

SOIL SURVEY OF THE SALEM AREA, NEW JERSEY.

By JAY A. BONSTEEL and F. W. TAYLOR.

LOCATION AND BOUNDARIES OF THE AREA.

The land area represented by the soil map, and discussed in this report, covers about 493 square miles in southwestern New Jersey. It lies between the parallels of $39^{\circ} 22' 30''$ and $39^{\circ} 52'$ north latitude and between the meridian of $75^{\circ} 11'$ west and the Delaware River. It comprises portions of Cumberland, Salem, and Gloucester counties. (See fig. 4.)

The cities of Woodbury, Bridgeton, and Salem, and the large towns of Woodstown, Swedesboro, and Elmer, are in or bordering on the area, while many smaller towns and hamlets are located within its borders. It approaches Camden and Philadelphia on the northwest. The area thus located near tide water and within easy reach of the large markets of the northeastern seaboard constitutes a rich and flourishing agricultural district, while the manufacturing interests of the cities and large towns provide a considerable nonagricultural population whose food supply is drawn from near-by farms.

PHYSIOGRAPHY AND GEOLOGY.

The southwestern portion of New Jersey lies entirely within the Coastal Plain region of the Atlantic seaboard. It is marked by low elevation, large tide-water indentations, and considerable areas of marshy land along the larger estuaries. Geologically, the rocks that comprise the area are of an age more recent than the Mesozoic, and the strata are unconsolidated. All the materials that constitute the land area of the region are of marine or estuarine origin, and the sheets or strata of gravel, sand,

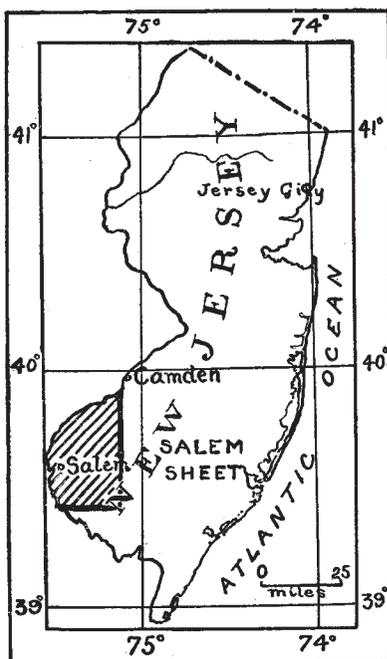


FIG. 4.—Sketch map showing area surveyed in New Jersey.

clay, and marl that build up the region dip at various angles from the northwest toward the southeast. The older strata thus reach the surface along the Delaware River, and the newer ones overlie them in orderly succession toward the Atlantic coast. The latest deposits, those classed by geologists as belonging to Pleistocene age, do not follow this orderly arrangement, but cover the older strata at all levels and in all localities, except where the larger streams have removed them, exposing the underlying material.

The shore of the Delaware River and Bay is formed by a low-lying, level terrace, which slopes back gently from tide water to an elevation of about 40 feet. It is somewhat marshy, and the stream courses are winding channels, in which the tide rises and falls. Owing to the low slope and the proximity of tide water, the natural drainage is apt to be inadequate, and some 20,000 acres of low land lying in Gloucester, Salem, and Cumberland counties have been partially reclaimed by dikes and ditches. Other areas have been underdrained by the use of tile, and extensive meadows and some cultivated fields now replace what was once partly flooded marsh.

Inland from the low foreland terrace and extending from an elevation of about 40 feet to one of 90 feet, a series of partially defined terraces is found. These terrace slopes are most pronounced just above the tidal portions of the larger streams. The soil found on these terraces differs but little from those on higher or lower levels, but the drainage facilities are different and the climatic conditions also vary slightly. Above 90 feet elevation the entire eastern part of the area consists of a rolling upland, which constitutes the divide between the Atlantic and Delaware drainage.

This upland does not rise above an altitude of 170 feet, and the greater part of the area lies below 150 feet.

The geological formations which constitute the basal framework of the region, consisting of the various layers of the Upper Cretaceous strata, which are the source of the glauconitic or greensand marl, reach the surface in the deeper stream cuttings along the slope that separates the upland from the low foreland.

The Sewell marls of the Rancocas formation outcrop at Woodstown and at Mullica Hill, and the marl is shipped from these points to different parts of the area. This marl is calcareous as well as glauconitic, and furnishes lime, potash, and phosphoric acid to the crops. Other formations of the Upper Cretaceous furnish some marls, while the Crosswick clays found at Woodbury constitute important deposits of brick clay.

Above the Cretaceous formations, along the margin of the highland, the Miocene is found. The shell marks found between Shiloh and Alloway occur in Miocene strata.

Overlying these formations are the different divisions of the Pleistocene, consisting of sands, gravels, and loams. They form an almost continuous surface covering and are of the greatest importance as the source of most of the agricultural wealth of the region.

The upland portion of the area is covered by a sheet of loam and gravel. The loam varies in thickness from 18 inches to 3 or 4 feet. It is underlain by a band of coarse gravel having a thickness of about 2 feet. In this gravel band are found numerous subangular bowlders of a size larger than that usually transported by water alone, and it is probable that these were carried to their present position by floating cakes of ice, as similar bowlders are deposited in small quantities every spring over the Delaware and Chesapeake flats. Under this gravel band is found a layer of cross-bedded sand of an orange color. Small seams and pockets of gravel are interspersed through the sand, and a small amount of clay makes the sand somewhat sticky and coherent. Large amounts of iron salts, chiefly the hydrated oxides, have been deposited in this formation, frequently cementing it into iron crust or ironstone. This orange sand usually rests upon either Miocene or Cretaceous sediments. Frequently the younger gravel or gravel loam rests directly upon the older strata without the interposition of the sandy layer. It is thus evident that the two belong to different periods of deposition, since the gravel and loam contain the ice-borne blocks and do not lie uniformly over the other strata. Some period of erosion must have intervened between the deposition of the cross-bedded orange sand and the gravel and loam of the surface formation.

Along the slope from upland to lowland the orange sand has reached the surface and under the influence of frost and rain has spread downward until it forms a deep covering over the so-called "barrens" of Cumberland and Salem counties. It gives rise to a definite soil type—the Norfolk sand; moreover, it has furnished large amounts of sand to ancient streams, and by their agency it has been rebuilt into the surface covering over part of the lower-lying areas, thus giving rise to younger Pleistocene terraces marked by the same soil types.

In other localities the deposit of loam covering the upland extends down over the slope and joins the newer Pleistocene terrace of the foreland. North of Alloway these coverings of later material are lacking over a considerable area, and a tough, plastic, Miocene clay forms the greater part of the surface. Small amounts of gravel, sand, and loam are still found in this region, showing that they were once continuous over its surface. They have been removed and redeposited to form Elsinboro fine sand, while the silts and clays derived from the older Pleistocene, and even Miocene, strata were deposited to form the low-lying Sassafra loam and the Elkton clay.

The geological formations of the region thus influence the soils, the

drainage, and the configuration of the region. Similarly, the changes that have occurred since the region finally became a land area influence the character of the surface and the drainage. These elements, the geology and the physiography, control the region and the character of the soil as we find them.

CLIMATE.

In the following tables are given some of the essential climatological features of this section of New Jersey. The tables contain the normal monthly and annual temperature and precipitation so far as available in the records of the United States Weather Bureau stations located at Bridgeton, Vineland, Billingsport, and Friesburg.

Normal monthly and annual temperature and precipitation for Salem area, New Jersey.

Month.	Temperature.		Precipitation.			
	Bridgeton.	Vineland.	Billingsport.	Friesburg.	Bridgeton.	Vineland.
1900.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
January.....	34.7	31.6	2.84	2.73	3.30	4.45
February.....	36.7	33.3	4.75	4.08	4.29	4.03
March.....	41.7	39.5	4.04	3.11	4.76	4.29
April.....	52.8	50.5	3.93	3.42	3.58	3.29
May.....	64.7	62.2	5.42	4.98	5.18	3.94
June.....	73.8	72.2	4.14	3.66	3.72	3.49
July.....	77.2	76.8	3.69	3.57	4.74	4.62
August.....	75.6	73.8	5.38	3.93	3.85	4.81
September.....	68.6	66.8	3.01	3.19	3.03	3.80
October.....	56.0	55.2	3.96	3.86	4.27	3.44
November.....	46.1	43.6	4.10	3.74	3.57	2.65
December.....	38.1	34.5	3.27	2.86	3.37	3.70
Normal annual.....	55.5	53.5	48.53	43.12	47.66	47.47

In the table below the average dates, as well as the first and last reported dates of killing frosts in the fall and spring, are given for the same stations, and also for the station at Salem:

Dates of first and last killing frosts.

Station.	Last in spring.		First in autumn.	
	Average date.	Latest date.	Average date.	Earliest date.
Billingsport.....	Apr. 9	Apr. 20	Oct. 26	Oct. 17
Bridgeton.....	Apr. 16	May 10	Oct. 18	Oct. 1
Salem.....	Apr. 12	Apr. 17	Oct. 17	Oct. 2
Vineland.....	Apr. 19	May 13	Oct. 19	Oct. 2
Friesburg.....	Apr. 20	May 10	Oct. 20	Oct. 28

SOILS.

There are 11 soil types, including Meadow, in the Salem area, the areas of which are shown in the subjoined table.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Norfolk sand	78,410	24.8	Elkton clay	11,240	3.6
Sassafras loam	64,930	20.6	Alloway clay.....	10,580	3.4
Meadow	52,250	16.6	Westphalia sand	4,470	1.4
Sassafras gravelly loam	43,210	13.7	Collington sandy loam	4,170	1.3
Windsor sand	18,280	5.8	Total.....	315,570	.....
Quinton sandy loam.....	16,790	5.3			
Elsinboro fine sand.....	11,240	3.6			

SASSAFRAS LOAM.

The Sassafras loam is one of the most extensive and most important of the soil types found in the area covered by the soil map. It occurs in two long, irregular strips, which converge toward the northeast and unite on the upland between Elmer and Woodstown. Several small, detached areas indicate a former greater extension of the areas of this type. The soil lies at all levels, from a few feet above tide to a maximum altitude of about 160 feet. The chief areas are found on the low foreland between tide water and an elevation of 50 feet, and above the 90-foot level. These two occurrences are usually separated by an area of Norfolk sand or Sassafras gravelly loam, lying along the intermediate slope, though in several instances the higher and lower areas overlap each other.

Throughout its extent the Sassafras loam is marked by a gently undulating surface, which gives slope sufficient to furnish adequate drainage, though forming an easily cultivated surface. The soil does not wash, even during the heaviest freshets, and is rarely subject to overflow.

The Sassafras loam, like all the other soil types of the area, is a marine sediment deposited during the latest submersion of this portion of the Atlantic coast. The materials were derived from land areas which existed at a time when this region was below sea level. These mineral particles were carried into the sea by streams, waves, and tidal currents.

The Sassafras loam may be defined as consisting of a soft, friable brown loam; usually slightly sandy, having a depth of about 8 inches. It is underlain by a somewhat clayey yellow or reddish-yellow loam, which varies in depth from a minimum of about 2 feet to a maximum of 6 or 7 feet. This is in turn underlain by a band of gravel. This gravel band, though not an essential feature of the Sassafras loam, plays a very important part in the natural underdrainage of the soil type.

The Sassafras loam occurs in several other Coastal Plain regions besides that of southwestern New Jersey, but in Gloucester, Salem, and Cumberland counties it has been brought to a very high state of cultivation, and its crop yields compare favorably with those of the heavy

clay soils of the limestone areas of the Appalachian valleys. In southwestern New Jersey the Sassafras loam supports that type of agriculture usually called general farming. Of the grain crops, wheat, corn, rye, and oats are produced. The yield of wheat will range from 25 to 35 or 38 bushels per acre; that of corn from 45 to 75 bushels per acre, while fields of timothy and clover mixed produce from 1½ to 2½ tons of hay per acre. Some fine herds of thoroughbred and grade cattle are maintained on this soil type. The chief breeds are Guernsey, Jersey, and Holstein. The milk is either manufactured into butter on the farm or shipped to Philadelphia, or, during the summer months, to some of the Atlantic seashore resorts. The price received by the farmers varies from 3 to 4 cents a quart for milk shipped, with a charge of one-half cent a quart for transportation. One or two small skimming establishments purchase some milk at a lower rate for the purpose of furnishing cream and ice cream to the cities and larger towns. Tomatoes and white potatoes are extensively produced on the Sassafras loam as well as on other soil types. The tomato crop averages 6 or 7 tons per acre, the average price paid by the canning companies being \$6 a ton. The potatoes yield from 150 to 225 bushels an acre. Among the fruits, apples and pears are the only kinds produced extensively on the Sassafras loam.

Under the climatic conditions existing in the region the Sassafras loam is the best soil for the production of the general farm crops enumerated. A larger amount of stock, and especially dairy cows, could be maintained to advantage on most of the farms located on the Sassafras loam.

The following mechanical analyses show the texture of the soil and subsoil of the Sassafras loam:

Mechanical analyses of Sassafras loam.

No.	Locality.	Description.	Soluble salts, as determined in mechanical analysis.		Organic matter and combined water.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>								
5669	1 mile S. of Daretown.	Brown loam, 0 to 9 inches.	0.01	3.64	1.28	1.56	1.96	2.62	3.16	74.28	9.95	
5671	½ mile S. of Sharptown.	Fine brown loam, 0 to 10 inches.	.....	4.86	.74	5.34	9.00	8.60	2.80	58.08	10.62
5670	Subsoil of 5669....	Heavy yellow loam, 9 to 32 inches.	.01	3.06	.62	1.76	1.14	1.42	1.38	74.22	16.08	
5672	Subsoil of 5671....	Heavy yellow loam, 10 to 36 inches.	.01	2.70	.50	2.46	3.90	5.28	3.26	65.78	15.49	

QUINTON SANDY LOAM.

The Quinton sandy loam is found chiefly in those localities where the clay layers of the older geological formations, particularly of the Miocene, have been partially reworked and mingled with the sands of a later period of deposition. This is true not only of the more extensive areas lying near the larger streams along the base of the Miocene escarpment, but also of those areas upon the upland where the clay approaches the surface. The surface of the Quinton sandy loam is generally slightly rolling and fairly well drained. The surface soil consists of about 8 inches of loamy sand, frequently containing a small percentage of rather fine gravel. The depth of this soil varies considerably between the limits of 4 and 18 inches. It is underlain by a subsoil which, though quite sandy, is also marked by a large percentage of stiff, plastic yellow clay. The combination of soil and subsoil constitutes an easily worked and finely productive agricultural area well adapted to general farming operations and only less productive than the larger areas of Sassafras loam. The sandy nature of the soil prevents saturation during periods of excessive rainfall, and clodding and baking during periods of drought, while the heavier subsoil provides an excellent reservoir for the maintenance of a large water supply throughout the growing season.

This soil is particularly well adapted to the production of corn. A good stand of clover is also easily obtained, and where the sandy soil is deepest some of the trucking crops can be produced to advantage, though they do not mature in time for the earliest markets.

The soil, as has been indicated, owes its origin to a reworking during Pleistocene time of the Miocene and older clays with the older sands of the Pleistocene deposition. The areas near the base of the Miocene escarpment constitute the marginal portions of delta deposits formed by the principal streams, which carried loads of sand from the upland within the reach of the waves that at one time worked along the base of this escarpment. The intimate mingling of the sand and clay of the subsoil is due to this wave action. The Quinton sandy loam frequently grades in one direction into Norfolk sand, as the sandy soil becomes deeper, and in the other direction into Alloway clay, as the basal formations approach the surface.

The following mechanical analyses show the texture of soil and subsoil of this type:

Mechanical analyses of Quinton sandy loam.

No.	Locality	Description.	Soluble salts, as determined in mechanical analysis.	Organic matter and combined water.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
5665	3 miles S. of Quinton.	Brown loamy sand, 0 to 9 inches.	0.01	1.86	4.20	12.36	17.70	31.86	6.36	19.30	5.39
5667	1½ miles W. of Elmers.	Medium loamy sand, 0 to 8 inches.	.01	1.40	2.66	17.04	22.00	22.06	5.76	24.20	3.67
5666	Subsoil of 5665....	Red, sticky sandy loam, 9 to 32 inches.	.01	2.56	4.46	11.96	15.40	27.90	3.50	19.00	16.05
5668	Subsoil of 5667....	Red, sticky sandy loam, 8 to 32 inches.	.01	1.70	1.52	11.72	19.96	20.76	4.74	28.26	10.17

ELSINBORO FINE SAND.

The Elsinboro fine sand occupies low, rounded hillocks and level spaces lying between them, upon the river necks along the Delaware. These sandy hillocks usually rest upon a layer of clay, which rises inland into areas of Elkton clay and sinks toward tide water into meadow areas. This clay plays an important part in determining the under-drainage and consequently the soil value of the Elsinboro fine sand.

The soil of this type consists of a fine, loamy brown sand having a depth of about 9 inches. It is underlain by a fine, loamy yellow sand, which varies in depth from 8 or 10 inches to 2 or 3 feet in the intervening hollows. In some localities the sand becomes coarser and less loamy, grading into typical Norfolk sand.

The surface of this soil type rarely attains an altitude of over 20 feet above tide level. The higher elevations are well drained and productive; but throughout the area small, irregular depressions exist, which, if of greater extent, would be mapped as Elkton clay or Meadow.

The Elsinboro fine sand is farmed to wheat, corn, and tomatoes and a few other truck crops. The yield of wheat varies from 15 to 25 bushels; that of corn from 35 to 50 bushels; that of tomatoes from 5½ to 7 tons per acre.

The Elsinboro fine sand is a better soil for late truck than for general farming. It should furnish an area well adapted to the production of

strawberries, and other small fruits, sweet corn for market and canning factory, and green peas. The fact that it can produce fair crops of grain is due to the near presence of the underlying clay stratum and to its proximity to tide water rather than to the texture and composition of the soil.

The following mechanical analyses of the Elsinboro fine sand show its texture:

Mechanical analyses of Elsinboro fine sand.

No.	Locality.	Description.	Soluble salts, as determined in mechanical analysis.		Organic matter and combined water.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.								
5653	2 miles SE. of Hancock's bridge.	Fine brown loamy sand, 0 to 8 inches.	0.01	3.88	2.14	8.44	13.48	23.32	4.74	37.88	5.87	
5654	Subsoil of 5653....	Fine loamy sand, 8 to 26 inches.	.01	1.90	1.70	7.00	10.20	14.78	1.24	52.34	9.65	

ELKTON CLAY.

The largest areas of Elkton clay are found near tide water, though a few small areas are located on the divide between the Atlantic and Delaware drainage. It usually adjoins the Sassafras loam. The surface of the areas of Elkton clay is usually very flat, or saucer shaped. This soil type owes its present condition to a lack of adequate drainage.

The soil consists of a brown or gray silty loam, having an average depth of about 6 inches. This is underlain by a grayish-yellow clay-loam subsoil, which becomes a mottled gray and yellow clay at a depth of about 28 inches.

Along the margin of the areas the Elkton clay usually grades imperceptibly into the Sassafras loam through an increase in the depth of the loamy soil and subsoil. It also frequently occurs in low-lying areas, which are so wet as not to be susceptible of general cultivation, and are classed as Meadow. The Elkton clay owes its existence as a soil type to the fact that it lies in such position that the circulation of the soil moisture and of the soil atmosphere is obstructed. As a result the mineral particles of the soil have only partially passed through the processes of decomposition which liberate and prepare the plant foods. In the same way the organic constituents of the soil are subject to only a partial decay, and as a result these soils are saturated with water and acid solutions, and are said to be cold and

sour. With proper underdrainage the level of the water table may be lowered, the impeded circulation of water and air improved, and this soil be made much more productive. In the course of time this process may be carried so far that the Elkton clay would gradually approach the condition of the Sassafras loam. Even at present the Elkton clay is capable of producing good crops of grass and wheat and fine pasturage.

The following table gives the mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Elkton clay.

No.	Locality.	Description.	Soluble salts, as deter-	Organic matter and com-	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			mined in mechanical analysis.									bined water.
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
5651	3 miles E. of Salem.	Yellow silty loam, 0 to 7 inches.	0.01	2.12	0.56	4.36	7.22	8.74	4.64	60.20	10.77
5652	Subsoil of 5651....	Brittle clay loam, 7 to 36 inches.	.01	3.42	.08	.70	1.14	2.00	3.00	61.34	28.27

ALLOWAY CLAY.

The Alloway clay has the largest area of any of the soil types derived directly from the older geological horizons of the region, forming one of the basal members of the Miocene formations. On the outcrops it consists of a plastic, sticky gray mass, very dense and impervious to water. It influences the soil over considerable areas, even when not forming the immediate surface of the country. Practically all this type lies between Alloway and Woodstown, in one large area of about 17 square miles, whose subsoil consists of this clay either in its original position or slightly reworked into a Pleistocene covering, separated from the Miocene clay by a thin gravel band.

This area is hilly and irregular, poorly drained, and only partially subjected to cultivation. Small forest areas are found, whose timber consists of black and sweet gum, several varieties of oak, and pitch pine.

The soil of the Alloway clay consists of a brown or reddish-brown loam, frequently containing 15 to 20 per cent of fine gravel, especially on the higher elevations. The soil has a depth of from 4 to 8 inches. It is underlain by a waxy, sticky gray or yellow clay, very impervious to water and difficult to drain. It is by far the most dense clay found in the region. Though it resembles the Elkton clay in color, it

is sticky and plastic, while the Elkton clay when dry is friable. The Alloway clay resembles the variegated clays of the Potomac group of the Cretaceous formation found in the Maryland-Delaware area, and as a soil type it is more nearly related to the Susquehanna clay loam than to any other Eastern soil type. Where cultivated the Alloway clay produces fair crops of corn, wheat, tomatoes, and grass, but it is farmed successfully only by the best agriculturists of the region. The Alloway clay could be greatly improved in texture and in productivity by generous applications of lime. The incorporation of additional organic matter, through the application of stable manures and the plowing under of green crops, would also be advantageous.

A general system of drainage for the large main area of the Alloway clay should be devised and put into operation through the joint efforts of the landowners of the region. In this way the land could be brought to a much higher state of productiveness than at present.

The following mechanical analyses show the textural characteristics of this soil type:

Mechanical analyses of Alloway clay.

No.	Locality.	Description.	Soluble salts, as determined in mechanical analysis.		Organic matter and combined water.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.								
5643	1 mile NW. of Alloway.	Brown loam, 0 to 6 inches.	0.02	4.98	0.72	4.60	6.28	8.04	2.12	54.48	16.96	
5645	1½ miles SW. of Ewans Mills.	Brown clay loam, 0 to 8 inches.	.01	6.00	5.26	12.70	6.40	9.90	7.10	35.12	18.93	
5644	Subsoil of 5643....	Stiff clay, 6 to 36 inches.	.01	4.44	.78	3.20	4.98	6.76	3.82	36.54	39.99	
5646	Subsoil of 5645....	Waxy clay, 8 to 32 inches.	.01	4.54	2.40	6.40	3.68	7.94	11.72	35.46	27.13	

NORFOLK SAND.

The Norfolk sand occurs at all elevations, from sea level to the highest portion of the upland. It covers the low forelands of the northern part of the area almost to the exclusion of all other types of soil. Near the large stream channels it has been extensively deposited as the surface covering of the deltas formed by these streams when the land lay about 50 feet lower than at present. The outcrops of the cross-bedded orange sand of the upland, when not too gravelly, also form small areas classed with this type, while the headwaters of the larger streams have spread out small local areas of this sand along their courses.

The areas of Norfolk sand occurring along the lowest foreland are relieved only by slight elevations, to be ascribed in part to old sand-bars deposited during the formation of this portion of the land area and in part to the drifting of this sand under the impulse of the wind from the time when the land first emerged from the water to the present day.

The large deltas found west of Swedesboro, Auburn, and Sharptown rise in gentle, undulating slopes to elevations of 80 or 90 feet, joining the lower-lying areas to the long strips of sandy soil which stretch inland along the stream courses. These in turn may be traced back to the sandy layers which outcrop near the headwaters of the same streams. Though belonging to several stages of Pleistocene deposition, the Norfolk sand has been continually reworked from its earliest advent into the region to the present time, and even now its surface is in motion in many places where air and water currents have access to the sand.

The southwestern New Jersey area is only one of many localities along the Atlantic seaboard where the Norfolk sand plays an important part in the agricultural wealth of the community. From the New England States southward past Cape Hatteras the low-lying river necks adjoining tide water have in recent years become the scene of extensive truck farming, and the New Jersey area has taken a foremost place in this line of industry. Sweet potatoes, cantaloupes, watermelons, peppers, eggplant, white potatoes, sweet corn, and various other crops are produced in large quantities upon this soil. The New Jersey locality is most noted for the quantity and quality of its sweet potatoes and melons.

The soil of the Norfolk sand areas consists of a loose reddish-brown sand of medium to coarse texture, containing a small percentage of silt and clay and amounts of organic matter that vary largely with the state of cultivation of particular fields. The soil proper extends to a depth of 6 or 8 inches and is underlain by a medium-yellow or reddish-yellow sand that usually becomes rather loamy at the depth of about 3 feet. In the lower-lying areas along the river necks a layer of clay is frequently encountered under this sand at depths of 5 or 6 feet. Along the slopes the sand is usually deeper. The areas of Norfolk sand lying near tide water are so situated that the surface of the permanent water table in the soil approaches nearly to the surface of the soil; in some instances the subsoil is permanently wet at a depth of only 3 or 4 feet. On the higher ridges and in the more elevated sloping areas this water table is found at greater depths. This difference in relation to underground circulation permits the production of crops of wheat and corn upon the river necks, such as would scarcely be expected from such a coarse and porous type of soil. Under the most

favorable conditions for grain production, which include an abundant and well-distributed rainfall, yields of 25 bushels of wheat and of 50 or 60 bushels of corn per acre are reported from the Norfolk sand in the tide-water regions, though smaller yields are more common. It is as a trucking soil that the Norfolk sand attains its greatest value and gives the best returns.

No soil of this region can compete with the Norfolk sand in the production of early melons and sweet potatoes. The sandy nature of the soil, which operates against the production of large grain crops, permits the forcing of the truck crops to an early maturity and brings the products of the fields upon a favorable market. These crops, on the other hand, are gathered and marketed before there is much danger from the summer droughts.

The position of this soil near tide water and the larger streams places the crops at an advantage in respect to water transportation, and in the case of the New Jersey area this same location permits the farmers to secure large quantities of the best stable manure, at little cost, from the cities located along the Delaware. Owing to this fact the fertility of the land is carefully maintained, and a system of intensive farming has been developed.

The following mechanical analyses show the physical constitution of the Norfolk sand:

Mechanical analyses of Norfolk sand.

No.	Locality.	Description.	Soluble salts, as determined in mechanical analysis.		Organic matter and combined water.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.		Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.			P. ct.	P. ct.					
5659	1½ miles north of Courses Landing.	Brown loamy soil, 0 to 8 inches.	0.01	1.66	0.94	9.60	26.80	37.80	2.26	16.64	2.55		
5661	Pecks Corners....	Medium to coarse yellow sand, 0 to 8 inches.	.01	.88	Tr.	5.72	17.48	56.32	2.90	13.38	1.91		
5663	1½ miles west of Mullica Hill.	Medium sand, 0 to 8 inches.	.01	3.38	1.54	18.60	23.34	25.62	4.62	16.42	7.67		
5660	Subsoil of 5659....	Yellow sand, 8 to 40 inches.	.....	.62	.....	10.44	26.84	40.84	2.14	15.04	2.54		
5662	Subsoil of 5661....	Medium to coarse yellow sand, 8 to 40 inches.	.01	.82	Tr.	3.46	13.60	62.08	2.60	13.42	3.89		
5664	Subsoil of 5663....	Medium red sand, 8 to 40 inches.	.01	1.98	1.04	14.04	22.54	28.00	4.44	17.90	10.55		

WESTPHALIA SAND.

The Westphalia sand occupies small areas lying along the slopes in the northwestern portion of the region. It is derived from sandy layers outcropping along these slopes, though the larger part of this soil formation owes its origin to a natural soil creep from the outcrops downward toward the stream courses.

The surface of this soil is moderately sloping and fairly well drained. The soil itself consists of a fine brown sand, slightly loamy from the accumulations of organic matter incorporated during cultivation. At a depth of about 6 inches this is underlain by a fine, sharp yellow sand of very uniform texture and containing very little other material. Below a depth of 30 inches it sometimes becomes slightly loamy, or even sticky. This soil constitutes a trucking type of fair value. It is better adapted to cantaloupes, watermelons, and tomatoes than to other truck crops. It also produces a fair yield of corn and is capable of making a good stand of clover. It is coarser and less loamy than the Elsinboro fine sand and appears much finer grained than the Norfolk or Windsor sand.

The following mechanical analyses show the texture of this soil:

Mechanical analyses of Westphalia sand.

No.	Locality.	Description.	Organic matter and com-	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			bined water.							
			<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>	<i>P. ct.</i>
5655	½ mile North of Harrisonville.	Fine brown sand, 0 to 8 inches.	0.98	.....	6.32	23.12	47.16	6.34	12.98	2.10
5656	Subsoil of 5655.....	Fine yellow sand, 8 to 32 inches.	.64	1.20	9.10	25.44	37.50	3.68	18.48	2.64

COLLINGTON SANDY LOAM.

The Collington sandy loam occupies positions in the present area where the greensands of Cretaceous age approach the surface, or where this material in large quantities has been reworked into a Pleistocene terrace covering. Although the total area covered by this soil formation is small, it presents a very interesting soil type, differing in its physical texture and chemical composition from all the other soils of the region.

The soil itself is a sandy loam, usually of a reddish-brown color, and frequently containing considerable amounts of gravel. It represents the weathering product of the original greensand. The loamy char-

acter of this soil is caused by the presence of partially decomposed glauconite, small green specks of which may usually be detected. Where the disintegration has proceeded further, the soil is usually more sandy and of a characteristic dark-red color. This arises from the fact that the other elements of the glauconite have been largely leached away, while the hydrated oxides of iron have accumulated as a rusty coating over the remaining soil grains. The characteristic sticky, green glauconitic subsoil is usually encountered at a depth of 6 or 8 inches. It is tenacious and claylike in texture and the color gives abundant evidence of the presence of considerable amounts of glauconite. This mineral is a complex silicate of potash, lime, and iron, containing small amounts of phosphoric acid. The extensive accumulations of this mineral in the Eocene and Cretaceous beds of the Atlantic seaboard constitute the greensand marl, and the chemical elements already enumerated constitute the fertilizing basis which has led to its extensive utilization as a natural fertilizer.

Since millions of tons of this greensand marl have been employed as fertilizers, it is at once evident that any soil type possessing a subsoil of this material will contain more than the ordinary amounts of potash and lime. When, in addition to this, its physical structure is also well adapted to crop production, it would seem that a particularly valuable soil was formed.

In southwestern New Jersey the areas of Collington sandy loam are rather limited in extent, and those derived directly from the weathering of outcrops of the marl are usually located upon the steeper slopes and are of no especial value. The larger terrace areas, however, like those between Woodstown and Swedesboro and near Mullica Hill form a productive soil for general farm crops. They also produce large yields of sweet potatoes, though the crop is somewhat late in maturing. This soil type is well adapted to the production of apples and pears. In the case of this peculiar soil the chemical as well as the mechanical analyses are given:

Chemical analyses of Collington sandy loam, Woodstown, N. J.

Constituent.	Subsoil.	Marl.	Constituent.	Subsoil.	Marl.
	<i>Per cent.</i>	<i>Per cent.</i>		<i>Per cent.</i>	<i>Per cent.</i>
Potash (K ₂ O).....	0.25	1.09	Phosphoric acid (P ₂ O ₅).....	0.08	3.28
Soda (Na ₂ O).....	.25	3.83	Sulphuric acid (SO ₃).....	.04	1.77
Lime (CaO).....	.17	1.28	Insoluble.....	87.86	49.33
Magnesia (MgO).....	.59	3.24	Moisture.....	1.33	6.25
Manganese (MnO).....	.02	.02	Volatile organic matter.....	1.93	4.69
Iron oxide (Fe ₂ O ₃).....	3.26	17.82		99.67	97.47
Alumina (Al ₂ O ₃).....	3.89	5.37			

The marl specimen was collected as a sample to show the amounts of plant foods in material actually used as a fertilizer. The potash

content is not high for a greensand marl, but the phosphoric acid content is unusually high.

The subsoil analysis reveals the fact that the lime, potash, and phosphoric acid of the original material have been extensively dissolved and removed, though fair amounts still remain.

The following table shows the texture of the soil and subsoil of this type:

Mechanical analyses of Collington sandy loam.

No.	Locality.	Description,	Soluble salts as determined in mechanical analysis.		Organic matter and combined water.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			<i>P. ct.</i>	<i>P. ct.</i>								
5647	2 miles N. of Woodstown.	Brown loamysand, 0 to 16 inches.	0.01	1.52	1.02	16.60	28.10	30.12	4.94	13.34	3.91	
5649	1 mile W. of Mullica Hill.	Brown loamysand, 0 to 12 inches.	.01	2.08	.96	14.80	22.04	28.56	9.02	15.38	5.87	
5648	Subsoil of 5647....	Sticky greensand, 16 to 40 inches.	.01	6.38	1.62	10.00	19.16	20.60	5.52	20.58	16.69	
5650	Subsoil of 5649....	Sticky greensand, 12 to 36 inches.	.02	4.36	.86	5.36	7.06	11.22	4.12	11.38	55.14	

WINDSOR SAND.

The Windsor sand occurs chiefly along the eastern border of the area, but it is also found near the Delaware River, in the vicinity of Paulsboro. The surface of this soil is usually flat or only gently inclined, and, with the exception of the deeper depressions, it is well drained.

The larger eastern areas of this soil type seem to owe their origin to wave action along an old shore line. The sand and fine gravel were piled together much as they are being heaped up along the present Atlantic coast. Wave action spread out and leveled the sand, and the uplift of the land carried with it a sediment which still closely resembles beach sand. Even the area near Paulsboro resembles such deposits, though it may have originated from stream deposition, where the water was moving most rapidly. Some of the smaller upland areas of Windsor sand owe their origin to the weathering of the cross-bedded sand and gravel which underlies the loam of the highest upland.

The larger part of the Windsor sand area is forested in scrub oak and pitch pine, while the cultivated crops are chiefly melons, sweet potatoes, tomatoes, and corn. On some of the lower-lying areas

asparagus is cultivated also. The cultivation of wheat is not generally attempted, but some rye is produced. The Windsor sand, when properly situated with respect to markets, constitutes a fair early truck soil. In its cultivation stable manures and other organic fertilizers are of greater value than commercial varieties. The open, porous character of this soil makes it necessary to furnish organic matter, both as a plant food and as an absorbent material for the storage of moisture. Crimson clover, cowpeas, and coarse stable manures should be plowed under to give the soil body and water-holding capacity.

The soil of the Windsor sand consists of medium to coarse sand and fine gravel, having a depth of about 8 inches. The subsoil consists of a similar coarse sand and fine gravel, frequently containing large amounts of iron crust. The whole mass has a depth of from 5 to 20 feet, and is usually separated from underlying formations by a bed of coarse quartz gravel.

The following mechanical analyses show the sandy nature of the soil:

Mechanical analyses of Windsor sand.

[Fine earth.]

No.	Locality.	Description.	Soluble salts, as determined in mechanical analysis.		Organic matter and combined water.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.								
5677	½ mile SW. of Mickleton.	Coarse sand and gravel, 0 to 6 inches.	0.01	2.98	5.34	26.30	33.32	20.20	1.26	7.08	2.49	
5679	Yorktown	Coarse sand and fine gravel, 0 to 8 inches.	.01	1.40	10.32	21.90	22.60	30.68	3.06	7.06	2.87	
5681	1 mile NW. of Hardingville.	Coarse sand and gravel, 0 to 6 inches.	.01	1.38	1.86	9.90	21.36	53.36	3.26	6.66	1.63	
5678	Subsoil of 5677.....	Coarse sand and gravel, 6 to 40 inches.	.01	1.02	5.30	22.36	32.10	26.46	1.38	7.00	3.43	
5680	Subsoil of 5679.....	Coarse sand and gravel, 8 to 36 inches.	.01	1.14	15.04	21.40	20.50	27.48	1.70	8.64	4.03	
5682	Subsoil of 5681.....	Coarse yellow sand.	.....	.98	2.34	11.48	20.54	52.60	2.84	4.92	3.28

SASSAFRAS GRAVELLY LOAM.

The Sassafras gravelly loam, in its most extensive development, occupies upland areas along the eastern border of the region. It is also found along most of the stream terraces. It also reaches the surface in numerous places where the lower lying areas of the Sassafras loam fail to overlap the higher lying portions of the same soil type. Some of the steeper slopes of the upland areas of the Sassafras loam have been worn so thin that the gravel content of the soil is sufficiently high to require its classification as Sassafras gravelly loam.

The later Pleistocene deposits throughout the entire Coastal Plain are almost uniformly marked by a pronounced gravel band which separates them from older Pleistocene or more ancient deposits. This gravel band varies in thickness from 5 or 6 inches to a maximum of 4 or 5 feet. The greater part of the gravel has a diameter of 2 or 3 inches, but embedded in it are angular, partly worn bowlders of ancient crystalline or sedimentary rocks. They are not as thoroughly waterworn as the pebbles with which they are associated. Their size is markedly greater than that of any of the pebbles with which they are associated. They come from remote regions, and are derived from many different rock ledges. Some of them bear indistinct traces of the slight scratches or striations usually attributed to glacial action. Their presence is best explained on the hypothesis that they were brought down the large main stream courses embedded in cakes of floating ice and were released when these cakes melted, to become a part of deposits of an entirely different kind that were formed over the bottom of the sea during or subsequent to the Glacial period.

The gravel bed thus characterized underlies several distinct terraces of Pleistocene age, both in the New Jersey area and in adjoining States. It may be covered by extensive deposits of loam or sand or these may have been partially swept away by recent stream action. In the latter case, especially where some portion of the formerly existing loam sheet survives, the mixture of loam and gravel forms a peculiar soil type, which has been described as the Sassafras gravelly loam.

The soil itself consists of from 20 to 40 per cent of medium-sized gravel mingled with a brown sandy loam, which contains the total supply of plant food. The gravel consists chiefly of rounded white quartz pebbles, varying in size from one-half inch to 2 inches in diameter. When larger masses are present they are usually of the angular variety already described, and are more properly bowlders or cobbles of Paleozoic sandstones, frequently containing characteristic fossils, and Archean gneisses or schists. The proportion of pebbles is frequently greater at the surface than immediately below it, for the finer particles which constitute the soil proper have been carried away by rain wash, or have been worked downward relatively through the same agency,

through frost action, or through cultivation. The immediate subsoil also is frequently more loamy than the surface soil, as it is not turned up by the plow and laid bare to these agencies. It consists of a somewhat sticky though gravelly reddish-yellow loam, descending to a pronounced gravel bed at a depth of from 18 to 24 inches. The lowest limits of this gravel bed are marked either by the orange-colored, cross-bedded sands already described or by the Miocene clays or older geological formations, upon all of which this characteristic gravel band rests unconformably.

The Sassafras gravelly loam in New Jersey, as in other localities, represents a partially eroded late Pleistocene formation, which in many cases may be followed until it merges into and passes under the Sassafras loam or one of the sandier types that mark the portions of the area where deposition took place in the more disturbed waters. It is highly probable that at one time the Sassafras loam constituted the surface covering where only the Sassafras gravelly loam is now found. This is indicated by the presence of small areas of Sassafras loam still existing within the boundaries of the more gravelly formation as well as by the marginal relationship of the two soil types.

The Sassafras gravelly loam, on account of its location, its drainage, its physical properties, and the accompanying climatic conditions, is the best adapted of any soil in the region to the production of peaches, pears, plums, and cherries. Extensive orchards of the first three fruits are already found on this soil type. The trees are thrifty, productive, and long lived. Most of the larger orchards on this type are located at an altitude of over 70 feet above tide level. They are less subject to late spring frosts than on lower lying portions of the region. The surface drainage is adequate for the removal of surplus water, and the orchard trees are able to send their roots downward to a sufficient depth to reach a good, permanent moisture supply. Corn also does well on this soil, though the blades are apt to fire during late summer droughts. This, however, affects the fodder yield more than the grain.

A considerable proportion of the Sassafras gravelly loam maintains a forest growth of oak and pine. Whenever the demand for orchard lands becomes greater, further considerable areas of this type will be used in fruit growing.

The following mechanical analyses show the gravelly nature of this soil:

Mechanical analyses of Sassafras gravelly loam.

[Fine earth.]

No.	Locality.	Description.	Soluble salts, as determined in mechanical analysis.	Organic matter and combined water.	Gravel, 2 to 1 mm.	Coarse sand, 1 to 0.5 mm.	Medium sand, 0.5 to 0.25 mm.	Fine sand, 0.25 to 0.1 mm.	Very fine sand, 0.1 to 0.05 mm.	Silt, 0.05 to 0.005 mm.	Clay, 0.005 to 0.0001 mm.
			P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.	P. ct.
5673	1 mile NE. of Harrisonville.	Brown gravelly loam, 0 to 8 inches.	0.01	2.68	10.92	14.86	11.94	16.80	4.78	30.70	5.53
5675	1 mile N. of Gouldtown.	Brown sandy loam, 0 to 8 inches.	.01	2.76	18.02	22.26	10.30	6.46	1.56	32.16	4.55
5674	Subsoil of 5673....	Red sandy and gravelly loam, 8 to 32 inches.	.01	1.02	29.60	32.32	11.60	7.80	1.86	8.70	6.13
5676	Subsoil of 5675....	Red gravelly loam, 8 to 28 inches.	.01	1.38	30.12	24.34	11.46	6.28	1.62	17.88	5.95

MEADOW.

The low-lying, nearly flat areas found along the stream courses and near tide water, whose soils are in an almost continual state of saturation and therefore not susceptible of any high degree of cultivation, are classed as Meadow. Land so low and wet as to be unfitted for any agricultural operations is not included in this classification. The reclaimed marsh meadows, from which the water has been shut out by extensive systems of banks, and where the water is disposed of by open ditches, constitute the largest meadow areas in the region under discussion. These dike and ditch systems are maintained by cooperative organizations among the landowners, and over 15,000 acres of former tide marsh have been reclaimed in Salem County alone, while extensive tracts have been similarly treated in Cumberland and Gloucester counties. Many of these areas lie below the level of high tide, and the grass and the small areas of cultivated crops which they produce are protected by rough dikes of mud which are reinforced on exposed tide-water reaches by a facing of stone. Within the areas large open ditches have been dug, and through these the surplus rainfall can be drained off at low tide. Over the greater part of this reclaimed marsh land the soil consists of a black muck, in some places almost peaty in character. This is usually underlain at a depth of about 2 feet by a gray clay or silty loam, though occasionally a gray sand is encountered.

From these meadows large quantities of herd's-grass are cut for rough forage. The meadows also furnish pasturage for cattle. Near some of the larger towns, and generally upon slight elevations, corn, wheat, tomatoes, cabbages and garden vegetables are cultivated on the meadow soils.

Scattered through the various soil types are imperfectly drained areas which differ slightly from the adjoining soils in their texture and composition, but which, on account of imperfect natural drainage, still maintain the meadow condition. Most of these areas are still forested. Black and sweet gums, willow oak, white oak, magnolia, and two or three varieties of cedar are the trees most commonly observed. Many of these areas might be easily brought under cultivation by opening a single drainage ditch and connecting the more remote portions of the area with it by means of tile drains. These areas, when thus treated, would gradually lose their characteristic features and become portions of adjoining soil types.

A third type of Meadow is found upon the upland, where head-water drainage has failed to provide an adequate outlet for the rainfall. Such areas could be drained even more easily than those that occur where natural depressions have no outlet. Some of these areas are more valuable for the oak timber they furnish for various farm uses than they could be for any other purpose, and a judicious system of forestry might make them worth still more. The meadow areas upon the upland are the natural habitat of the white and willow oak.

Since the meadow areas constitute a soil condition rather than a soil type, no mechanical analyses of these soils are given.

AGRICULTURAL CONDITIONS.

The area in southwestern New Jersey described in the present report is a noteworthy locality in the eastern part of the United States, from the fact that the adaptation of certain crops to definite soil conditions has proceeded further and has met with greater success there than in the great majority of communities.

The heavier soils, that is, those containing the larger proportions of clay either in soil or subsoil, are farmed on a system of crop rotation which includes corn, wheat, grass, white potatoes, and tomatoes. In conjunction with these crops dairying is carried on. Some of the herds are full-blood Guernsey, Jersey, or Holstein, though the majority consists of grade cattle having different mixtures of these bloods with native stock.

Upon the lighter soils, that is, those which contain large proportions of sand in the soil or subsoil, the production of the truck crops has of late years attained considerable importance. The finer sands produce tomatoes, sweet corn, and some melons and sweet potatoes, while the coarser sands, particularly in the northern part of the area, are almost

entirely devoted to the production of sweet potatoes, watermelons, cantaloupes, eggplant, and peppers. Corn is also raised, and a fair clover stand can be secured. Many farms in this region produce the truck crops alone. Very little stock is kept, and the fertility of the soil is maintained by the use of commercial fertilizers and stable manures purchased in the near-by cities along the Delaware.

The Sassafras gravelly loam occupies a unique position among the soils of this area. It is used for the extensive production of orchard fruits. Along the eastern border of the area this soil occurs at elevations that insure considerable freedom from unseasonable frosts. These localities have been selected by private individuals and nursery companies as the best available orchard sites. Within recent years orchards of pears, plums, cherries, peaches, and apples have been set out for the purpose of the extensive production of these fruits. Other soils and other localities are occupied by small orchards, producing chiefly for family use, but the Sassafras gravelly loam, occurring at the higher elevations, should gradually be employed in more extended commercial orcharding.

The general appearance of the southwestern New Jersey area is a convincing argument in favor of specialization in farming. Within this area the adaptation of crops to soils has been worked out slowly, but with increasing definitiveness, by men who are interested in the profits to be derived from farming rather than in the experimental proof of an agricultural theory. Moreover, the variety of soils occurring here, the presence of some of the best types of truck soils, fruit soils, and general farming soils to be found in the Coastal Plain region of the United States, the proximity of markets, and the advantages of transportation both by water and rail, have all tended to develop a phase of agriculture showing sharp contrasts between the productive capacity of the different soil types. Even in single, small fields the adaptation of crop to soil is frequently seen. Some small area of heavier soil is producing a crop of cabbages, while the remainder of the field, having a lighter, sandier soil, is devoted to the production of sweet potatoes and melons.

Over the entire area the specialization in agriculture has followed contrasts between soils similar to the small differences shown in single fields. In the western part of Salem County and the northwestern part of Cumberland County, particularly at the lower elevations, the Sassafras loam, Quinton sandy loam, and Elsinboro fine sand predominate, with Alloway clay, Elkton clay, and Norfolk sand less extensively developed. This general locality shows a great preponderance of general farming over trucking or fruit raising. The presence of large areas of meadow land in proximity to these heavy soils leads naturally to stock raising and dairying, to which the production of grain and grass is essential. In addition, the localities mentioned lie at such a distance from the Philadelphia market that the farmer must

ship his products by boat or rail, and naturally selects those of a less perishable nature.

In the northwestern part of Salem County and the western part of Gloucester County the Norfolk sand is the prevalent soil type, with the Windsor sand, Westphalia sand, Collington sandy loam, and Quinton sandy loam also present. The first of these soils is the typical truck soil of the Atlantic seaboard, while only the Collington sandy loam and the Quinton sandy loam contain sufficient clay in their subsoils to compare favorably with the average of general farming types. Moreover, the nearness to Philadelphia permits a large proportion of the farm crops to be carried to market by the farmers' own teams, while stable manure can be secured in the city and transported to the farm in the same manner. In this way the maintenance of the trucking industry is favored not only by peculiarities of soil, but also by transportation advantages and the possibility of keeping up the fertility of the soil without devoting any large proportion of it to cattle raising.

In the vicinity of Bridgeton, Cumberland County, areas of the sandier soils are devoted to market gardening rather than to trucking. The crop adaptations are the same for the two systems, but the method of farm management is entirely different. Near Bridgeton a great variety of truck crops is raised on a single farm, and small quantities of each crop are brought to maturity at different seasons of the year. In this manner the market gardener maintains a small supply of each of a variety of products, which he disposes of at retail in small quantities. On the other hand, the truck farmer produces single large crops, which are disposed of in the wholesale market.

The following table, compiled from Bulletin 133 of the Twelfth Census of the United States, gives an idea of the magnitude of the truck interests of the State of New Jersey and the relative importance of the principal truck crops:

Areas of different truck crops in New Jersey.

Crop.	Acres.	Per cent.	Crop.	Acres.	Per cent.
Potatoes	52, 896	39. 2	Asparagus	2, 089	1. 5
Tomatoes	25, 332	18. 7	Peas, green	1, 822	1. 4
Sweet potatoes	20, 588	15. 3	Beans, green	1, 460	1. 1
Sweet corn	11, 646	8. 6	Cucumbers	1, 314	1. 0
Muskmelons	6, 548	4. 9	Other vegetables	2, 099	1. 5
Cabbage	5, 121	3. 8	Total for State	134, 955	.....
Watermelons	4, 040	3. 0			

While no statistics are available for the exact area which the soil survey has covered, the figures here given will show, at least approximately, the relative importance of the different crops in what is believed to be a typical truck area. It is probable the potatoes are raised on many of the heavier soils of the State, but all the other crops given can be classed as early truck crops, grown almost exclu-

sively on the light sandy soils in the Coastal Plain region of the State. The above acreage does not include the family gardens.

The same bulletin notes an increase of 32.2 per cent in the number of apple trees, a large increase in the number of pear trees, and a decrease of 37.8 per cent in the number of peach trees.

Of small fruits there were 25,371 acres reported for the State at large, of which 8,746 acres, or 34.5 per cent, were devoted to strawberries; 8,356 acres, or 32.9 per cent, to cranberries; 5,254 acres, or 20.7 per cent, to blackberries and dewberries; 2,240 acres, or 8.9 per cent, to raspberries; 161 acres, or 0.6 per cent, to currants; 104 acres, or 0.4 per cent, to gooseberries, and 510 acres, or 2 per cent, to other fruits.

The localities in which fruit culture is being carried on as a special branch of farming are those gravelly uplands that until recent years supported a growth of forest or scrub timber. The soil is not particularly adapted to trucking, and it is still less valuable for the purpose of grain production. Its textural peculiarities, its drainage, and its altitude above sea level, together with its position near large bodies of tide water, constitute the factors which adapt the localities to this special branch of agriculture. The process of bringing these recently timbered lands under cultivation is not nearly complete. The majority of the orchards are young and have not yet proven their full producing capacity. The trees are uniformly thrifty, and the stone fruits in particular give promise of abundant returns.

Aside from advantages in climate and in soil, the area described is also favorably located with regard to the seacoast markets and transportation facilities. Freight and passenger steamers afford communication between the smaller tide-water towns and Wilmington, Chester, and Philadelphia. Two different railroad systems also afford communication not only with the larger cities, but with the summer markets at the beach resorts.

The climate of the area is such that the great majority of crops adapted to temperate regions have sufficient length of season to reach maturity. The rainfall varies over the area, but it is sufficient if properly distributed to produce a considerable range of crops upon each soil type. The streams by which the area is drained are navigable upon their lower courses, while their upper courses furnish considerable power for milling purposes. If at any time it should become desirable to irrigate any of the lower-lying sandy types, these streams would furnish a water supply sufficient for the purpose.

There still remain within the area considerable tracts of desirable soils which may be converted into fertile farms by simple processes. Considerable progress has already been made in the reclamation of the marshy areas along the coast. Throughout the entire area more extensive underdraining of the farms would increase the acreage of tillable land and bring under cultivation considerable portions of Alloway clay, Elkton clay, and Meadow.

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