole lima beans is shown in Plate IV, figure 2, and a good field of string beans in Plate V, figure 1.

Early market peas and canning peas are of more or less importance in all parts of the area. The early crop is seeded as soon as the danger of frost is past, and the canning crop later. Peas are grown quite extensively in the Cape May district. They are manured and fertilized with 400 to 800 pounds of a fertilizer analyzing 1-8-10 to 3-8-10. The canning variety mainly grown is the Alaska. The early market varieties are the Telephone, which is the most important, and the Gradus, Alaska, and Potlatch.

The peach orchards in the area are generally well cared for, and few neglected orchards are to be seen. A variety of truck crops are grown in the orchards for two or three years, or until the trees come into bearing. Plate V, figure 2, shows a typical young orchard with peppers between the rows. There is much variation in the fertilizer practices in different parts of the area. In the western part, excluding the Vineland district, about 600 pounds of bone meal and 6 tons of manure are used per acre. In the Vineland district many farmers use about 400 pounds of acid phosphate, often mixed with poultry manure, 200 pounds of muriate, and about 100 to 200 pounds of nitrate of soda. More nitrate is used on young orchards. In the eastern part of the area some farmers depend mainly upon manure, various combinations of nitrate, acid phosphate, and raw and steamed bone. The nitrate is applied after the fruit sets, at the rate of 150 to 300 pounds per acre. The best growers spray four or five times, using commercial lime sulphur in the first two treatments and home mixed in the later ones. Arsenate is added in one or two sprayings. Atomic sulphur is becoming very popular, as it is said to give better fruit and in addition is a great labor saver. The bulk of the peach crop is shipped to New York in either the Georgia carrier or the Michigan bushel and half-bushel basket. The hamper is used mainly for inferior fruit. At the present time it costs 23 cents to ship a 24-quart carrier from Vineland to New York, and about 5 cents must be added to this for carting. Special trains are run by the Central Railroad of New Jersey from the peach and fruit district of Vineland to New York during the harvest season. About one-third of the present plantings in the Vineland district, which is probably quite representative of the whole area, consists of the Elberta variety. A survey of this district recently made shows plantings as follows: Elberta (midseason), 43,503 trees; Carman (early), 22,921; Belle of Georgia (midseason), 13,387; Champion (midseason),

11,750. Other varieties, named in the order of their importance, are the Iron Mountain (late), Greensboro (early), Ray (late), Hiley (midseason), Krummel (late), Late Crawford, Lola (early), Fox Seedling (late), Hale (midseason), and Mountain Rose. Thirty-six other varieties are listed in the district.<sup>1</sup>

Cranberries are grown largely on the soil mapped as Swamp. The areas are cleared, diked, and flooded for several years to kill the weeds before the vines are planted. If well cared for they produce for a long period of years. Cranberries are sold mainly through an association. There were reported in Cape May County in 1909, 328 acres of cranberries, producing 600,736 quarts, with a value of \$29,174.

The Kieffer pear is the only variety grown extensively. The crop is of low quality and is sold largely to canners. Many orchards, however, are well sprayed, fertilized, and cultivated, and are profitable. In recent years the pear orchards have been damaged by the blight.

Grapes are an important crop locally, as in the vicinity of Vineland, East Vineland, Egg Harbor, Woodruff, and Woodbine. They are grown in rows about 5 or 6 feet apart, and the vines are tied to wires stretched from posts in the rows. The principal varieties are the Ives and Concord.

Blackberries, raspberries, and dewberries are grown extensively in Atlantic County. In Cumberland County blackberries and dewberries are important. They are fertilized rather heavily and given level cultivation. Plate VI, figure 1, shows an excellent patch of blackberries in bloom on a Sassafras soil.

Strawberries are grown extensively throughout the area. There are some patches as large as 20 acres, but they usually range from 1 to 3 acres. The best growers plant about 1 or 2 acres each year, and plow under a like acreage. Many of them maintain the beds for 2 or 3 years or longer. Many growers top dress the plants in the fall with about 600 pounds of bone meal, and add 100 pounds or more of nitrate of soda in the spring. Some top dress them with manure in the fall, and remove the manure before the nitrate is applied. Most of the strawberry growers use the matted-row method. Many growers give the patches clean cultivation until July, after which the cultivator is drawn up a bit each time, and cultivation is discontinued about September 1. The runners which root after this are transplanted to new beds the following spring. The space between the rows is kept clean the second year. The strawberry rows are set  $3\frac{1}{2}$  feet apart, with 18 inches between the plants. The cost of shipping the berries is high, averaging about 32 cents per bushel. The leading varieties grown are the Gandy or Gandy Prize, Big Joe, Doris, Gen-

<sup>1</sup>The adaptation of a number of varieties of peaches is discussed in Circular 41, N. J. Agr. Expt. Sta.

tile, Campbell, Early, and Ruby King. Plate VI, figure 2, shows a thriving strawberry patch on the Sassafras loamy sand.

Watermelons and cantaloupes are grown in hills, and cultivated as long as the growth of the vines permits. Most of the crop is sold locally or at the shore markets, but part is shipped to New York and Philadelphia. The Tom Watson, Kleckley Sweet, and Rattlesnake are the principal varieties of watermelons grown, and Fordhook and Jenny Lind of cantaloupes.

The farms of the Millville area are only moderately well equipped, and on the smaller farms a large amount of hand labor is necessary. More vegetable storage space is needed on most farms, especially for sweet potatoes and Irish potatoes. Only one or two work horses are kept on the average farm, and they are generally of light draft. Good methods of cultivation are followed throughout the area. Crops are cultivated as soon as possible after every rain, and in the absence of rain the period between cultivations is not often longer than one week.

Definite rotations are not generally followed, especially in the eastern part of the area, but in Cape May County a systematic rotation is practiced to some extent. A cover of rye and vetch or crimson clover is sown in the corn at the last cultivation. It is turned under the next year for late potatoes, which are followed by rye, and this is turned under for an early truck crop the third year. Grass is usually followed by corn or potatoes. Early peas are followed by late potatoes. In Atlantic County sweet potatoes are often grown continuously for a period ranging from 3 to 20 years. Occasionally land that has been in sweet potatoes is heavily manured and given over to a truck crop for one year, after which sweet potatoes are grown for another period. In Cumberland County sod land is usually planted to corn, which is followed by potatoes, tomatoes, or corn. Potatoes are followed by wheat, alfalfa, or tomatoes the next year. Tomatoes are succeeded by grasses or corn, but never by potatoes. Peppers are often substituted for tomatoes on the heavier soils. Sweet potatoes are frequently succeeded by rye. Very often the rotation consists of sod, corn with a cover crop, then strawberries two years, or sweet potatoes two or three years. Root crops ordinarily should not succeed each other, but they are often grown successively in this area. New land is first planted to strawberries, then corn, and the third year watermelons are often grown. In the northern part of the county corn follows strawberries.

In normal times the fertilizers in general use analyze about 2 to 4 per cent nitrogen, 8 per cent phosphoric acid, and 10 per cent potash. The applications range from 200 to 1,600 pounds per acre, averaging 600 to 800 pounds. Some fertilizer is mixed at home, and in some sections poultry manure is supplemented with 16 per cent acid phos-

phate. Tobacco is used as a fertilizer to a small extent in Atlantic County. In some cases bone meal is used, both raw and steamed. On the bay shore of Cape May County the gathering of king or horseshoe crabs for use as fertilizer material is an important industry. The product is worth about \$90 a ton, chiefly for the nitrogen. This material ought to be used in the county, but at present it is shipped away. Cape May County in 1909 spent a total of \$43,349 for fertilizer, which is an average of \$84.83 for each of the 511 farms using fertilizer. The average for Atlantic and Cumberland Counties is somewhat higher. The price of manure ranges from \$2 to \$6 a ton. Poultry manure sells for 25 to 30 cents a bushel. At the present time (1917) potash is very scarce and expensive, and the fertilizers contain from 1 to 3 and occasionally 5 per cent of nitrogen and from 7 to 10 per cent of phosphoric acid. Applications are lighter than formerly because of the much higher price.

The farm laborers are mainly white persons of foreign birth. At present most of the work is done by the farmer and his family. Farm laborers receive \$40 to \$50 or more per month.

The table below gives some interesting data, taken from the 1910 census, in regard to the comparative development of the three counties:

*Number of farms and percentage of improved and unimproved land in farms, Atlantic, Cape May, and Cumberland Counties, 1910.*

County.	Total farms.	Area in farms.		Improved land.		Per-centage of im-proved land in county. <sup>1</sup>
		In farms.	Per farm.	In farms.	Per farm.	
		Per cent.	Acres.	Per cent.	Acres.	
Atlantic.....	1,572	20.0	46.4	46.7	21.6	19.5
Cape May.....	632	24.8	66.6	43.7	29.1	15.8
Cumberland.....	2,724	49.5	58.2	61.1	35.5	37.7

<sup>1</sup> Exclusive of Tidal marsh.

The percentage of improved land is seen to be highest in Cumberland County, but if figures were available for the surveyed portion of the county alone they would show a much smaller proportion. A considerable area of the land given as improved is at present lying idle in all the counties, while on the other hand a small acreage is cleared on many farms each year, and the census of 1920 will doubtless show considerable change in the figures. One of the principal reasons for the slow progress in agriculture is the prevalence of mosquitoes. Their elimination, which is possible, would be followed by a more complete development of the natural resources.

It is rather unusual to find a farming region in which the number of owner operators is increasing, but this is true in both Cumberland

and Cape May Counties. In the latter county the proportion of tenants decreased from 22.8 to 16.3 per cent in the decade preceding 1910. In Atlantic County there has been very little change since 1880. In the latter county cash rents are the rule. The rate depends upon the soil and is ordinarily from \$2 to \$5 an acre, but as much as \$10 is paid in some cases. Share renters usually meet half the expenses and retain half the crops, but in some cases they provide the labor only and get one-third the produce. In Cumberland and Cape May Counties the equal-share basis is the rule. Land rented for growing corn often brings \$5 an acre, and for sweet potatoes about \$3.50.

Farm land in Cape May County sells for \$15 to \$100 an acre, depending upon the location, the nearness to roads and railroads, and other conditions. Some farms have changed hands recently at \$125 an acre. In Atlantic County farm values have been rather inflated in recent years. Uncleared land would probably average \$15 to \$20 an acre and good farm land \$100 an acre. Land in bearing peach orchards brings a much higher figure. Farm values in Cumberland County are somewhat lower. Farms favorably situated, however, as in the Vineland district, with a poultry plant and peach orchard, sell for \$100 to \$250 or more an acre. In more distant locations the price is from \$20 to \$100. Uncleared land ranges from \$6 to \$20 an acre.

Overhead irrigation by the Skinner system is practiced in many parts of the area, especially in the northwestern part, and irrigation plants are being extended steadily. Most of them are on the Sassafras gravelly sandy loam, sand, and loamy sand. They cover from one-half acre to 6 acres or more. Plate VII, figure 1, shows one of the larger plants. The source of water is either a stream or shallow well, and gasoline pumps are used for raising the water. Two to three crops are grown each year. They are put in as soon as the ground can be prepared, lettuce as early as March 20. Irrigation can be done at any time, but if begun in sunshine it must be continued until the sun disappears. Some of the crop sequences on irrigated plots are as follows: Early peas or early Irish potatoes (Irish Cobbler) or strawberries are succeeded by late red-skin potatoes. Early lettuce may be followed by late cabbage, onions, or string beans. Often a third crop is then planted, perhaps spinach or lettuce. Cucumbers put in about May 10 may be followed by late tomatoes, cauliflower, or celery in June. The crop to be grown seems to be determined solely by the prospect of a good return, and no definite rotation is practiced. The productiveness of the soil is maintained largely by the use of manure, supplemented with fertilizer. Cover crops are seldom grown. There are a number of greenhouses in the area devoted to the growing of tomatoes, cucumbers, and many other crops for winter use.

## SOILS.

The Millville area lies within the Coastal Plain province, which extends as a narrow belt along the ocean from the south shore of Long Island to the Gulf of Mexico and the Rio Grande River. It gradually becomes wider to the southward, reaching a maximum width of about 200 miles. Soils of a sandy nature predominate throughout the Coastal Plain region.

The soils of the Millville area are derived from unconsolidated beds, mainly of marine origin. The chief formations are the Cohansey sand,<sup>1</sup> which overlies practically the entire area, and in the southern and eastern parts the Cape May formation. Remnants of the Bridgeton terrace formation are local in extent, confined chiefly to the northern and western parts of the area. The Cohansey formation is composed of relatively coarse sand as compared to the underlying Kirkwood and Cretaceous deposits that outcrop farther to the north and west in the Camden, Salem, and Freehold areas. It is further characterized by local beds of clay and gravel, the latter composed of quartz, chert, and quartzose-sandstone pebbles ranging from one-fourth inch to 1½ inches in diameter. This is the most extensive geological formation in the southern two-thirds or Coastal Plain region of New Jersey. The Bridgeton and Cape May formations, overlying the Cohansey sand, are largely of fluvial origin, and from the standpoint of soil-forming material do not differ materially. They are composed essentially of gravel, sand, and local beds of clay. The materials were derived in varying degree from older formations, such as the Cohansey, Kirkwood, Cretaceous, and Triassic, and were laid down under varying degrees of submergence in bays or estuaries.

The Cohansey formation gives rise to soils of each of the series mapped in the Millville area. Much of the Bridgeton and Cape May formations, where exposed, has given rise to areas of the Sassafras gravelly sandy loam, one of the important types of the area.

The soils are classed into series, each of which consists of a group of types having similar characteristics in color, drainage, profile, kind of material, and the process by which it was accumulated, topography, and chemical composition. The soil type represents the textural unit of classification, determined by the relative proportions of gravel, sand, silt, and clay.

The Sassafras series is distinguished by its brown, yellowish-brown, or light-brown surface soils and reddish-yellow or orange-colored subsoil. In many places a gravel stratum is encountered within the 3-foot section, and the lower part of the section is always

<sup>1</sup> Geological data used in this report from publications of Geological Survey of New Jersey.

coarser textured. These soils occupy well-drained, level to gently rolling areas and have a low to moderate content of organic matter. They also are low in lime carbonate. The members of this series predominate in the southern two-thirds of New Jersey. No types of any important extent heavier than sandy loams occur in the Millville area.

The Norfolk series has gray to light-gray surface soils and yellow to pale-yellow subsoils. In other characteristics its soils are quite similar to the Sassafras series. In this area the Norfolk series is represented only by poorly drained phases.

Those areas of the Cohansey sand which are practically free from loamy material give rise to the Lakewood series, which has a white surface soil and an orange, orange-yellow, or brownish-yellow subsoil. The topography ranges from level or gently rolling to rough and hummocky, and drainage is always good or excessive. These soils are very low in organic matter, as well as in other elements essential to a productive soil.

The Portsmouth series is characterized by a dark-gray to black surface soil and a gray to white subsoil, often mottled with yellow. These soils are developed in low areas at the heads of streams and adjacent to swamps, and the poor drainage accounts for the accumulation of organic matter and the resultant dark color. A gravel stratum is very often encountered in the lower subsoil.

The St. Johns and Scranton series are closely related to the Portsmouth. The surface soils are similar, but in the types of the St. Johns series a coffee-brown or black organic stratum resembling a hardpan is encountered in the subsoil. The subsoil of the Scranton series closely resembles the Norfolk in its yellow color. It frequently shows mottlings of gray.

The general distribution of soil textures in the area is shown in figure 2. Frequently one or more types are absent in the sequence; e. g., where the relief is gentle the Sassafras sandy loam or a similar soil may take the place of the Sassafras sand, or, if the slope to the Swamp is relatively steep, the belt of Portsmouth or similar soil may be absent. In other places the Sassafras gravelly sandy loam may be lacking.

In addition to the soils classed in the various series there are several soils of miscellaneous character. The wet, mucky areas through which most of the streams flow are mapped as Swamp. Areas along the coast subject to tidal action are mapped as Tidal marsh. Large areas of this land have been diked and are mapped as Reclaimed tidal marsh. Narrow strips of Coastal beach have been mapped at various points along the shore.

In the following pages the several soil types and phases are described in detail, and a general discussion of their agricultural re-

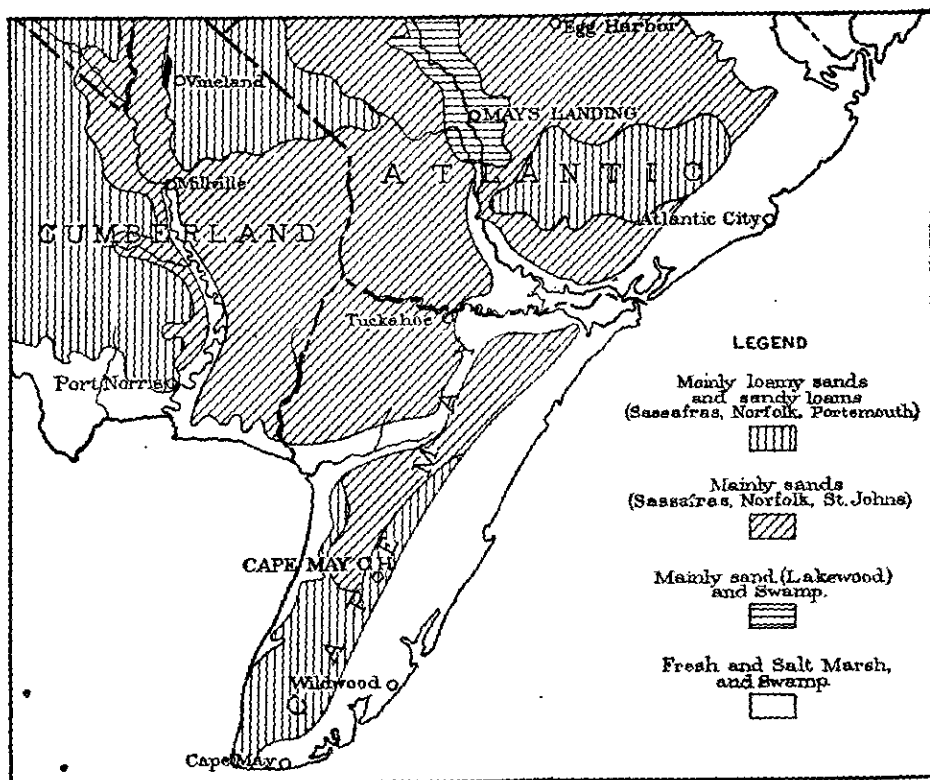


FIG. 2.—Sketch map showing distribution of soils by texture.

relationships is given. The table below gives the name and the actual and relative extent of each type:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Sassafras sand.....	168,768		Norfolk sandy loam, poorly		
Mixed phase.....	25,656	32.3	drained phase.....	13,376	2.1
Flat phase.....	12,736		St. Johns sand.....	10,496	1.6
Tidal marsh.....	117,376	18.3	Norfolk sand, poorly drained		
Sassafras gravelly sandy loam.....	74,240		phase.....	7,744	1.2
Flat phase.....	1,356	11.9	Reclaimed tidal marsh.....	6,272	1.0
Sassafras loamy sand.....	41,920	7.4	Sassafras loamy coarse sand.....	5,824	.3
Flat phase.....	5,760		Sassafras coarse sand.....	5,696	.9
Swamp.....	47,296	7.4	Scranton sandy loam.....	4,864	.8
Sassafras sandy loam.....	32,128	5.6	Sassafras coarse sandy loam.....	4,736	.7
Flat phase.....	3,712		Madeland and clay pits.....	2,048	.3
Portsmouth sandy loam.....	19,264	3.0			
Lakewood sand.....	15,232	2.4			
Coastal beach.....	14,080	2.2			
			Total.....	641,280	



## SASSAFRAS GRAVELLY SANDY LOAM.

The surface soil of the Sassafras gravelly sandy loam, where typically developed, is a light-brown loamy sand to sandy loam, 6 to 8 inches deep. The subsurface material is a yellow to yellowish-red sandy loam to heavy sandy loam, extending to a depth of 10 to 14 inches. Below this the subsoil is a reddish-yellow to dull-red, friable sandy clay containing more gravel and coarse sand at depths between 24 and 40 inches. Small to medium-sized white or yellow quartz gravel, about one-eighth to one-half inch or more in diameter, is abundant from the surface down through the entire 3-foot section, but the content varies greatly.

This type is quite variable in texture. In the western and north-western parts of the area it includes small developments of gravelly loam and gravelly fine sandy loam. These occur most often in the lower lying areas, as in the vicinity of Woodruff and Gouldtown. Throughout the area there are included also patches of sandy loam, in which gravel makes up, perhaps, 10 per cent of the soil mass. Where the type occurs on the slopes of hills it often includes small areas of gravelly coarse sandy loam, loamy coarse sand, and loamy gravel, the finer material having been washed away. There are also included many areas, a few acres in size, of Sassafras sand and loamy sand. In the wooded parts of the type the surface 2 to 6 inches is gray or yellow rather than brown, as organic matter has not become incorporated as in cultivated areas.

The mapping of this soil, and in fact of all the principal types, is difficult in the wooded areas because of the prevailing dense growth of underbrush, made up mainly of scrub oak. Where there are few roads, not as much detail has been shown as would otherwise have been possible.

The Sassafras gravelly sandy loam has a general distribution throughout the area, and it is the predominant type in the north-western part. It occurs chiefly in the higher parts of the area, and includes practically all of the Bridgeton and the higher parts of the Cape May formation. It has the most rolling topography of any type mapped, although many areas are nearly level, as in the region north of Dennisville. The type has adequate surface drainage and underdrainage, and some of the lighter textured areas at rather high elevations are excessively drained.

This is one of the most important types in the area. About 50 per cent of it is cleared, a larger proportion than in the case of any other type. Almost all the important crops are grown more or less extensively, with the exception of sweet potatoes, cantaloupes, and watermelons and several kinds of bramble berries, all of which are grown mainly on the lighter soils. Corn occupies a larger acreage

than any other crop. Rye is grown to an important extent. Plate III shows a good growth of each of these crops. Much hay, chiefly clover and timothy mixed, is grown. Other important crops are late potatoes, of both white and red skin varieties, late tomatoes for market and canning, strawberries, grapes, and peaches. Plate V shows a peach orchard on this soil. Many of the orchards in the Vineland peach district are located on this soil, and it ranks as the best peach soil in the area. Its slightly higher elevation and rolling topography are favorable to peach culture, and it produces a healthy, vigorous, long-lived, but not too rapidly growing, tree. Owing to its moderately heavy subsoil the trees are not pushed too rapidly in the spring, and hence they are not as subject to frost as on the lighter soils. They are naturally more productive, and less fertilization is necessary. Apples do very well and are a crop of growing importance. In the Camden area to the north this is one of the most important apple-producing types. Plate VII, figure 2, shows what can be done with apples on this soil, and incidentally shows an implement much used in orchard cultivation. Note the healthy and vigorous appearance of the trees.

Crops of minor importance are asparagus, cabbage, turnips, sweet corn, onions, sweet potatoes, pole lima beans, market and canning peas, rhubarb, pears, okra, horse beans, apples, and alfalfa. Some wheat is grown on this type in the northwestern part of the area. There is a considerable acreage in French, cranberry, and bush lima (Fordhook) beans. A large acreage is devoted to peppers in the vicinity of Vineland and east of that place. Near Vineland one farm is devoted largely to dahlia production. Several farmers in the vicinity of Buena are engaged in growing French lilacs.

Very little dairying is carried on, but cows, hogs, and a small number of goats are kept to supply the home demands for milk and meat products. Poultry raising is an important source of income, and in some places this industry is highly developed, as in the vicinity of Vineland.

Ordinary yields of some of the more important crops run about as follows: Corn, 15 to 40 bushels per acre; tomatoes, 6 to 10 tons; clover and timothy hay,  $\frac{1}{2}$  ton to  $1\frac{1}{2}$  tons; potatoes, 100 to 225 bushels; alfalfa,  $1\frac{1}{2}$  to  $3\frac{1}{2}$  tons; and onions, 200 to 400 bushels. French cranberry beans, dried, yield 10 to 20 bushels per acre, and green, about 100 bushels. Peppers occasionally yield as much as 250 barrels per acre, but the average is considerably less.

Some fall plowing is done, but where cover crops are grown the fields are plowed in the early spring, to a depth of 5 to 7 inches. Both 1 and 2 horse plows are used. All crops are cultivated frequently, and level cultivation is the rule. A wide variety of shallow-toothed cultivators are used. Nearly all crops are fertilized with

commercial mixtures or manure, or both. The applications of fertilizer range from 300 to 1,600 pounds per acre. Fertilizers analyzing 3 to 5 per cent nitrogen, 7 to 10 per cent phosphoric acid, and 8 to 10 per cent potash are generally used in normal times. At present, very little potash being obtainable, the fertilizers generally analyze 2 to 5 per cent of nitrogen and 8 to 10 of phosphoric acid, and carry no potash.

Farm land of this type in favorable situations, with buildings, varies in price from \$100 to \$150 an acre, and in more remote localities from \$15 to \$60 an acre. Uncleared land ranges from \$6 to \$25 an acre, depending upon the situation, the value of the timber, and the size of the tract sold. It costs from \$25 to \$70 per acre to clear the land. Some areas of this soil are very highly improved.

Sometimes in breaking more extensive areas large tractor-drawn disks are employed. The disks chop the small roots into short lengths and eliminate many of the smaller stumps. Deeper plowing would give good results on this soil, and the depth should be increased at the rate of, say, one-half inch a year for several years.

The Sassafras gravelly sandy loam, like all the other soils of the area, is low in lime, as is indicated by the prevalence of hackberry, laurel, and similar growths, and since the maximum benefits from fertilization and green manuring depend upon the satisfying of the lime requirement this should receive greater attention. More lime and acid phosphate, in connection with leguminous cover crops, should be used to build up the soil. Even though many crops such as strawberries, raspberries, bush lima beans, and watermelons, do not require an alkaline soil, lime should be used for the benefit of the green-manure crops. Until the soil has reached a fair degree of productiveness one cover crop supplemented with lime and acid phosphate ought to be turned under for every money crop removed. The lower grades of fertilizer commonly used on this and other soils contain more filler or worthless material than the higher grades, and are less economical. Home mixing should be practiced more widely. Fertilizers often are bought on credit and are said to cost at least 8 per cent more, when the money could be had in most cases for 6 per cent at the local banks.

In those sections of the area where mosquitoes and flies are not too prevalent, especially in the northwestern part, more dairy stock should be kept. In other sections hogs should be raised on a larger scale, as they use the waste from truck crops economically. Along the shore hog raising is even more strongly to be recommended, since garbage from the resorts is to be had in large quantities.

The manure produced from the small number of animals kept is not economically used. Perhaps 50 per cent of its value is lost by

In some places the surface 1 to 3 inches consists of a clean, loose, white sand passing abruptly into orange-yellow sand and this, at depths varying from 18 to 30 inches, into reddish-yellow sand, in many places slightly loamy. In places the whitish surface soil is underlain directly by reddish-yellow sand, but this appears to be less frequently the case than in those areas where the surface soil is a brownish-gray or light-brown sand. The white sand surface soil of this variation is exactly like the Lakewood sand, and where the soil is deep enough to plow up gray and the areas are large enough to warrant separation, they are mapped as Lakewood. Where the white soil is as deep as this the reddish-yellow subsoil typical of the Sassafras is rarely found. There are included in this type as mapped some flat or low areas where the subsoil shows no reddish yellow, such areas representing the Norfolk sand. Even many of the higher areas show none of the typical reddish yellow, but usually the lower subsoil is orange yellow, and not pale yellow like the Norfolk sand subsoil. The included depressions are frequently moist in the lower subsoil.

Areas which have a scattering of small quartz gravel on the surface are indicated on the map by gravel symbols. Frequently small areas of Sassafras gravelly sandy loam are thus shown. Generally these latter areas are characterized by a slightly loamy subsoil resembling the Sassafras loamy sand, but in many cases no difference in texture can be noted. Where the type approaches a coarse sand small gravel is frequently present throughout the 3-foot section.

There also are included some small areas, as 1 mile south of Hunters Mill, 2 miles west of Mays Landing, and elsewhere, of a deep variation of the Sassafras sandy loam, which consists of more or less typical Sassafras sand material overlying reddish-yellow sandy clay or clay at 24 to 36 inches. These areas if more extensive would be separated, and included with the Sassafras sandy loam. There are a number of inclusions of Sassafras fine sand, as in the vicinity south of South Seaville, 3 miles west of Mays Landing, east of English Creek, and elsewhere. In the cleared portions of the area there are included some patches of Sassafras sandy loam, loamy sand, coarse sand, and coarse sandy loam. In the wooded regions there are included, in addition, small developments of other types.

The Sassafras sand is the most extensive of the upland soils, and it is distributed quite generally over the entire area (see Fig. 2) at all elevations. In general the surface is level to gently undulating. The more nearly level areas are mapped as a flat phase. The type has good to excessive drainage, and in dry seasons crops suffer from lack of moisture.

This is a very important early-truck soil, although probably less than one-fifth of it is cleared. It covers the greater part of the

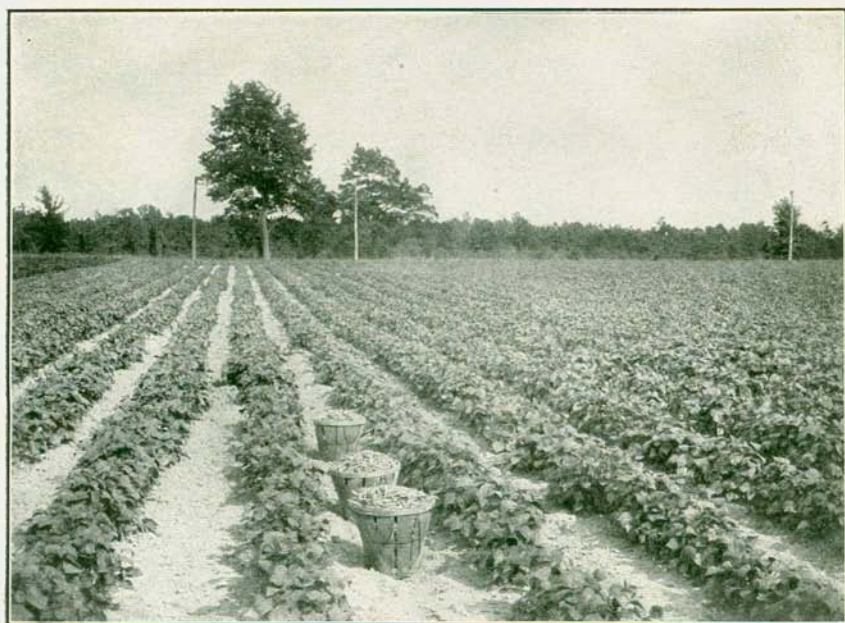


FIG. 1.—STRING BEANS ON SASSAFRAS LOAMY SAND.

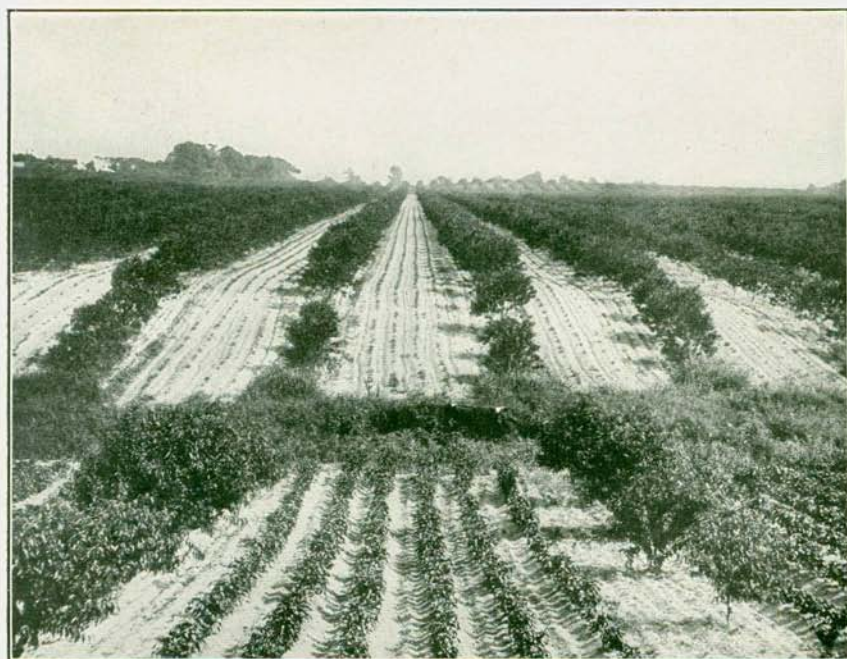


FIG. 2.—PEACHES ON SASSAFRAS GRAVELLY SANDY LOAM.

Note the topography, which is that of the more rolling areas of the northwestern part of the survey; also the healthy tree growth. The interplanted crop is peppers.



FIG. 1.—A FIELD OF BLACKBERRIES.

The soil is Scranton sandy loam in foreground and Sassafras loamy sand in background.



FIG. 2.—STRAWBERRIES ON THE SASSAFRAS LOAMY SAND.

NEW JERSEY GEOLOGICAL SURVEY

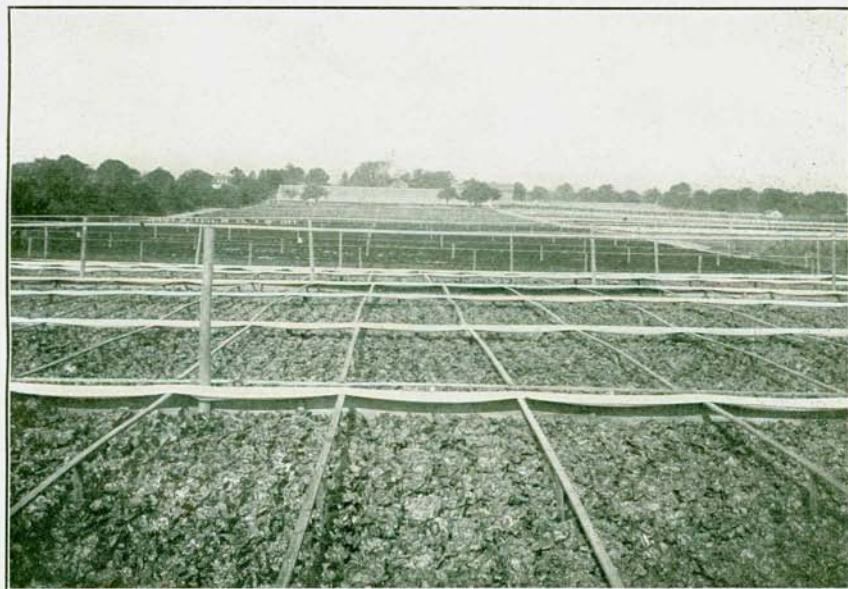
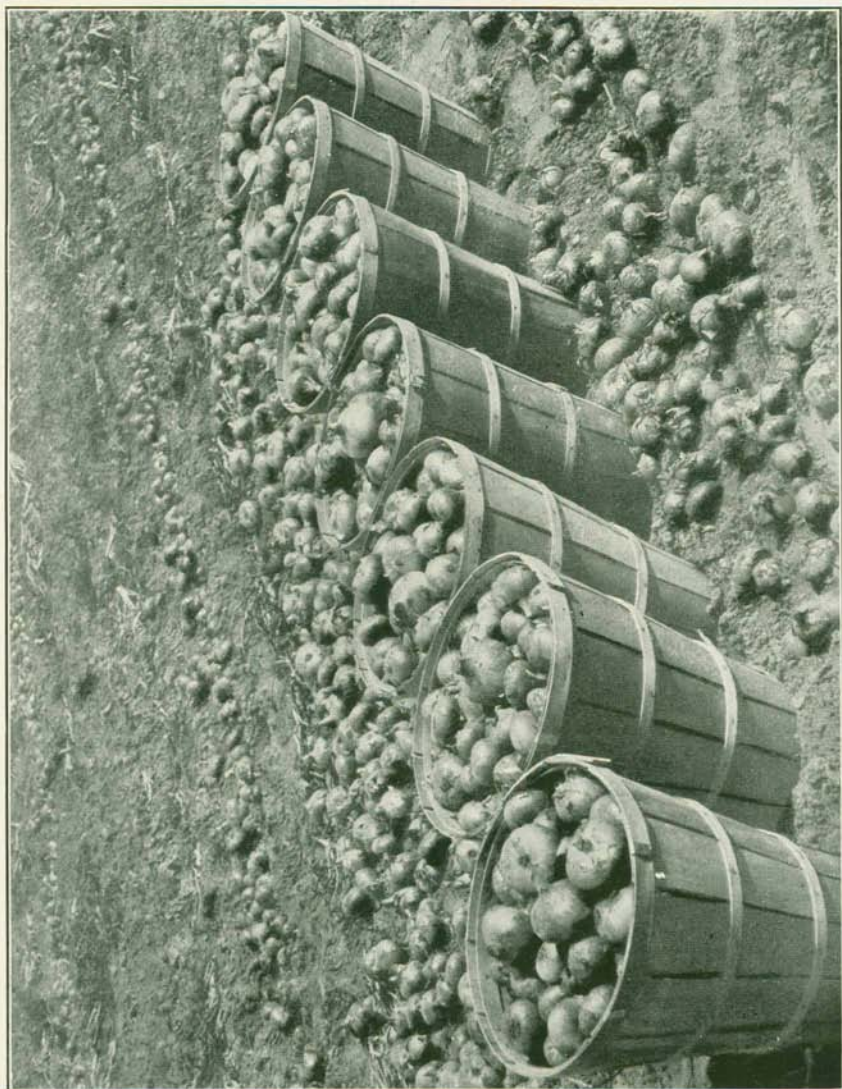


FIG. 1.—SKINNER SYSTEM OF IRRIGATION ON SASSAFRAS GRAVELLY SANDY LOAM.  
Lettuce in foreground, strawberries and other crops in background.



FIG. 2.—APPLES ON SASSAFRAS GRAVELLY SANDY LOAM.

Small horses are not needed when this tool is used.



ONIONS GROWN ON SASSAFRAS SANDY LOAM.



sparsely settled region of the area. The timber growth is similar to that on the Sassafras gravelly sandy loam, except that the proportion of pine is probably greater.

This type is commonly referred to as a "sweet-potato soil." It is used for all the upland crops, among which corn and hay are important, but especially for early truck crops such as potatoes, tomatoes, sweet corn, green peas, and onions. The bulk of the sweet-potato crop of the entire Millville area is produced on this soil. Dewberries are grown extensively on this type in Cumberland County, and both dewberries and raspberries in Atlantic County. Watermelons and cantaloupes are grown more or less extensively in some sections, as along the Maurice River. There are some good stands of alfalfa on this soil.

Yields of practically all crops are somewhat lower than on the Sassafras gravelly sandy loam and sandy loam, and the type in general has a lower selling value. It requires more organic matter and heavier fertilization than the sandy loam, and owing to its leachy nature the effect of commercial fertilizer soon disappears. None of the crops give as good yields as on the heavier members of the Sassafras series, although the crops most extensively grown are those best suited to the type. This soil should not be allowed to go through the winter without a cover crop of rye and vetch or clover. It will produce a good growth of rye.

*Sassafras sand, flat phase.*—The Sassafras sand, flat phase, consists of a light-brown or brownish-gray sand passing at 6 to 8 inches into yellow sand and this at 18 to 24 inches into reddish-yellow, slightly loamy sand. The latter gives way to yellow or pale-yellow sand at about 30 inches. In many places, however, the upper subsoil is reddish yellow to a depth of only 20 inches, where pale-yellow, wet sand is encountered. A stratum of gravel is of common occurrence at 20 to 36 inches. The very low areas have a yellow subsoil throughout, and if they were of sufficient size they would be mapped as Norfolk sand. Small areas of other types are included, such as the Sassafras sandy loam, loamy sand, and sand.

This phase occurs closely associated with the Sassafras sandy loam, flat phase. It is used for much the same crops as the typical Sassafras sand. Strawberries are grown more extensively. Late tomatoes and pole lima beans are important crops along the north shore of Delaware Bay. A considerable proportion of the phase is cleared and under cultivation, but part of it is not adequately drained.

*Sassafras sand, mixed phase.*—The Sassafras sand, mixed phase, was originally mapped as Norfolk sand, but owing to its extreme lack of uniformity it has been thought best to class it as a mixed phase of the Sassafras sand. It includes patchy areas of (1) Sassa-

fras sand with a grayish-brown surface soil to a depth of 6 or 7 inches overlying reddish-yellow sand throughout the 3-foot section; (2) Norfolk sand, with a light-gray to whitish surface soil and a pale-yellow subsoil; and (3) an intermediate soil between the Sassafras and Norfolk sands which has a grayish to whitish surface soil in the forested areas and a grayish-brown soil in the cleared areas. The upper subsoil is like that of the Sassafras sand in being reddish yellow or orange yellow, and the lower subsoil pale yellow like the Norfolk. In addition there are included areas with a rather loamy subsoil, some small areas having a reddish-yellow sandy loam to sandy clay subsoil, small areas of Lakewood sand, and in the northeastern portion of the area several areas of Sassafras sand, flat phase, which are moist in the lower subsoil.

The surface of the Sassafras sand, mixed phase, is usually flat to gently rolling, but the drainage is good, and noticeably better than on the flat phase. The mixed phase occurs chiefly in the northeastern part of the area, where it is associated with the typical Sassafras sand and with the gravelly sandy loam. Its lighter color indicates that oxidation has not proceeded as far as in the typical Sassafras sand, and the phase is not as productive, although in general its use and adaptations are similar. It lies mainly in Atlantic County, and large areas of it belong to the county, which according to law must purchase all lands sold for taxes where the proceeds do not cover the three years taxes due, plus the cost of sale.

#### SASSAFRAS LOAMY SAND.

The typical Sassafras loamy sand consists of a brownish-gray sand or slightly loamy sand passing at an average depth of about 6 inches into a yellow sand or slightly loamy sand, this in turn changing to a reddish-yellow loamy sand at any depth from 12 to 24 inches. Always in forested areas and in some places elsewhere the surface soil is yellowish, with one-half inch or more of gray sand at the immediate surface. In places the lower subsoil is a sandy loam, sometimes passing into loamy sand or loamy coarse sand. There are some areas where the entire subsoil is reddish yellow, the yellowish upper subsoil being absent.

The Sassafras loamy sand is quite widely distributed over the area, and is one of the most important soils of the Cape May Peninsula. There are included with it some small areas of Sassafras sand and sandy loam, as well as one area of loamy fine sand, the latter lying northwest of Dividing Creek.

This is a level to gently undulating soil, but it is well drained. It bears much the same relation to the agriculture of the area as the Sassafras sand, but it is devoted more largely to late truck crops such as peppers, greens, Irish potatoes, and tomatoes. It is also used quite

extensively for sweet potatoes, of which it gives somewhat larger yields than the Sassafras sand. Probably one-fifth of the type is under cultivation.

*Sassafras loamy sand, flat phase.*—The Sassafras loamy sand, flat phase, consists of a brownish-gray sand or slightly loamy sand, about 6 inches deep, overlying yellow sand to loamy sand which passes at 18 to 26 inches into reddish-yellow loamy sand. The lower part of the 3-foot section has a pale-yellow color and is wet. Often the lower subsoil continues reddish yellow, as in that part of the phase south of Newport. There are included with this phase small areas of Sassafras sandy loam, flat phase, and Sassafras sand, flat phase. The topography is level and drainage is not always adequate, although in most cases sufficient for crop production. In its crop use and management this soil is very similar to the flat phase of the Sassafras sand. Perhaps 35 to 45 per cent of its area is cleared.

#### SASSAFRAS COARSE SANDY LOAM.

The Sassafras coarse sandy loam consists of a brown to grayish-brown coarse sandy loam to loamy coarse sand, underlain at 5 or 6 inches by yellowish to reddish-yellow coarse sandy loam and at 8 to 12 inches by reddish-yellow to dull-red or yellowish-red coarse sandy clay. Often there is much gravel and sand in the lower subsoil.

This type is found in small areas associated with the other Sassafras soils, chiefly in the northern half of the area. It occurs largely on slopes, differing in this respect from the Sassafras sandy loam. Its surface ranges from sloping to level.

This is a good soil, but it is hardly as productive as the sandy loam. It is used for much the same crops as the Sassafras gravelly sandy loam and sandy loam. It is not extensive and only a small acreage is under cultivation.

#### SASSAFRAS SANDY LOAM.

The Sassafras sandy loam consists of a light-brown or grayish-brown loamy sand to sandy loam underlain at 6 to 8 inches either by yellowish-red friable sandy clay, or by yellow heavy sandy loam which passes into yellowish-red friable sandy clay. The lower part of the 3-foot section is always coarser textured and more friable. Frequently the upper subsoil is yellow or orange yellow, especially in the lower and flatter areas, but there is always a distinct reddish cast to the lower subsoil, and in places it is dull red. In forested areas and frequently elsewhere the surface inch or two is light gray to white, resembling the Lakewood sand, but brown Sassafras material is encountered beneath this surface layer. Small gravel and coarse sand are nearly always found between depths of about 28 to 40

inches, this part of the 3-foot profile consisting of loamy sand to gravelly or coarse sandy loam.

This type in some respects resembles the Ruston sandy loam, an extensive soil of the southern Coastal Plain, but it differs markedly in its browner soil and looser textured lower subsoil. Variations from typical occur at a number of places. In the vicinity of Beesleys Point there are included areas having a lighter textured surface soil and a typical subsoil, and vice versa. Some areas on the lower part of the Cape May Peninsula and in the vicinity of Newport Landing run light in texture throughout the soil section, approaching a loamy sand. Included with the type are many small areas of nearly all the other Sassafras soils, chiefly the coarse sandy loam, loamy sand, loamy coarse sand, and gravelly sandy loam.

There are also included several areas of Sassafras loam and fine sandy loam, the former occurring one-fourth mile south of Woodruff and three-fourths of a mile northwest of that place. These soils are more productive than the sandy loam. They consist of about 10 inches of brown loam over reddish-yellow sandy clay or clay loam. At 24 inches a gravel stratum is encountered. The fine sandy loam areas are found 2 to 3 miles west of Mays Landing and consist of about 7 inches of brownish-gray fine sandy loam to loamy fine sand over yellowish to reddish-yellow fine sandy clay to clay. In some places these areas are really the Norfolk fine sandy loam.

The Sassafras sandy loam occurs throughout the area, usually in the lower situations, associated with the Sassafras gravelly sandy loam, sand, and loamy sand. It is most extensive in the southwestern part of the area and on the Cape May Peninsula. Its surface is level or only gently rolling, but the drainage is good.

This soil is important in the agriculture of the area. Between one-third and one-half of it is under cultivation. It is similar in crop adaptations, in tree growth, and in other respects to the gravelly sandy loam, and it is devoted to practically the same uses.

*Sassafras sandy loam, flat phase.*—The flat phase differs from the typical Sassafras sandy loam in its level or nearly level surface and in having always a moist subsoil. In texture it is identical with the typical soil. As mapped the phase includes some small areas with a yellow subsoil, mottled slightly with gray. These areas represent inclusions of the Norfolk sandy loam, poorly drained phase. The Sassafras sandy loam, flat phase, occurs in small bodies, chiefly in the southern part of the area, in the vicinity of Tuckahoe and elsewhere, associated mainly with flat phases of the other Sassafras soils. Its agricultural uses and adaptations are very similar to those of the Sassafras gravelly sandy loam and the typical sandy loam.

## NORFOLK SAND, POORLY DRAINED PHASE.

The Norfolk sand, poorly drained phase, is typically a grayish sand or loamy sand, underlain at 4 or 5 inches by a yellow sand which in the lower subsoil is usually pale yellow and often mottled with grayish or orange yellow. The water table is seldom encountered above 26 inches, but it is nearly always reached within the 3-foot section. Variations within the type as mapped are much the same as in the case of the Norfolk sandy loam, poorly drained phase. In low places where the soil is dark gray to black there is included some Portsmouth and Scranton sandy loam. Much of the soil as mapped is really Norfolk loamy sand, poorly drained phase, which it is not possible to separate because of the variability in texture.

The crops grown on this soil are very similar to those on the Norfolk sandy loam, poorly drained phase. In seasons of plentiful rainfall where the drainage is deficient corn often turns yellow.

## NORFOLK SANDY LOAM, POORLY DRAINED PHASE.

The surface 3 to 5 inches of the Norfolk sandy loam, poorly drained phase, is a brownish-gray loamy sand to sandy loam. This overlies pale-yellow sandy loam which passes at 10 to 20 inches into pale yellow, heavy sandy loam or sandy clay. Mottling is usually present in the lower part of the 3-foot section.

This soil is quite variable in color and texture. In the less depressed areas the subsoil below 15 inches contains considerable red, but such areas are not extensive. In the vicinity of Newport and 5 miles south of Mays Landing, the surface soil is a rather dark-brown sandy loam underlain by a yellow, heavy sandy loam to sandy clay. Below 22 to 24 inches the material is always moist or even wet, and gravel is commonly encountered in the lower subsoil. Occasionally at 20 inches stiff, yellowish clay to sandy clay is found, which becomes lighter colored and coarser in texture with depth, the soil in such places resembling the Sassafras soils. In the forested part of the type it is not uncommon to find an inch of black, mucky soil overlying 6 inches of grayish-brown to brownish-gray sandy loam. This in turn is underlain by 6 to 30 inches of the typical yellow to pale-yellow sandy loam or sandy clay. Below 30 inches in the higher situations there is found yellowish or reddish-yellow, moist sandy loam to loamy sand, or in the lower situations a heavy, light-gray and pale-yellow mottled, plastic sandy clay. The type as mapped includes in the lowest positions areas of Portsmouth and Scranton soils and small patches of a poorly drained phase of the Norfolk sandy loam, as in the area south of Eldora.

A soil similar to this was mapped in the Camden area as Sassafras sandy loam, imperfectly drained phase. It was not as gray in the

surface portion or as yellow in the subsoil as the present type, however, and it was not as poorly drained.

The Norfolk sandy loam, poorly drained phase, occupies low, flat, depressed areas adjacent to and at the heads of streams and swamps, often occupying the normal position of the Portsmouth soils, although it naturally lies at a higher elevation than the latter. There are rather large bodies adjacent to the Tidal marsh in the southern and southwestern parts of the area, and it is these that are chiefly farmed. The surface is level, and artificial drainage is necessary to produce the best results. The soil is used for corn, hay, pole lima beans, and other vegetables, as well as strawberries. Yields are good when the season is not too wet. The forest growth on this soil is abundant and includes, in addition to the trees on the Sassafras gravelly sandy loam, a number of swamp species.

#### LAKWOOD SAND.

Typically the soil of the Lakewood sand is a white, loose, clean sand, 6 to 20 inches deep, with perhaps an average depth of 12 to 14 inches. This overlies either orange-yellow sand or brownish-yellow sand which passes below into orange-yellow sand.

This brownish-yellow subsurface stratum represents an approach to the Leon sand. In the lower situations it is developed as a coffee-brown, organic, somewhat compact layer, such areas representing the Leon sand as mapped extensively in Georgia and Florida. This compact layer varies from 3 to 8 inches in thickness and is encountered at depths of 10 to 30 inches.

There are included with the type some developments of the St. Lucie soils, which consist of clean white sand 3 feet or more deep. These soils also are common to Florida and other southern coastal States. Neither of these inclusions is extensive. The most important inclusion of Leon sand occurs one-half mile east of Mays Landing, while the St. Lucie soil occurs in small scattered patches. There are included also some small areas of Sassafras sand, whose surface soil is rather grayish, but not as white as that of the Lakewood series. Other areas are included, such as those north and east of Mays Landing, where the soil is decidedly coarse, with much fine gravel present. In several places about 3 miles southeast of Mays Landing the soil to a depth of 8 inches or more is a grayish, coarse sand, with more or less fine gravel in the surface soil and subsoil, both of which are slightly loamy. The soil here is not cultivated, but it would be more productive than the typical Lakewood sand. It is mainly associated with Swamp. The largest areas are found along the Maurice River and north of Mays Landing.

The surface of the Lakewood sand ranges from level, as south of Millville, to rolling and hummocky, suggesting wind action. The

drainage is usually excessive, and in dry weather vegetation suffers from lack of moisture.

The type is not extensive, and practically none of it is cultivated. There are some moderately successful vineyards and patches of bramble berries, but the soil is so leachy and so low in humus and mineral plant food that the expense of improving it to the point of reasonable fertility would be disproportionate to the returns.

#### PORTSMOUTH SANDY LOAM.

The Portsmouth sandy loam typically consists of 4 to 10 inches of dark-gray loamy sand to black mucky sand, overlying whitish or mottled white and yellow sandy loam to sandy clay. In some places the upper subsoil is a light-gray or white sand or loamy sand passing beneath into a white and yellow mottled sandy loam to sandy clay. Some included areas, such as that 1 mile south of Buckshutem, have the texture of a loam, with a correspondingly heavy subsoil. This area is cleared and ditched and gives excellent yields of hay, corn, and late vegetables. In places it shows an organic hardpan layer similar to that of the Leon soils. Another area of this included loam soil is recognized 4 miles southeast of Dennisville, bordering Timber and Beaver Swamp.

There are also included some small areas of Elkton gravelly loam, loam, and sandy loam, which are gray in the surface portion and light gray in the subsoil, and mottled with yellow. Gravel is often encountered in these areas at about 30 inches. They occur in the western part of the area in the vicinity of Gouldtown, Woodruff, and Cedarville. One of them occupies a rather large depression  $2\frac{1}{2}$  miles south of Centerton. The Elkton soils, like the Portsmouth, are flat and poorly drained, and the small fields that are cleared are used for the same crops as the Portsmouth sandy loam.

The Portsmouth sandy loam as mapped includes small areas of Leon sandy loam, which differs in having a highly organic, compact layer resembling a hardpan in the subsoil. One-half mile south of Vineland there is included a small area of Portsmouth silt loam. Many of the areas are variable, and many of the borings show Scranton sandy loam, but the areas are mapped as Portsmouth where the latter seems to be the predominating soil.

The Portsmouth sandy loam is an extensive type. It lies adjacent to swamps, and often as a belt between Tidal marsh and the upland types. Its surface is level and it is poorly drained, but a gravel stratum that is usually present in the lower subsoil aids the internal movement of water. Artificial drainage is effected by means of open ditches, practically no tile being used.

Only a very small part of this soil is cleared. The timber growth is abundant, including much or all of the upland vegetation and in

addition many of the swamp species. Wintergreen or tea berry is always abundant on this and similar soils. The type is used largely for the production of hay, of which it gives splendid yields when limed and manured, and corn, tomatoes, peppers, potatoes, beans, and strawberries are also grown extensively. The type produces large yields of strawberries of good quality.

This soil has considerable agricultural possibilities, and it should be more generally used for crops not grown for seed. Drainage is the essential in its improvement, and this should be accomplished with tile drains, the open ditches now used having been found very unsatisfactory. If the type were properly drained alfalfa could be grown over much of its area.

#### SCRANTON SANDY LOAM.

The Scranton sandy loam consists of a dark-gray to black loamy sand or sandy loam underlain at 6 to 10 inches by a pale-yellow sandy loam which passes below into yellow sandy clay. Frequently the moist or wet lower subsoil shows some gray mottling. Where it adjoins the Sassafras soils, the type resembles the soils of that series in its subsoil, but where typical the surface soil is like that of the Portsmouth sandy loam and the subsoil much like that of the Norfolk sandy loam, poorly drained phase. In most places a gravel stratum is present in the subsoil below a depth of 16 to 20 inches.

The Scranton sandy loam is much less extensive than the Portsmouth sandy loam. The largest areas are mapped in the vicinity of Marshallville and Risleyville.

The type is somewhat more productive than the Portsmouth sandy loam, but not much of it is farmed.

#### ST. JOHN'S SAND.

The St. Johns sand consists of a dark-gray to black sand, about 5 to 8 inches deep, overlying whitish sand which is underlain at any depth from 10 to 30 inches by a dark coffee-brown layer of rather compact sand, resembling a hardpan. This passes in turn into whitish or pale-yellow, wet sand or gravel. The hardpanlike stratum, which apparently has been cemented together by iron, is also rich in organic matter, which seems to further the cementing process. The stratum often is nearly black, showing an abundance of organic matter. Its hardness seems to be related to its color, as where it is only medium brown little or no resistance is offered to the soil auger, while where it is very dark brown or nearly black it is difficult to penetrate.

In some areas the brown hardpan stratum lies directly under the surface layer. Occasionally it is absent, such areas being really Portsmouth or Scranton sand, depending upon whether the subsoil



is white or yellow. The material below the hardpan is more frequently pale yellow than white. In places it is orange yellow.

There are included with the St. Johns sand, as mapped in this area, small areas of Swamp, Leon sand, Portsmouth sandy loam, Scranton sand, and Norfolk sand and sandy loam, imperfectly drained phases.

The St. Johns sand occurs in level or depressed, narrow belts adjacent to and at the head of swamps. The drainage is poor, and not much of the type is farmed. Artificial drainage would be somewhat difficult where the hardpan is well developed, as it interferes with the free internal movement of water whether the latter is moving under force of gravity or by capillary attraction. The type is not as productive as the Portsmouth sandy loam, although in many places the surface material is similar, both soils having sufficient organic matter to make them quite loamy. The forest growth is very similar to that on the Portsmouth sandy loam, and the type has about the same place in the agriculture of the area.

#### SWAMP.

The soil classed as Swamp occupies low, wet areas along streams and broad, wet flats about stream heads. The soil is highly variable. It consists chiefly of black mucky sand, loamy sand, sandy loam, or loam, 2 to 3 feet deep, overlying white or yellowish sand or dark-brown sand or sandy loam. This material was mapped as Hyde loamy sand in the Camden area, but because of its highly variable nature it is classed as Swamp in this survey. Occasionally the Swamp areas are full of small islands. This is particularly true of Bear Swamp between Cedarville and Dividing Creek. These islands are elevated 2 to 3 feet above the general surface and consist of Portsmouth sand and sandy loam, Elkton loam (in Bear Swamp), and Norfolk sandy loam, poorly drained phase. The soil in Bear Swamp is not very wet except in rainy seasons, and the growth is largely beech. Of less importance are Carolina red maple, sweet gum, sour gum, white cedar, and holly. The most valuable of the areas of Swamp are the "cedar swamps" or "cedar brakes," in which the most striking growth is white cedar. Good cedar-swamp areas bring \$200 to \$400 an acre for the timber. Other species occurring in abundance are sweet bay or swamp magnolia, Carolina red maple, sweet pepperbush, sour gum, marsh alder. Among the smaller plants blueberry, sumac, azalea, and ferns are abundant. In addition there are many grasses, mosses, rushes, and sedges.

Swamp is one of the most extensive types mapped in the Millville area, but it is of little agricultural importance. It is used only for the production of cranberries, a small acreage having been drained and diked and converted into cranberry bogs. Where the Swamp

adjoins Tidal marsh it is not always easy to determine the boundary, which therefore is drawn more or less arbitrarily in places.

#### TIDAL MARSH.

Tidal marsh consists typically of bluish or mottled rusty-brown, reddish-brown, and bluish-gray silty clay loam, overlying dark bluish-gray silty clay loam or silty clay which contains some sand in places. In some places the material consists of a brown to dark-brown or nearly black sand, sandy loam, or loam over bluish silty clay or silty clay loam. There is always present in the upper soil an abundance of plant roots and partly decomposed vegetable matter, and occasionally the upper soil consists largely of this fibrous material. The subsoil is charged with hydrogen sulphide.

This is one of the most extensive soils in the area. It forms a more or less continuous belt 3 to 5 miles wide along the south and east boundary of the area, and extends up the main rivers for a considerable distance.

The only agricultural product taken from this soil is "salt hay." Probably 10,000 to 12,000 acres or more are cut over each year for this hay. Where the land is dry enough to support machinery the grass is cut in summer; from the remainder the crop is harvested in the winter when the ground is frozen. If cut before it is frosted the hay is of better quality, and is used for feeding horses. The better grades of hay bring \$5 to \$6 a ton locally, and \$8 to \$10 at more distant markets. Many "meadows" are ditched and the ditches provided with flood gates. When it is desired to flood or irrigate the land these gates are opened so that the tidewater may come in.

In mapping Tidal marsh a distinction has been made between that part inundated by the tidal flow of salt water and that part similarly flooded with fresh water, the latter being shown on the map by symbol. Differences in vegetation, in ease of reclamation, and in agricultural value seem to warrant this separation. Much of the marsh originally overflowed by fresh water has been reclaimed by diking.

#### RECLAIMED TIDAL MARSH.

The Reclaimed tidal marsh consists of areas which have been protected from tidal inundation by dikes. The soil consists of a mottled brown and rusty-brown silty clay loam passing at 4 or 5 inches into mottled bluish-gray and rusty-brown silty clay and at 15 to 24 inches into bluish silty clay.

This is not a very extensive type. It occurs mainly along the Maurice River. Part of the type is farmed and the remainder is used for pasture. Deep open ditches are used to provide drainage. The surface soil after a few years' cultivation becomes quite mellow, but no

attempt is made to farm the land for two or three years after diking. The land is used chiefly for hay, corn, oats, strawberries, late potatoes, and tomatoes. Alfalfa is grown successfully in Cumberland County. Not much fertilizer is used, but some farmers use lime at the rate of 50 bushels per acre every four years. Acreage yields of 3 tons or more of hay or 100 bushels of corn are not uncommon. Strawberries yield abundantly.

#### COASTAL BEACH.

Areas mapped as Coastal beach consist of whitish to yellowish fine quartz sand, with a high content of black sand in places. They occupy the barren, wave-washed beaches and a higher adjoining strip upon which some vegetation has established itself. Here myrtle, yarrow, and beach grasses grow, with some pitch pine, red cedar, various oaks, wild cherry, sumac, red maple, and holly. The type is not extensive, and it is of little importance agriculturally. It is used in a small way for garden truck. The surface is rather hummocky in places.

#### MADELAND AND CLAY PITS.

In the areas mapped as Madeland and clay pits the soil has been filled in by artificial means or has been mined for industrial purposes. In most places the soil of the filled areas consists of sand and rubbish deposited by hydraulic dredges. Madeland proper occurs chiefly along the shore, at points where it has been desired to extend or make town sites.

#### SUMMARY.

The Millville area comprises the most southerly part of New Jersey. It covers all of Cape May County, the eastern three-fourths of Cumberland County, and the southern two-thirds of Atlantic County.

The area has no striking physiographic features. It is mainly level, but in places rolling. The general slope is to the south and east, and the range in elevation is from sea level to 141 feet above.

Delaware Bay receives the drainage from the western half of the area, and the Atlantic Ocean that from the eastern half. The two drainage basins are separated by a broad but not well marked ridge. The principal streams of the Delaware Bay watershed are the Maurice River, Dividing Creek, and Dennis Creek. The Tuckahoe and Great Egg Rivers, and the Mullica River lying outside the area surveyed, drain the Atlantic watershed.

All the rivers are tidewater streams for 5 to 15 miles from their mouths, and their tributaries, which penetrate all parts of the area, have their sources in or flow more or less sluggishly through low,

swampy areas. The upland, however, is for the most part well drained except in a broad belt adjacent to Tidal marsh north of Delaware Bay, where drainage is only moderately well developed.

Settlements in this region date back to the early part of the seventeenth century. From one-half to three-fourths of the population is native stock. The foreign population consists chiefly of Italian, Russian, Irish, German, or English people. The average number of rural inhabitants per square mile ranges from 28.6 in Atlantic County to 46.4 in Cumberland County and 74.5 in Cape May County.

The chief coast towns are Atlantic City, Ocean City, Cape May City, and Wildwood. The most important inland towns are Millville, Vineland, Egg Harbor, Cape May Court House, Mays Landing, and Port Norris.

Railroads reach nearly every part of the area, and graveled roads, well graded and well kept, reach all the farming sections.

The principal outside markets are New York and Philadelphia. Much produce is sold in the shore cities and in the local markets. There are a large number of canning factories in the area, and these take much produce.

The climate is mild and characterized by a generally high humidity, which at times makes the cold in winter penetrating and the heat in summer oppressive. The growing season averages 200 days in length.

Prior to 1880 general farming predominated in this region, but with the growth of the large centers of population, such as Philadelphia and New York, and the development of numerous resort towns along the Atlantic shore, there has been a heavy demand for all sorts of truck crops and products for human consumption, and the principal sources of income now are truck crops, poultry, and fruits. Hay and corn still are grown to a large extent, but mainly for use on the farm. Some rye and wheat are grown locally. The chief crops produced for sale are Irish potatoes, tomatoes, sweet potatoes, onions, beans, peas, peppers, sweet corn, watermelons, cantaloupes, asparagus, cranberries, strawberries, grapes, brambleberries, peaches, apples, and pears.

The poultry industry is important throughout the area. The chief breed of fowl is the White Leghorn.

The heavier soils are used for hay and corn, late truck crops, and tree fruits, and the lighter soils for potatoes, early truck crops, and small fruits. Drained areas of Swamp are used for growing cranberries.

Modern methods are used in farming, except that much of the labor is performed by hand. This is largely due to the small size of many

farms. Insects and diseases are kept well under control by modern methods such as spraying. Level cultivation is the rule for most crops. The farm equipment, including houses and barns, while not elaborate is well suited to the needs of the farmers.

In some sections no crop rotations are followed, in others only partial rotations. Continuous cropping, especially of sweet potatoes, is rather the rule. Cover crops are used widely. They consist chiefly of crimson clover, rye, and vetch.

Fertilizers are used for nearly all crops, in applications ranging from 200 to 1,600 pounds per acre. Potatoes receive the heaviest applications. The fertilizers in normal times run from 2 to 4 per cent of nitrogen content, from 8 to 10 per cent of phosphoric acid, and 7 to 10 per cent of potash. Much low-grade fertilizer is used, analyzing only 1.5 or 2 per cent of nitrogen. Stable manure and poultry manure, fish scrap, and bone are widely used.

The farms are for the most part small. They are largest in Cape May County, averaging 66.6 acres, and smallest in Atlantic County, averaging 46.4 acres.

Farms are generally rented on an equal-share basis, although in Atlantic County many farmers pay a cash rent. The number of owner-operators is unusually high.

The average price of farm land is in the neighborhood of \$50 an acre, and of uncleared land about \$20 an acre. The range for the former is from \$20 to \$250, and for the latter from \$6 to \$40. In Atlantic County the prices of uncleared land are higher than elsewhere.

From four-fifths to five-sixths of the area is uncleared. In the forested regions the growth consists mainly of huckleberry, pitch pine, and various oaks, often of bushy or only medium growth.

The Millville area lies wholly within the Coastal Plain province, and the soils have all been derived from unconsolidated material. Three geologic formations give rise to the soils, the most important of which is the Cobansey sand, followed by the Bridgeton and Cape May terrace formations.

Six series of soils are identified in the Millville area, the Sassafras, Norfolk, Portsmouth, Scranton, St. Johns, and Lakewood. The last four are each represented by one type.

The Sassafras series is made up of well-drained types with brown or grayish-brown surface soils and reddish-yellow subsoils. The gravelly sandy loam, sandy loam, and coarse sandy loam are used for medium to late truck crops, corn, hay, and tree fruits. The lighter members, the sand, coarse sand, loamy sand, and loamy coarse sand, are used largely for early truck, small fruits, sweet potatoes, and peaches.

The Norfolk soils are gray to brownish-gray, with yellow to pale-yellow subsoils. A large proportion of the sandy loam, poorly drained phase, is farmed, but comparatively little of the sand, poorly drained phase. These soils are used for hay, corn, late truck crops, and strawberries.

The Portsmouth sandy loam is largely uncleared. The surface soil of this type is dark-gray to black, and the subsoil is white to grayish, often mottled with yellow. Drainage is poor. Hay, corn, late truck, and strawberries are grown.

The Scranton sandy loam has the same character of surface soil as the Portsmouth, but the subsoil is yellow or pale yellow. This type is largely uncleared. Its agricultural use is similar to that of the Portsmouth sandy loam.

The St. Johns sand has a dark-gray to black surface soil and a white to yellowish subsoil. It differs from the Portsmouth in having at varying depths a coffee-brown, compact layer of sand, resembling a hardpan, which contains more or less organic matter. This soil is not as productive as the Portsmouth sandy loam, and not much of it is farmed. It is poorly drained.

The Lakewood sand is white to a depth of 14 or 20 inches, and below this orange to reddish yellow. This soil is excessively drained for the most part, and it is not productive. Practically none of it is farmed.

Tidal marsh is an extensive soil forming a more or less continuous belt around the south and east boundary of the area. Much of it is cut over for "salt grass," and no other use is made of the land. A part lying mainly along streams is overflowed by fresh water. Much marsh of this sort has been reclaimed by diking.

Reclaimed tidal marsh occurs mainly along the Maurice River. Part of this land is farmed, and it is also pastured quite extensively.

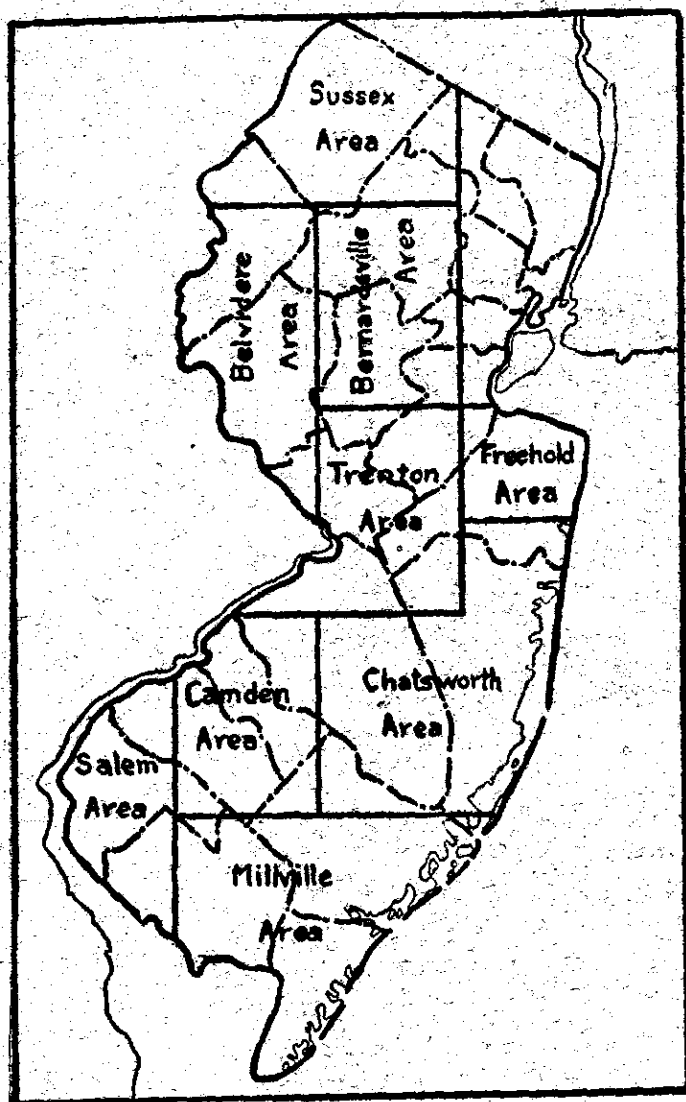
The soil mapped as Coastal beach occurs on long islands separating the marshes from the sea and Delaware Bay. The resorts along the shore are built mainly on this type.

Swamp comprises low, wet areas along streams, and broad, wet flats about stream heads. It is one of the most extensive types mapped, but is of little agricultural importance.





## SOIL MAPS OF NEW JERSEY.



Reports and maps of the Sussex, Freehold, Camden, Belvidere and Millville areas have been published; those for the Bernardsville and Chatsworth areas are in course of publication. The Trenton area is being surveyed; the Salem area remains to be done.

February, 1921.