

SOIL SURVEY OF THE TRENTON AREA, NEW JERSEY.

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DESCRIPTION OF THE AREA.

The Trenton area comprises about three-fourths of Mercer County, one-half of Middlesex County, about one-fourth of Burlington and Monmouth Counties, and one-sixth of Ocean and Somerset Counties. It is situated in the west-central part of New Jersey, the lower half of the western boundary being formed by the Delaware River, the dividing line between the States of Pennsylvania and New Jersey. The city of Trenton, situated in the west-central part of the area, is 33 miles by rail from Philadelphia and 57 miles from New York. The area surveyed is approximately a rectangle in outline, 32 miles from north to south, and from 21 to 38 miles from east to west. The Trenton area is east of the Belvidere area, south of the Bernardsville area, west of the Freehold and Chatsworth areas, and north of the Chatsworth and Camden areas. It contains 794 square miles, or 508,160 acres.

The Trenton area comprises parts of two distinct physiographic provinces, the Piedmont Plateau¹ and the Atlantic Coastal Plain. The Piedmont Plateau in the northwestern part has a rather rolling to hilly topography, with steep to gentle slopes, frequently eroded. Many streams in this region have cut narrow, steep-sided trenches, along the walls of which the country rock is exposed in many places. Intrusive masses of extremely resistant diabase give rise to two small highland areas locally known as Sourland Mountain and Rocky Hill. These uplands range in height from 300 to a little more than 500 feet above sea level, or 150 to 350 feet above the adjacent country. The lower elevations of the Piedmont region are underlain by relatively soft red and gray sandstones and shales, together with some small areas of massive, fine-grained mud rock (argillite), which, being more resistant to the agents of weathering and erosion than the softer sandstones and shales, forms relatively higher elevations. The soils of the region have been derived chiefly from these different types of rock.

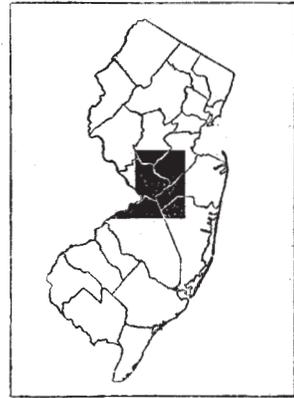


FIG. 53.—Sketch map showing location of the Trenton area, New Jersey.

¹ In New Jersey the Piedmont is at so low an elevation that it should be called a plain rather than a plateau.

The greater part of the Trenton area lies southeast of the Piedmont and constitutes a part of the Atlantic Coastal Plain. Its topography is level to gently rolling, being interrupted only in a few localities by isolated hills, which rise abruptly from the surrounding plain. The stream bottoms are wide, and in many places the streams are sluggish. Terraces border the Delaware River and some of the larger creeks.

The elevation ranges from sea level along the Delaware River on the west and near the town of South River in the extreme northeast to 560 feet on Sourland Mountain, near Hopewell, in the northwestern part.

Streams are numerous and the waters of all of them eventually reach the Atlantic Ocean. The Delaware River is the most important and with its numerous tributaries drains over half of the area. Millstone and South Rivers are next in importance and furnish drainage outlets for the northern portion of the surveyed area. Crosswicks Creek in the central part of the area and Assanpink Creek farther north, both flowing into the Delaware, are important streams. Rancocas Creek drains the extreme southwestern part of the region surveyed.

The area as a whole is well drained except in the extreme southeastern part, where the streams are sluggish and bordered by rather wide swampy areas. The flat, level surface of this region further retards surface drainage. Bear Swamp near Lawrence and Pigeon Swamp northeast of Monmouth Junction are other rather important poorly drained areas.

Mercer County was formed from parts of Hunterdon and Burlington Counties in 1838. Middlesex County was established at a much earlier date. English and Dutch immigrants settled the Trenton area as early as 1682, but actual development did not begin until early in the eighteenth century. From the beginning farming has been an important industry. In the area as a whole about 50 to 60 per cent of the population is listed as urban. The rest, those living on farms and in villages and towns of less than 2,500 population, is classed as rural. The density of population in 1920 ranged between 125 and 150 persons per square mile.

Trenton, in the west-central part of the area, is the largest city with a population of 119,289 in 1920. Burlington with a population of 9,049 is the second city in importance. South River with 6,596, Princeton with 5,197, Bordentown with 4,371, Hightstown with 2,674, and Hopewell with 1,339 inhabitants are other towns of note.

The Trenton area has excellent transportation facilities. The main lines of the Pennsylvania and of the Philadelphia & Reading Railroads traverse the northwestern part of the area. The Trenton division of the Pennsylvania crosses the area diagonally from Bordentown to Old Bridge. Another branch of this system from Trenton to Camden follows the Delaware River, with a branch line from Kinkora to Lewistown, which serves the southwestern section. The Pennsylvania & Atlantic Railroad from Lewistown to Hightstown connects with the Pennsylvania at both ends and serves the south-central part of the area. At various junction points connections are made for New York and Philadelphia as well as points east, west,

south, and in New England. Only the extreme southeastern part is remote from railroad transportation.

The public roads are excellent, except in the extreme northwestern and southeastern sections. The main highways are almost without exception of concrete, bituminous, or gravel construction, and many of the less important roads are graded and surfaced with gravel. There are few if any sections in the United States affording better transportation facilities both by rail and public roads.

Practically every farm is accessible to telephone service, if desired, and rural schools are of the best. Transportation from farms to schoolhouses is furnished by auto busses maintained by county or township educational systems. Electricity for light and power is available on many farms, especially near the towns and main highways.

Agricultural products are marketed principally in Trenton, Philadelphia, and New York. Princeton, Hopewell, Jamesburg, Hightstown, Bordentown, Burlington, Allentown, and Englishtown are important local markets, as is also New Brunswick, situated a few miles northeast of the area. Most of the potatoes and a large proportion of the fruit and cranberries grown are shipped by rail to the larger cities and distant points throughout the entire United States. Products for local markets are frequently hauled in motor trucks. Dairy products are sold to local creameries or shipped by rail to the larger cities.

CLIMATE.

The climate of the Trenton area is characterized by rather cold winters and moderately warm summers. Snow sometimes covers the ground for several weeks in winter, but extremely low temperatures are not of long duration. The ground always freezes a foot or more. Although the summer months are warm, temperatures above 100° F. are rare and of short duration. Late frosts in the spring often cause injury to early blooming fruits, and during more severe winters the grain, clover, and grass crops are in danger of being winterkilled, especially on the heavier soils. As a whole, however, climatic conditions are very favorable for successful farming.

On the average the rainfall is abundant and well distributed throughout the year, the monthly rainfall being about 3½ inches for each month except July and August, in which it is greater. If, however, individual years are considered, great variations in the monthly rainfall are found, and excessive rains or extreme droughts may occur in any month. The summer rainfall (June, July, and August) averages 30 to 35 per cent more than that of the other seasons, and is due primarily to sudden and heavy thunderstorms. Summer droughts occasionally cause serious damage to special crops such as potatoes and truck.

The average growing season, as recorded at Trenton, extends from April 16 to October 28, a period of 195 days. Killing frosts have been recorded as late as May 12 and as early as October 11.

The following table, which gives complete climatic data for the city of Trenton, is fairly representative of climatic conditions throughout the area.

Normal monthly, seasonal, and annual temperature and precipitation at Trenton, Mercer County.

(Elevation, 190 feet.)

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1914)	Total amount for the wettest year (1889).	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	34.4	70	-7	3.16	4.64	2.03	3.4
January.....	30.5	72	-8	3.17	2.72	4.40	7.2
February.....	30.7	72	-10	3.31	3.00	3.36	10.2
Winter.....	31.9	72	-10	9.64	10.36	9.79	20.8
March.....	39.1	86	6	4.04	3.28	5.67	3.8
April.....	49.8	93	21	3.29	2.57	5.00	.2
May.....	61.1	99	33	3.52	1.98	4.47	.0
Spring.....	50.0	99	6	10.85	7.83	15.14	4.0
June.....	69.5	98	41	3.49	1.74	2.67	.0
July.....	74.5	101	50	4.77	4.75	9.86	.0
August.....	73.0	105	46	5.37	1.63	7.23	.0
Summer.....	72.3	105	41	13.63	8.12	19.76	.0
September.....	66.9	97	35	3.59	.41	10.13	.0
October.....	55.6	89	28	3.41	1.74	4.66	.0
November.....	44.4	78	10	3.43	1.62	7.75	1.1
Fall.....	55.6	97	10	10.43	3.77	22.54	1.1
Year.....	52.5	105	-10	44.55	30.08	67.23	25.9

AGRICULTURE.

From the days of early settlement agriculture has always been an important industry in the Trenton area. It has constantly advanced and expanded until at the present time this region ranks favorably with the best in New Jersey if not the whole of the United States. In the early days great stress was laid upon the production of grain and cattle, but with the coming of the railroads and improved highways and the development of near-by large cities the tendency has constantly been toward specialized farming. For example, in 1879, in Mercer County there were cultivated 21,673 acres of corn, 12,899 acres of oats, 11,985 acres of wheat, and 5,107 acres of rye. Potatoes were grown on 1,659 acres. In 1899 corn occupied 20,334 acres, oats 5,417 acres, wheat 12,370 acres, and rye 4,375 acres. The potato acreage was 3,708 acres. Twenty years later, in 1919, the area in potatoes had increased to 8,168 acres, while corn occupied only 14,612 acres, oats 3,815 acres, wheat 7,609 acres, and rye 8,572 acres. These figures show that potatoes as a specialized crop are displacing corn, wheat, and oats and that the acreage in rye has increased because of the extensive use of this grain as a cover crop when potatoes are grown. The same is true in Middlesex County, where in 1899, 3,714 acres of potatoes were under cultivation as against 6,468 in 1919. In the corresponding period the combined wheat, corn, and oats acreage had decreased from 26,675 acres in 1899 to 17,200 in 1919. The acreage of rye during the same period increased from 5,723 acres in 1899 to 7,172 acres in 1919.

General farming in conjunction with potato production or dairying is therefore at the present time the predominating type of agriculture. Fruit and truck crops are important locally. Potatoes and wheat, along with some corn, are the chief money crops. The corn, oats, and hay are grown mainly as subsistence crops, but most farms have a surplus for sale. Rye is grown almost exclusively as a cover crop and plowed under as green manure. Fruit and truck crops bring cash returns on many farms, as do also dairy products.

Dairying is important on many farms throughout the area. Good breeds of cattle are maintained. Holstein cattle predominate, but there are also many Jersey and Guernsey herds. The products are sold directly to local creameries or shipped by rail to New York and Philadelphia. The feeding of hogs and cattle for slaughter is of little importance.

As indicated by the census data, potatoes are very extensively grown in the Trenton area, especially in the central and southwestern parts. The potato acreage is constantly increasing. The production of fruit and truck crops is important, but is confined to the southwestern part of the area along the Delaware River. Some truck is raised locally near Trenton and other smaller towns, and practically every farm has a vegetable garden to supply home needs. Cranberries are grown on the poorly drained lighter textured soils in the southeastern part of the area.

The crops produced in the Trenton area are materially influenced by the topography and the character of the soil. For example, in the northwestern part in the vicinity of Hopewell and Harlingen, where the topography is rolling to steep and the soils are heavy, dairying and general farming are of prime importance. Near Cranbury, Englishtown, and Allentown the topography is gently rolling to level with lighter and more mellow soil. In these sections potato growing and general farming are the general practice. Near Clarksburg and Perrineville the topography becomes somewhat rugged, with rather steep slopes, and in this section fruit growing is extensive. Along the Delaware River between Bordentown and Palmyra the sandy nature of the soils and flat topography have influenced the production of early truck crops and fruit, principally peaches. The Lakewood soils in the extreme northeastern part of the area, because of their low productiveness, remain uncleared of forest growth. In the same section the low, poorly drained areas are extensively used as cranberry bogs.

The farmers of the Trenton area have been very keen in recognizing the importance of crop adaptation. For example, the more sandy soils, including the Sassafras sand and fine sand, Collington sand, Lakewood fine sand, and the various loamy sand types, are extensively used in the production of truck crops such as peas, tomatoes, watermelons, and cantaloupes and in the growing of peaches and apples. The heavier sandy loams, fine sandy loams, and loams are generally used for potatoes, late truck, and the later varieties of peaches and apples, or general farm crops. Dairying, general farming, and the production of rye, wheat, and oats are confined principally to the Penn, Lansdale, Montalto, and Croton silt loam types, which because of their heavy character are best adapted to these types of agriculture.

The systems of cultivation practiced in the Trenton area are in general commendable. Plowing begins as early as practicable in the spring, with a two-horse plow on the heavier soils or a one-horse plow on the smaller farms and lighter soils. Many tractors drawing two 2-bottom plows are also in use, particularly in the potato-growing sections. Considerable fall plowing is practiced, especially on land seeded to rye following potatoes, the rye being plowed under late in November. It is claimed that this practice makes possible earlier planting in the spring. The plowing is followed by a thorough harrowing, either with a disk or spring-tooth harrow. When rye or grass follows potatoes or truck the land is disked to obtain a suitable seed bed. Some of the heavier soils are rolled. Careful cultivation is always given after each rain, using a one-horse or two-horse cultivator. Ridging is favored by some potato growers, but this practice is not general. Corn is planted either with hand planters or drills. A grain drill usually is employed in sowing rye and wheat and is also used in spreading lime. Manure spreaders are in common use.

Corn is planted about May 15. It usually follows the grass crop and receives little fertilizer, except a small quantity applied in the hill just as the plants begin to come up. Careful cultivation follows each rain as long as the height of the plants allows, thus keeping out weeds and conserving moisture. Corn is grown on practically all the well-drained soils and on some of the heavier imperfectly drained types with excellent results. Early Dent and White Dent are the most popular varieties, practically all the seed being home grown and selected from the field. Cutting begins about September 15 and is done either by hand or with a harvester. The stalks are shocked, and later the corn is husked in the fields and stored in bins or cribs.

Wheat, rye, and grass are sown with drills as early in September as the land bearing the preceding crop is in satisfactory condition. When timothy is sown with the grain, clover is usually sown broadcast the following spring. Wheat and rye mature early in July or in late June. Modern reapers and binders are used in harvesting; the grain is shocked in the field for drying and later stacked until threshing begins. This is frequently very late in the fall or may be even the next spring.

Potatoes are planted with horse-drawn implements on carefully prepared seed beds about the middle of April or as soon as the weather allows. Most of the seed comes from Maine, south Jersey, and Virginia and is usually certified. Great care is exercised in cutting the seed, which frequently is given formaldehyde treatment to control scab. Gold Coin, Irish Cobbler, Mills Pride, and Green Mountain are the chief varieties. Some American Giants are grown, particularly on the more sandy soils. When late potatoes are grown on sandy soils following an early truck crop, such as peas, the "pink eye" and "red skin" varieties are commonly chosen. Commercial fertilizers are applied heavily in growing potatoes, applications ranging from 1,500 to 2,000 pounds per acre. The crop is cultivated frequently, and the better growers spray to kill the potato beetle and control the blight. Scab does considerable damage. Many farmers are experimenting with sulphur to control scab injury, and results thus far obtained are encouraging.

Harvest begins about July 1, the time depending to some extent on the variety, and continues late into the fall. The rapidity with which the crop is dug depends largely upon market conditions of supply and demand. Harvesting is done with diggers of the elevator type equipped with a small gasoline motor and drawn by two horses. Potatoes are hauled to local dealers, where grading and sacking takes place. The 150-pound sack is the standard container. Some growers have their own equipment for grading and sacking the crop. In these cases the work is usually done in the field at the time of digging.

After the potatoes are harvested the land is cleared of plants and weeds and disked for rye. The potato vines, together with the accumulation of weeds and other growth, uprooted in the digging process, are collected in large piles and burned. This destroys such fungous, bacterial, and insect pests as may have existed on the potato plants, thus preventing or checking infection of succeeding crops.

When truck crops are grown the land is broken as early as possible in the spring and a good seed bed prepared. Peas are sown about March 25 to April 10, depending on the season. Thomas Laxton and Alaska are the favorite varieties. Just before the plants appear above the ground the hills are top-dressed with a 5-9-3 fertilizer mixture at the rate of about 500 pounds per acre. Frequent cultivation keeps down weeds and conserves moisture. Plant lice often cause considerable damage, but are controlled by spraying. Peas mature about June 15. The greater part of the crop is shipped by rail or motor truck to New York and Philadelphia.

Sweet corn is planted about April 1 to April 10, using two-row horse planters. Home grown seed is used. When the plants are of sufficient height they are thinned to stand 12 to 15 inches apart. When 18 inches to 2 feet high all suckers are broken off. Commercial fertilizer is applied at the rate of 800 to 1,000 pounds per acre after planting and just before the plants appear. Later when the plants are about a foot high a side dressing of 150 to 200 pounds is added. The mixture usually analyzes 5-9-3 or 5-9-4. The crop matures about July 10 and is shipped to New York and Philadelphia markets.

Tomatoes are an important truck crop. Both early and late varieties are grown. Among the former, Earliana and Bonny Best are the most common, and the late crop consists of Greater Baltimore, John Baer, and Stone. Hotbeds are prepared and planted about February 20 and the plants set out early in May in rows 4 feet apart. Manure is applied to the hills, sometimes supplemented with commercial mixtures analyzing about 4-8-8. Picking begins about July 10 to 15 and continues for several weeks. The crop is either sold on the open market or grown under contract for canning factories.

Peaches are gaining favor as a crop on the lighter soils, and many new orchards are being set out. The young trees are set 20 feet apart each way and lightly fertilized with nitrate of soda. The second year the trees are carefully pruned. During this year the orchards are intercropped with sweet corn or other truck crops. The trees come into bearing the third year, usually yielding about one-half basket of fruit. This increases in amount yearly until the sixth

year, when the trees come into full bearing. Intercropping ceases after the fourth season, but cover crops of rye or rye and vetch are sown and plowed under yearly. The trees are carefully sprayed several times each year, fertilized yearly, and pruned when necessary. Among the varieties grown the most important are Greensboro, Carman, Belle, Hiley, Elberta, Fox, Iron Mountain, and Krummel. The crop is picked by Italian labor brought from the near-by cities, and is shipped to the New York and Philadelphia markets by motor truck or railroad.

Apples are important locally, and many old and neglected orchards are scattered throughout the area. The chief varieties grown are Yellow Transparent, Starr, Red Astrachan, Wealthy, Stayman Winesap, Delicious, Rome Beauty, and Smith Cider. More orchards are being set out yearly, especially in the southwestern part of the area. These orchards are on a large commercial scale and receive the best of care. The bulk of the crop goes to New York and Philadelphia.

Crops of minor importance include sweet potatoes, peppers, watermelons, cantaloupes, string beans, lima beans, eggplant, and cabbage. Some cherries also are grown. Careful cultural methods are always followed and excellent yields obtained.

The value of crop rotations is generally recognized, and certain rotations are practiced by many farmers in the Trenton area. On the heavy residual soils the general rotation consists of corn, oats, and wheat each one year, followed by timothy and clover hay one or two years. The grass is plowed under after the last cutting. Rye sometimes replaces wheat. Farther south on the more mellow soils, where potatoes are an important crop, the rotation usually is corn, wheat or rye, potatoes, and grass two years. Less attention is paid to rotation on soils utilized for potato or truck growing than where general farming is practiced.

Fertilizers, both of animal manures and commercial mixtures, are extensively used in the Trenton area. In Mercer County alone the average farmer spends nearly \$650 annually for commercial fertilizer and the expenditure for this purpose is constantly increasing. Commercial mixtures and cover crops are replacing animal manures on many farms, especially those where potatoes are grown and only a small herd of cattle is maintained. Potatoes are very heavily fertilized with mixtures ordinarily analyzing 4-8-10 or higher, at the rate of 1,500 to 2,000 pounds per acre. Corn, if fertilized at all, receives from 100 to 300 pounds per acre, and small grains about the same quantity. All available stable manure is applied to sod land before plowing under for the succeeding crop.

Most of the farm labor is performed by the farmers themselves, but extra help is required during the summer months and harvest season. On the larger farms at least one extra hand is retained throughout the year. In general there is an abundance of labor, but efficient hands are hard to find and retain. Wages asked are high, owing to the high scale of wages paid for unskilled help in the larger near-by cities. The cost of farm labor has more than doubled in the Trenton area during the last decade.

According to the census of 1920 the farms of Mercer County have an average size of 81 acres, of which 66.5 acres are improved land.

These figures have remained practically constant since 1880, at which time the average farm contained 78 acres, of which 68.6 acres were improved. In Middlesex County in 1880 the average farm comprised 74 acres of land, 55.8 acres of which were classed as improved. In 1920 corresponding figures were 68.7 acres and 50.8 acres. These figures indicate that in spite of the change in farming methods and on many farms in crops grown, the average size of farms has not materially changed in the last 40 years.

In the Trenton area, according to the census of 1920, about 70 per cent of the farms are operated by the owners, 25 per cent are rented, and 5 per cent are worked by managers. These figures have not materially changed during the last 30 years, there being a slight tendency, however, toward more landowners and fewer tenants and managers. At the present time most tenants operate on the share system under various agreements with the owner.

The value of farms in the Trenton area is high and has materially increased during the last 20 years. This is to be expected when present economic conditions are considered. In 1910 the average assessed value of farm land per acre in Mercer County was \$57.35. In 1920 it was \$81.67. The same is true of Middlesex County. In both of these counties the average selling price of farm land per acre in 1920 is over two and one-half times as great as it was in 1900. Few improved farms can be bought for less than \$100 an acre and prices as high as \$300 are frequently paid for the better type of farms. Unimproved land is valued from \$5 to \$50 an acre, depending upon location, timber growth, and soil conditions. At the present time (1922) there has been a slight reaction in prices demanded for improved farm land. Some decline is to be expected in the course of postwar readjustment, but just to what extent it will go can not be determined.

SOILS.²

The discussion of the soils in the next few pages is more or less technical and will be of interest mainly to students of soil science. In later pages, under the proper headings, the individual soil types are described more from the viewpoint of their use in agriculture. The soil types are the units of soil mapping. A soil series includes those types that are similar with respect to their most prominent soil characteristics, but differ from each other with respect to the texture of their surface soils. The Sassafras sandy loam, for example, is a soil type belonging to the Sassafras series.

² Along the border of the area about 1 mile of Lansdale stony loam in the Trenton area joins with Lansdale silt loam, shown with stone symbol in the Belvidere area northwest of Amwell. This discrepancy is more apparent than actual, since the stony loam is essentially the same as the silt loam with stone symbols. A narrow strip of Lansdale silt loam in the Trenton area joins with Penn silt loam in the Belvidere area north of Hopewell. This is a slight discrepancy which can be corrected in the final State map. For a short distance the Lansdale gravelly loam of the Trenton area joins with Penn shale loam of the Belvidere area north of Hopewell. There actually is not much difference between these two types, especially in agricultural value. A patch of Penn shale loam in the Trenton area joins with Montalto silt loam in the Belvidere area one-half mile south of Hopewell. Some Lansdale silt loam in the Trenton area joins with Penn silt loam in the Belvidere area west and north of Federal City. This is undoubtedly due to the fact that the Lansdale and Penn, both being derived from Triassic rocks, sometimes grade into each other with indistinct lines of separation. A small area of Sassafras loam, shallow phase, in the Trenton area joins with Penn silt loam in the Belvidere area 4 miles north of Trenton. This will need to be corrected in the final State map. A little Elkton loam in the Trenton area joins Croton silt loam in the Belvidere area just north of Trenton.

Along the line of junction with the Bernardsville area a small body of Lansdale stony loam in the Trenton area joins with Lansdale gravelly loam with stone symbols. This is

The soils of the Trenton area have a characteristically belted distribution. A glance at the soil map will disclose about four rather well defined northeast-southwest belts, each passing out of the area unchanged and known to continue for considerable distances beyond this area without any fundamental change in character. The Trenton area, therefore, is merely a part of a broad region whose features extend across the arbitrarily bounded area designated the Trenton area. Plate LII shows the distribution of the soils of the area according to the prevailing textures.

The most southeasterly belt covers the southeastern corner of the area, the southeastern boundary lying outside the area. This is predominantly a belt of sands. Of these there are two kinds on the well-drained uplands. They are described in this report and designated on the soil map as Sassafras sand and Lakewood sand. Both are light in color.

The Sassafras sand is gray at the immediate surface, with more or less dark stain due to organic matter. Underlying the thin gray or dark-gray surface layer is a pale-yellowish layer ranging up to somewhat more than a foot in thickness. This in turn is underlain by a faint reddish-brown layer, which may be slightly heavier than the one above it, but the percentage of fine material is very small. These three layers constitute the layers of the true soil the "solum," and are underlain by the parent geological formation, which in this case consists of grayish to yellowish sands. Beds of heavier materials, clays and silts, are found at considerable depths but at too great a depth to influence the character of the soil.

The Lakewood sand is nearly white, almost pure quartz sand, with some dark stain or mixture of organic matter in the upper 2 to 4 inches. Under cultivation this organic matter soon disappears, leaving a nearly white sand. Below depths ranging up to about 2 feet the color is slightly yellow and continues so to about 3 feet, where parent geological material essentially like that beneath the Sassafras sand is encountered.

In imperfectly drained areas within this belt there are the dark-colored soils, usually sands, the dark color being due to the presence of organic matter, which was accumulated in these soils, and not in the well-drained soils, because of their permanently wet condition. Beneath the dark-colored surface layer, which ranges up to somewhat more than a foot in thickness, the sand is gray to a depth of about 3 feet. This overlies an indurated layer acting as a hardpan, which has a rusty-brown to dark-rusty color and consists of sand cemented with organic matter, with or without iron oxide. The parent geological material lies immediately beneath the 3 to 6 inch layer of hardpan.

not a real difference, but is an apparent discrepancy due to two methods of showing essentially the same soil. Two small bits of Watchung silt loam in the Trenton area join Watchung silty clay loam in the Bernardsville area about 3 miles west of Plainville. A small area of Elkton silt loam in the Trenton area joins Elkton clay loam in the Bernardsville area south of New Brunswick. For one-half mile the Sassafras sandy loam in the Trenton area joins with Sassafras sandy loam in the Bernardsville area west of Sayreville. This will require revision in the final State map. West of the Raritan River the Sassafras loamy coarse sand of the Trenton area joins with Sassafras sand in a region of clay pits. Actually there are not many important discrepancies in the boundaries.

In the Trenton area a small area of Woodstown sandy loam joins with Norfolk sandy loam, imperfectly drained phase, of the Chatsworth area, the latter phase in the more recent mapping having been included with the Woodstown, a new series. Aside from this and a few other small areas, the boundaries join, although there are some places where the soils grade into each other in such a way that the boundaries had to be arbitrarily drawn.

The northwestern boundary of this belt lies approximately along the boundary between Ocean and Monmouth Counties from where it enters the area southwestward to Hornerstown. Thence it runs southward to New Egypt and thence southwestward by Pointville.

The second belt is one in which loams and sandy loams predominate. It extends from the line described in the preceding paragraph northwestward to a line roughly parallel to and from 1 to 3 miles northwest of the main line of the Pennsylvania Railroad. Just as the southeastern belt may be described as one in which gray soils prevail, this belt is one in which yellowish and brownish soils predominate.

A glance at the soil map shows that the second belt consists of two sub-belts, the division line running approximately along the middle. The southeastern sub-belt is dominated by the soils of the Collington series, mainly sandy loam, or fine sandy loam, and loam. These soils are characterized by a well-developed or mature profile or section, which is fundamentally identical with the normal or mature profile found throughout the region in which this area occurs. In uncultivated areas it consists of the following:

1. A thin, dark-brown layer, the dark color being due to organic matter. This layer ranges up to about 3 or 4 inches in thickness. It is usually sandy, with around 10 per cent of fine material, the rest being sand.

2. A yellowish-brown layer containing about the same proportion of fine material as the surface layer. It is usually loose in forested regions, but in fields cultivated for many years it is apt to bake on drying unless it is well supplied with organic matter. On account of its sandy nature it bakes less than heavier soils.

3. A brown, strong yellow brown, or rusty-brown layer with a considerably higher percentage of clay than is present in the layers above. It is usually friable, often breaks into small angular particles, half an inch or less in diameter at the top of the layer, becoming larger and less well defined downward. The top of this layer lies at a depth ranging, in the various types, from about 15 to 24 inches, and the bottom lies at 30 to 36 inches in depth. The lower part becomes greenish yellow and finally passes into the greenish sandy clay of the parent material, the glauconitic sands.

The Sassafras soils, associated with the Collington soils as soils of subordinate importance because less extensive, have a profile essentially like that of the Collington soils, with generally lighter colors throughout and with a light-textured, sandy parent material instead of the greenish sandy clay underlying the Collington soils. The third layer of the Sassafras soils usually has a lower percentage of clay than the corresponding layer in the Collington soils, but the color of this layer is apt to be a brighter brown, reddish brown, or yellowish brown than the somewhat rusty brown color in the Collington soils.

In the northeastern corner of the Trenton area an outlier of sands, similar to the sands in the southeastern belt, extends a few miles into the area from the northeast. The normal characteristics of the loam and sandy loam belt are known to be well developed southeast of this, in the region around Freehold. Another sandy area lies in the southwestern part of the area, along the Delaware River.

The northwestern half of the loam and sandy loam belt is dominated by the Sassafras loam. Collington soils do not occur in it, though considerable areas of Sassafras sandy loam occur.

The loam occupies all the even upland watershed areas, while the sandy loam is found mainly on the slopes and along the hilly belts bordering the valleys. These are apparently due, at least in part, to their freshness and imperfect development as soils. It will be remembered that the Sassafras soils are underlain by rather sandy materials. The loam of the smooth uplands between the streams has lain in place long enough to have developed a rather thick subsoil layer, the number 3 of the profile, and the surface has decomposed to a loam. The sandy loam on the slopes is eroded continually, lies lower than the loam, and a larger part of it is developed from the sandy layer underlying the loam, but the materials of the three layers are not allowed to lie in place long enough to become decomposed into loam.

In the northeastern part of the area, along the northwestern boundary of the loam and sandy loam belt, lies a strip of Elkton soils. These have developed in poorly drained situations. They are gray in color, with imperfectly oxidized or spotted subsoils, the latter often rather heavy in texture.

Small areas of Collington soils are found in this sub-belt, but they are not so large as the principal area of Sassafras soils in the Collington or southeastern sub-belt. These small areas are mainly if not entirely sand, and they lie along slopes adjacent to stream valleys in positions similar to those occupied by the Sassafras sandy loam in this belt from Trenton northeastward.

The Collington soils are mapped also as phases characterized by a low content of glauconite. They were not found northeast of Trenton, except in a few small spots on the lowest slopes of the tributaries of the Raritan and one or two spots along the Assanpink Creek. This part of the area lies in general too high for the exposure of the beds from which this soil has been developed, since it is apparent that this bed lies beneath those from which the Sassafras loam and sandy loams of this sub-belt have been developed. In this connection it should be stated that the Collington soils have been separated from the Sassafras soils almost wholly on the basis of the character of the parent geological formation from which they have been developed. The Collington soils have been developed from beds containing a noticeable percentage of greensand or glauconite. This is a silicate of iron, alumina and potash, the percentage of alumina varying rather widely. In the process of soil development this mineral is decomposed, the iron being partly removed and presumably partly oxidized, the latter remaining in the soil as hydrous iron oxide, while the potash is removed from the soil in solution or is adsorbed on the colloidal material which is developed from the alumina in both the glauconite and the other alumina-bearing minerals in the parent material. It is well within the range of the possible that the glauconite in any particular spot may be decomposed to so great a depth that it will not be found within the range of observation open to the field man in the soil survey. On smooth land this is usually somewhat less than 6 feet.

In cases where the field man is not able to identify greensand particles in the deeper parts of this section, the soil is mapped as Sassafras if it be well drained and yellow to yellowish brown in color with some faint reddish color in the heavier layer of the sub-soil. These soils have developed from material that never contained any noticeable percentage of greensand, but, as just stated, it is possible that Sassafras soils may be mapped as such even where they have been developed from material containing more or less greensand.

In cases where the parent material contained originally a considerable percentage of greensand, the resulting soil is usually heavier than that derived from soil free from greensand. The Collington soils are as a rule heavier than the Sassafras soils, looking at these soils not merely from the point of view of their features in the Trenton area but from that of the whole belt in New Jersey and Maryland.

The following table shows the chemical composition of samples of Collington fine sandy loam collected near Auburn in Salem County, south of Salem. Analyses of samples collected in the Trenton area have not been made, but this series of analyses will serve to show the general chemical features of these soils. The percentages of all the constituents except silica will be higher in the loam than in this type, which is a fine sandy loam. The relative percentages in the successive layers or horizons from the surface downward will be about what they are in these samples.

Chemical composition of Collington fine sandy loam.

(Samples taken 2 miles southeast of Auburn, N. J.)

Constituents.	Soil sample numbers and depths.				
	29441, 0 to 1 inch.	29442, 1 to 3 inches.	29443, 3 to 24 inches.	29444, 24 to 36 inches.	29445, 36 to 60 inches.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
SiO ₂	88.58	91.58	95.19	87.24	64.76
TiO ₂.....	.62	.53	.62	.50	.67
Fe ₂ O ₃	1.49	1.41	2.11	1.28	13.54
Al ₂ O ₃	1.74	1.52	.50	7.10	9.30
MnO.....	.02	.01	.01	.01	.035
CaO.....	.36	.21	.31	.19	.04
MgO.....	.15	.25	.18	.33	2.06
K ₂ O.....	.68	.12	.22	.36	4.37
Na ₂ O.....	.46	.34	.52	.56	.97
P ₂ O ₅.....	.11	.08	.09	.36	.11
SO ₃.....	.22	.23	.15	.21	.07
Loss.....	7.63	3.51	.95	1.51	4.37
Total.....	102.06	99.79	100.85	99.65	100.29
Nitrogen.....	.23	.10	.05	.04	.01

The following tables show the chemical composition of Collington loam and Sassafras sandy loam, according to analyses of samples taken in Maryland.

Chemical composition of Collington loam.

[Samples taken in Prince Georges County, Md.]

Constituents.	Soil sample numbers and depths.			
	29677, 0 to 12 inches.	29678, 12 to 18 inches.	29679, 18 to 40 inches.	29680, 40 to 45 inches.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
SiO ₂	87.98	87.08	77.71	77.65
TiO ₂.....	.85	.92	.82	.47
Fe ₂ O ₃	2.91	4.29	9.44	12.23
Al ₂ O ₃	4.67	3.54	5.20	2.52
MnO.....	.01	.01	.01	.01
CaO.....	.21	.41	.30	.28
MgO.....	.32	.49	1.09	1.25
K ₂ O.....	1.45	1.62	2.91	2.51
Na ₂ O.....	.40	.40	.30	.30
P ₂ O ₅.....	.09	.10	.12	.12
SO ₃.....	.04	.05	.04	.24
Loss.....	1.79	1.67	2.98	3.01
Total.....	100.72	100.58	100.92	100.59
Nitrogen.....	.03	.02	.025	.02

Chemical composition of Sassafras sandy loam.

[Samples taken near Cabin Creek, Md.]

Constituents.	Soil sample numbers and depths.			
	29407, 0 to 2½ inches.	29408, 4 to 20 inches.	29409, 20 to 32 inches.	29410, 33 to 60 inches.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
SiO ₂	87.83	90.57	80.74	82.03
TiO ₂.....	.34	.29	.34	.29
Fe ₂ O ₃	1.76	1.11	2.25	2.25
Al ₂ O ₃	3.92	4.77	10.58	8.57
MnO.....	.006	.006	.01	.006
CaO.....	.24	.16	.74	.76
MgO.....	.14	.14	.26	.20
K ₂ O.....	1.62	1.62	1.97	2.07
Na ₂ O.....	.16	.09	.44	.42
P ₂ O ₅.....	.03	.02	.08	.07
SO ₃.....	.06	.05	.06	.07
Loss.....	3.87	1.45	3.67	3.01
Total.....	99.97	100.27	101.14	99.736

These analyses show a high percentage of iron oxide in the Collington soils, becoming especially high in the lower depths where the material is unchanged or but slightly changed glauconite. The potash content is high also in this layer, while in the other layers it is but little higher than in the Sassafras. In these upper layers of the soil the potash content is determined to a greater extent by the stage of development reached by the soil, and by its texture, than by the composition of the parent material. The alumina varies somewhat, like the potash, with the texture rather than with the green-sand content of this parent material. The percentage of phosphoric acid is somewhat higher, as a rule, in the Collington soils than in the Sassafras soils of the same texture.

The mechanical composition, or the percentages of the various classes of materials classified according to the diameter of the particles, is given in the following tables:

Mechanical analyses of Collington fine sandy loam.

(Samples taken 2 miles southeast of Auburn, N. J.)

Grade of material.	Sample numbers and depths.				
	29441, 0 to 1 inch.	29442, 1 to 3 inches.	29443, 3 to 24 inches.	29444, 24 to 36 inches.	29445, 60 inches.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Fine gravel.....	2.5	1.0	0.4	0.2	0.6
Coarse sand.....	7.4	7.7	9.0	7.4	9.3
Medium sand.....	16.5	17.6	22.6	18.6	13.8
Fine sand.....	53.5	52.7	54.6	47.7	30.4
Very fine sand.....	4.7	6.3	3.4	7.1	7.1
Silt.....	8.9	9.1	7.0	9.3	9.9
Clay.....	6.6	5.6	3.1	9.7	28.9

Mechanical analyses of Sassafras fine sandy loam.

(Samples taken three-fourths mile southeast of Freehold, N. J.)

Grade of material.	Sample numbers and depths.			
	30377, 0 to 2 inches.	30378, 2 to 16 inches.	30379, 16 to 30 inches.	30380, below 30 inches.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Fine gravel.....	1.4	0.2	0.0	0.0
Coarse sand.....	3.4	4.0	1.9	4.6
Medium sand.....	12.0	14.3	8.3	16.2
Fine sand.....	69.0	75.5	62.2	62.7
Very fine sand.....	4.4	2.8	9.2	6.4
Silt.....	3.0	1.8	5.9	4.2
Clay.....	6.7	1.5	12.5	5.9

Only one set of samples from the Collington and one from the Sassafras has been selected. The actual figures will vary between any two samples of either series, even of the same type, and still more between the several types of each series, but the succession or relationship of the various horizons in each series is constant regardless of the number of samples of the type in the series. The percentage of fine material in the thin surface horizon in the virgin soil, consisting largely of decomposed organic matter or leaf mold, is always somewhat higher than in the material immediately beneath. In the Collington series the percentage of fine material is low in the upper part of the soil section and increases thence downward; the percentage in the parent material, as shown at the 60-inch level in the sample from Auburn, N. J., is relatively high. In many cases it is higher than that in the layer above it, represented in the Auburn sample by the horizon from 24 to 36 inches, though it may be somewhat less. The essential fact is that it is usually high. In the Sassafras soils, on the other hand, the highest percentage of fine material is found in a horizon lying from about a foot to two feet beneath the surface, while the percentage in the deeper horizons is relatively low.

The third belt of soils in the Trenton area is a belt of silty soils, and that part of it crossing the Trenton area occupies the northwest corner. In this area the soils have been developed from material accumulated in the place it now occupies through the disintegration of consolidated rocks, sandstones, shales, and dark-colored crystalline rocks. On the other hand the soils of the other two belts have been developed from unconsolidated sands, silts, clays, and glauconite beds accumulated by sedimentation in water, presumably sea water.

In the southern part of this belt, a few miles north of Trenton, the Lansdale soils have developed from fine-grained sandstones, and the profile is essentially like that of the Sassafras soils in all respects except that of surface texture and that of the character of the layer immediately beneath the B horizon or the heavy subsoil layer. In the Lansdale soils this layer is intermediate in character between the Sassafras and Collington soils, usually heavier than that of the Sassafras and lighter than that of the Collington, and it is relatively thin. The consolidated sandstone is reached at relatively shallow depths.

The Penn soils, occupying the greater part of this belt, have two marked characteristics through which they vary in their profile from the soils of the region as a whole. This regional profile, it will be recalled, is marked by a relatively light textured surface layer ranging up to more than a foot in thickness (leaving the thin leaf-mold layer in the timbered soil out of account), and a relatively heavy layer whose lower boundary lies at about 3 feet in depth, the color being yellowish in the surface horizon and deeper yellow brown to faint reddish brown in the heavier horizon. The third horizon (that of the parent material) is heavy or light according to the nature of the parent material and varies also in other respects than texture according to the characteristics of the material.

In the third belt as a whole the parent material varies in character, but in the area of the Penn soils, and especially the Penn silt loam, it is relatively uniform in character and consists of dark-red shale. This shale decomposes slowly on account of its density and the apparent slowness with which water penetrates it. The layer of disintegration is thin, so that necessarily the soil layer is thin and the soil profile is not so well developed as in the Sassafras and Collington loams and sandy loams.

In addition to the slow weathering of the rocks from which the Penn silt loam is developed, these rocks have a characteristic color that differentiates them from the other rocks of the region and that is resistant to weathering. This brings about a slow development of the *color profile* of the soils developed from them, just as their slow disintegration and also to a certain extent their fine grain brings about the slow development of the *texture profile* of these soils. The color of the parent material is still present at much shallower depths than in the majority of the soils developed from the glauconite.

As a consequence of these conditions the profile or section of the Penn silt loam consists of the following:

1. Pale-yellow silt loam stained with organic matter. It is usually but a few inches thick and in cultivated fields has been mixed

by cultivation with the material beneath it, since as a rule its thickness is less than the depth of plowing.

2. Pale reddish brown to Indian-red heavy silt loam to slightly heavier, becoming redder and somewhat heavier downward, with an increasing percentage of shale fragments, usually reddish.

3. A mass of disintegrated reddish shale, with interstitial reddish clay usually reached at depths of less than 3 feet from the surface.

4. Red shale.

The Penn shale loam consists essentially of the equivalent of horizons 2 and 3 of the silt loam, horizon 1 not being present.

The Montalto soils are found in two strips in the Trenton area. One strip runs across the extreme northwest corner of the area, the other east and west by Rocky Hill. They are brown soils, rather heavy in texture, with an imperfectly developed soil section, and overlie dark-colored igneous rocks from which they have developed.

The Lehigh soils are grayish, shaly soils lying in narrow strips flanking the Montalto soils in places. They are thought to have been developed from shales subjected to heat when the rocks from which the Montalto soils have developed were erupted.

In the following paragraphs are given brief summaries of the characteristics of soil series which are represented by soil types mapped in the Trenton area.

The types of the Penn series are derived from red sandstones and shales—the Triassic rocks. They are characterized by Indian-red or reddish-brown surface soils and brighter chocolate red or Indian-red subsoils. The color of the soil is much the same as that of the parent rock.

The soils of the Lansdale series are derived principally from dense grayish argillite, grayish sandstone, or shale. The surface soils are brown and underlain by brownish-yellow subsoils.

The Croton soils have grayish-brown or gray surface soils and are underlain by mottled yellowish and grayish subsoils overlying a very compact hardpan layer of reddish-brown or mottled rusty-brown clay. They are imperfectly drained and adjoin the Penn and Lansdale soils.

The soils of the Montalto series owe their origin to the disintegration of dense, massive trap rock (diabase) of Triassic age. The surface soils are reddish brown in color and are underlain by reddish-yellow subsoils.

The Watchung series includes imperfectly drained soils derived from trap rock. The surface soils are light brown or gray, the subsoils are mottled grayish, yellowish, and bluish gray. The lower subsoil is often compact and impervious.

The Lehigh soils have light brownish-gray or gray surface soils overlying mottled grayish, yellowish, and bluish-gray or dove-colored subsoils. They are derived from sandstones and shales that have been altered by the intrusion of great masses of molten trap rock, which, apparently, subjected them to great heat and compression.

The Sassafras series is characterized by the brown color of the surface soil and the reddish-yellow color and friable character of the subsoil. In the heavier types the lower subsoil is lighter in texture

and frequently contains gravel or sand or both. These are well-drained soils.

The types of the Woodstown series have brown to light-brown surface soils and mottled gray and yellow or bluish-gray and yellow subsoils. These types in the surface section are much like those of the Sassafras series, but in the subsoil they are more like the Elkton soils. The mottled subsoil indicates poor drainage.

The Elkton series includes types having ashy-gray to light-gray surface soils, overlying mottled yellowish-gray or bluish-gray subsoils. The mottling in the subsoil is due to imperfect drainage. At depths of about 30 to 40 inches the material is frequently lighter textured than above.

The types of the Portsmouth series are dark gray to black in the surface layer, and light gray, gray, or whitish in the subsoil, which in many places is mottled in the lower part with yellow, gray, and bluish gray. These soils have poor drainage.

The Collington series includes types with brown to dark reddish-brown surface soils and reddish-yellow or greenish-yellow subsoils. They contain greensand (glauconite) throughout the soil section, usually more in the subsoil than in the soil. The subsoil in many places has a rather greasy feel and olive-green color, the intensity of the color depending upon the quantity of greensand present. These are well-drained, well-oxidized soils.

The types of the Colts Neck series have brownish-red and reddish-brown surface soils overlying dark reddish-brown or reddish-brown subsoils, with some yellowish material in the subsoil in places. Locally the lower subsoil contains partly decomposed greensand marl, which gives rise to greenish and reddish colors.

The types of the Shrewsbury series have brownish-gray to gray surface soils overlying mottled grayish, yellowish, brownish, and greenish subsoils. Both soil and subsoil contain greensand marl, and in places the quantity is sufficient to give the material a greenish color. The Shrewsbury soils are more poorly drained than the imperfectly drained phases of the Collington soils and occupy lower topographic positions.

The Keansburg series include types having black surface soils overlying mottled yellowish, greenish, and reddish subsoils. They have poor drainage and contain much greensand marl.

The types in the Keyport series have grayish-brown or brown surface soils overlying subsoils of yellowish and brownish color, in many places friable in the upper portion but stiff below. The lower subsoil consists of mottled yellowish, grayish, and brownish, stiff, clayey material on the order of a claypan.

The types included in the Lakewood series are characterized by the nearly white or very light grayish surface soils and friable or loose orange-colored subsoils. They are well drained and in many places excessively drained.

The Leon series include types with light-gray or white surface soils overlying a layer of compact sandy material, coffee brown in color, below which the material becomes orange or light yellowish brown to yellow in color and less compact. The Leon soils occupy depressed areas of poor drainage.

The types in the St. Johns series also have a compact or hardpan-like sandy layer of essentially the same character as the layer in the Leon. Above the coffee-brown compact layer the surface soil is black, and below this layer the subsoil consists of looser, lighter colored material, usually light brownish, yellowish, or mottled grayish and yellowish in color. In places there is a lighter colored layer between the dark surface section and the coffee-brown compact layer.

The Birdsboro soils have brown surface soils and yellowish-brown to reddish-brown subsoils. They occupy terraces along the streams in the belt of Triassic rocks and are composed of relatively old alluvium derived from the local sandstones and shales.

The types of the Chenango series have brown surface soils overlying friable, yellow to brownish-yellow subsoils. They occupy stream terraces and are derived from glacial material reworked and redeposited by water. They are well drained.

The Bermudian soils are reddish brown in color, showing very little variation in color to a depth of 3 feet or more. The material is more brownish where the wash is largely from the lighter colored shale or argillite. They consist of stream sediments derived from the Triassic rocks.

The Freneau series includes poorly drained first-bottom types. The surface layers are dark brown and the subsoils are mottled rusty brown, bluish, greenish, and reddish brown. They contain varying quantities of greensand marl. The material has been washed largely from the Collington and Sassafras soils.

Besides the series above described a number of miscellaneous types are shown on the soil map. These include Meadow, Muck, Swamp, Clay pits, and Tidal marsh.

Meadow consists of low, rather wet areas of variable material occurring along streams in the Coastal Plain region. The areas mapped as Muck consist of black, well-decomposed vegetable matter, mixed with considerable mineral material, frequently occurring without change to a depth of 3 feet or more. The strips of material which are excessively wet at all times have been classed as Swamp. They support a thick growth of forest trees and are covered with water the greater part of the year. Areas that are subject to daily inundations by tides are classified as Tidal marsh. Clay pits represent excavations made in mining clay for industrial purposes.

In subsequent chapters the various types of soil are described in detail, their general location is given, and their relation to agriculture is discussed. The accompanying soil map shows the distribution of the types. The following table gives the actual and relative extent of each soil type mapped. In some of the Collington soils certain phases are described whose area is not given in this table. In such cases the area given for the typical soil includes the phase areas. One reason why this was done was because of overlapping of phases and consequent duplication of area. The estimated extent of the phases, however, is given in the descriptions of the several types.

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Sassafras loam.....	68,992	14.2	Shrewsbury silt loam.....	4,672	0.9
Shallow phase.....	2,944		Lansdale gravelly loam.....	4,096	.8
Collington sandy loam.....	32,832	9.1	Montalto silt loam.....	3,008	.8
Deep phase.....	13,120		Gravelly phase.....	1,024	
Sassafras sand.....	34,112	6.7	Bermudian silt loam.....	3,904	.8
Sassafras sandy loam.....	27,840	5.5	Tidal marsh.....	3,840	.8
Collington fine sandy loam.....	21,696	4.6	Lakewood fine sand.....	3,776	.7
Deep phase.....	1,472		Leon fine sand.....	3,456	.7
Collington loam.....	22,592	4.4	Colts Neck sandy loam.....	2,466	.7
Meadow.....	22,336	4.4	Light-textured phase.....	632	
Sassafras fine sandy loam.....	17,920	3.5	Sassafras silt loam.....	3,264	.6
Penn silt loam.....	17,152	3.4	Lehigh shale loam.....	3,072	.6
Sassafras loamy sand.....	14,272	2.8	Sassafras loamy coarse sand.....	2,816	.6
Swamp.....	13,760	2.7	Keypoint sandy loam.....	2,304	.4
Elkton loam.....	12,608	2.5	Lansdale stony loam.....	2,304	.4
Lakewood sand.....	10,560	2.1	Keypoint loam.....	2,176	.4
Collington sand.....	10,304	2.0	Keansburg sandy loam.....	1,984	.4
Lansdale silt loam.....	9,920	2.0	Portsmouth loam.....	1,920	.4
Woodstown loam.....	9,280	1.8	Woodstown sandy loam.....	1,856	.4
Penn shale loam.....	9,216	1.8	Portsmouth sandy loam.....	1,792	.3
Shrewsbury sandy loam.....	8,064	1.6	Lehigh silt loam.....	1,792	.3
St. Johns sand.....	7,424	1.5	Colts Neck loam.....	1,728	.3
Sassafras gravelly sandy loam.....	7,296	1.4	St. Johns fine sand.....	1,664	.3
Sassafras fine sand.....	6,912	1.4	Muck.....	1,024	.2
Freneau loam.....	6,848	1.3	Clay pits, etc.....	832	.2
Elkton silt loam.....	6,784	1.3	Watching silt loam.....	704	.1
Chenango loamy sand.....	6,464	1.3	Elkton sandy loam.....	576	.1
Croton silt loam.....	6,016	1.2	Keansburg silt loam.....	384	.1
Keansburg loam.....	5,376	1.1	Birdsboro fine sandy loam.....	320	.1
Shrewsbury loam.....	5,312	1.0			
Montalto stony loam.....	5,120	1.0	Total.....	508,160	

PENN SHALE LOAM.

The typical Penn shale loam consists of a chocolate-red or Indian-red silt loam 8 to 12 inches deep, overlying chocolate-red or light Indian red silty clay loam to clay. Numerous platy shale fragments occur on the surface and throughout the soil section. The parent shale is usually reached at depths ranging from 15 to 30 inches.

This soil occurs throughout the red shale belt in the northwestern part of the area. It is very largely confined to the slopes bordering streams and to hillsides. Some patches represent areas which are constantly exposed to erosion. A few areas occupy nearly level positions in places where the parent rock is very close to the surface. The drainage is generally excessive, especially on the slopes, where the soil is easily eroded by heavy rainfall.

The Penn shale loam is closely associated with the Penn silt loam. Practically all of it is cleared and is farmed in much the same manner as the silt loam. Lower yields are obtained, particularly over a period of years, owing to the shallow depth and droughty nature of the type. Corn, rye, wheat, oats, and grass are the chief crops grown.

This type is held at the present time at \$50 to \$100 an acre. Where it is associated with better soils higher prices prevail.

In cultivating this soil the greatest care must be exercised to prevent erosion, especially on the more sloping areas, where the soil is thin. This is best accomplished by seeding cover crops in the fall, the turf thus formed preventing excessive washing and at the same time conserving valuable plant food. This soil on sloping ground should not be allowed to lie bare over the winter season.

PENN SILT LOAM.

The surface soil of the Penn silt loam consists of dark chocolate red to reddish chocolate brown, mellow silt loam, 8 to 10 inches deep, overlying lighter chocolate red or Indian-red silt loam, which grades abruptly at about 12 to 15 inches into silty clay of Indian-red color. Small fragments of the parent rock are present locally in both soil and subsoil, especially in the sloping areas. Bedrock is frequently encountered at 20 to 30 inches below the surface, particularly in the vicinity of Franklin Park, where the unweathered red shale is rarely more than 20 to 24 inches below the surface. The color of the soil is much the same as that of the parent rock. In places the soil is chocolate brown in color and underlain at an average depth of about 10 inches by yellowish-brown silty clay loam, which passes beneath into yellow or brownish-yellow silty clay and this into reddish-brown to chocolate-red silty clay. Some quartz gravel is scattered over the surface of this variation in the vicinity of Rocky Hill.

The Penn silt loam occurs in large bodies in the northwestern part of the area, where it is the predominating soil type. It is extensive in the vicinity of Princeton, Hopewell, Skillman, Harlingen, and Franklin Park, where it occupies nearly level to gently undulating country. The drainage is good. Practically all of this type is under cultivation.

The Penn silt loam is a strong soil, and, with good management, gives excellent yields of corn, small grains, and timothy and clover hay. General farming is extensively practiced and dairying is of special importance, particularly in the vicinity of Skillman and Harlingen. Purebred Holstein cattle predominate, but there are a few Jersey and Guernsey herds. The sire of almost every herd is of registered stock. Hogs and chickens are raised on most farms, but only in sufficient number to supply the needs of the home. Potatoes are not grown commercially on this type, but a few rows usually find a place in the garden plots. Yields of potatoes range from fair in good seasons to poor in dry seasons.

General farm crops give good yields on the Penn silt loam. Corn averages 35 to 40 bushels per acre, but in exceptionally favorable seasons some fields produce as high as 75 bushels. The yield of wheat ranges ordinarily from 15 to 20 bushels per acre, and as much as 25 bushels per acre has been obtained. Rye does slightly better than wheat. Oats, which are extensively grown, yield 30 to 40 bushels per acre. Timothy and clover commonly return from 1 to 1½ tons of hay per acre, depending largely on the rainfall during the growing season.

Generally speaking the soil is well handled. The ground is usually broken as early as possible in spring, using two-horse plows, or, on the better farms, tractors and gang plows. Cultivation with spike-tooth harrows, disks, and other implements follows until a good seed bed is obtained. Frequently such land is rolled following cultivation, especially if clods have been formed during the plowing. Little fall plowing is practiced.

Crops are usually grown in a four-year or five-year rotation, consisting of corn, oats, and wheat, each one year, followed by timothy and clover hay one or two years. Rye sometimes displaces wheat.

Commercial fertilizers are in general use and the land is usually limed once during the rotation. The lime is applied after wheat or rye when clover and timothy are seeded. On many farms more attention should be given to liming. All stable manure available is applied to the sod before it is plowed under for corn. Corn and wheat are fertilized, generally with a good grade of fertilizer at the rate of about 200 pounds per acre. Manures are distributed with manure spreaders or by hand, and commercial mixtures are drilled in at the time of seeding. Modern farm equipment is extensively used on this soil type and the farm buildings are good and in excellent repair.

The selling price of the Penn silt loam is controlled somewhat by location, but the values ordinarily range from \$75 to \$150 an acre. In exceptional cases some land is sold for less, while farms of more favorable location and better equipment sometimes bring as high as \$400 an acre.

This type as a whole is well managed, but more careful attention should be given to the growing of leguminous crops. Sweet clover and alfalfa, with inoculation and liming, give good results and should be more extensively grown. Fall plowing and slightly deeper plowing should prove beneficial. Great care should be exercised in increasing the plow depth, however, so as to increase it only slightly each season until the desired depth is finally reached; otherwise crops may suffer. This soil needs lime once during a rotation.

LANSDALE STONY LOAM.

The Lansdale stony loam consists of a brown silt loam, 4 to 6 inches deep, underlain by yellowish-brown silt loam, which at about 20 inches passes into yellowish-brown silty clay loam or silty clay. Where it is covered with forest growth, as is commonly the case, leaf mold an inch or more in thickness overlies the surface soil. The surface is marked by numerous rock fragments and outcrops of the parent grayish argillite.

The Lansdale stony loam occurs only in the northwestern part of the area. The principal bodies lie north of Amwell and west of Plainville. It occupies steep slopes and is excessively drained. Practically all of it is forested with various species of oak, ash, maple, and elm. The growth is heavy and constitutes the only economic resource of this soil. The slopes are much too steep for successful farming and the quantity of rock fragments present would make cultivation difficult if not impossible. In the Trenton area, therefore, this land should be considered a nonagricultural soil and no attempt should be made to bring it under cultivation. It is, however, a valuable forest soil.

LANSDALE GRAVELLY LOAM.

The Lansdale gravelly loam consists of a brown to light-brown silt loam 6 to 8 inches deep, overlying yellowish-brown silt loam, which at about 12 to 15 inches passes into brownish-yellow silty clay loam or silty clay. In places traces of reddish material occur in the subsoil. Angular fragments of gravel cover the surface of this type and also occur throughout the soil section. These fragments con-

sist chiefly of dense, dark-gray argillite or sandstone, but in some areas platy shale fragments, varying in diameter from 2 to 8 inches or more, are present.

Some areas of Lansdale shale loam are included with the gravelly loam as mapped. The soil material in these two types is practically the same, but they differ in that the Lansdale shale loam contains fragments of grayish shale instead of gravel. Areas of this description are mapped near Lawrenceville, southwest of Princeton, and in other scattered locations, closely associated with the Lansdale silt loam. There are also included with this type some small areas of soil resembling the Lehigh shale loam. In such places it is impossible to determine whether the soil material is derived from argillite and gray shale or from the metamorphosed shale from which the Lehigh soils have been formed.

The Lansdale gravelly loam is extensive only in the northwestern part of the area, especially north of Skillman and west of Stoutsburg. It occupies rather steep and hilly situations, with good drainage.

This is not an important soil agriculturally, but a considerable part of it is cleared and used for general farm crops. Wheat, rye, oats, buckwheat, and some corn and grass are the principal crops. The yields are considerably lower than those obtained on the Lansdale silt loam. Dairying is important on this type and some fruit is grown.

LANSDALE SILT LOAM.

The Lansdale silt loam consists of a brown mellow loam, underlain at 10 to 12 inches by yellowish-brown friable silty clay loam grading into brownish-yellow friable silty clay loam, which at 20 inches passes into brownish-yellow friable silty clay. In places fragments of gray shale or argillite are present in the lower subsoil, and in some places chips of rock are present from the surface down.

In flat situations, where the drainage is slightly imperfect, some areas consist of a chocolate-brown silt loam 10 inches deep, underlain by yellowish-brown and then by brownish-yellow silty clay loam to silty clay, somewhat compact below 24 inches and showing slight mottling in the lower subsoil. Such areas approach the Croton silt loam in character.

The Lansdale silt loam is an important type, occurring in large bodies near Princeton, Lawrenceville, and northeast of Hopewell. It is derived from material coming from the underlying rock, either a grayish shale or a dense grayish sandstone known as argillite. It occupies well-drained, nearly level to rolling country.

This is a valuable agricultural soil and ranks favorably with the most productive soils of the area. It is for the most part cleared and under cultivation. The remaining woodland consists chiefly of plots used as woodlots, and most of these occupy low, flat situations of rather imperfect drainage. The native trees include various kinds of oaks, hickory, walnut, and maple. Considerable stands of chestnut formerly grew on this type, but this tree has been completely destroyed during recent years by the blight.

General farm crops are successfully grown on this soil. Corn, wheat, oats, some rye, alfalfa, and timothy and clover are the most

important. The yields are slightly better than those on the Penn silt loam. This is especially true during dry seasons, when the more mellow nature and good depth of the soil of the Lansdale silt loam proves of great advantage. Potatoes are produced in small quantities. The yields are only fair. Dairying is of great importance, many fine Holstein herds being maintained on farms situated on this type. Hogs and chickens are kept principally to supply pork and poultry products for home use, but a small surplus finds a ready market. Fruits, especially apples and peaches, produce well, but fruit growing is not an important industry.

Farm practices are practically the same as those on the Penn silt loam. The same practice is followed in applying fertilizers and lime.

Farms on the Lansdale silt loam at the present time (1921) have a valuation ranging as high as \$200 an acre. The average is probably around \$125 for cleared improved land, and some isolated tracts can be bought for as little as \$50 an acre.

The productiveness of this soil could be increased by practically the same methods as recommended for the Penn silt loam. Alfalfa on inoculated and limed land produces well, and the acreage of this crop should be increased, especially on the dairy farms. Apples, such as the Gravenstein, Baldwin, and Stayman Winesap of the late varieties, and Wealthy, Fall Pippin, Astrachan, and Yellow Transparent of the early varieties, should do well on this soil, provided the orchards are properly sprayed, pruned, and cultivated.

CROTON SILT LOAM.

The typical Croton silt loam is a light-brown or ashy-gray (when dry) silt loam 8 to 10 inches deep, underlain by mottled yellowish and grayish silt loam or silty clay loam, which at about 15 to 18 inches overlies a very compact silty clay loam, yellowish and grayish in color, passing into limonite-yellow, gray, and pinkish compact clay beneath. This compact layer in the lower subsoil acts as an impervious hardpan. It is difficult to penetrate with the soil auger. In other situations having better drainage this soil consists of a brown silt loam, 6 to 10 inches deep, grading into brown friable clay loam, underlain at about 20 inches by a hardpan layer of mottled reddish-brown or chocolate-red and rusty-brown clay, which frequently passes beneath into bluish-gray compact silty clay. Such areas represent inclusions of a better drained phase of the Croton silt loam. The subsoil of the Croton silt loam as mapped is variable in color, depending upon drainage conditions and the adjoining soil types. Where closely associated with the Penn soils more reddish, pinkish, and brownish colors are present, and in areas near the Lansdale types more yellowish shades appear. In the better drained situations the surface soil is usually brown, while poorer drainage conditions give rise to a brownish-gray or grayish surface layer.

The Croton silt loam is rather extensive in the northern part of the area, where it occurs in low, flat depressions at the heads of or adjacent to streams and in other situations having poor drainage. The type as a whole has imperfect to very poor drainage. Its greatest development is at Franklin Park in the northern part of the survey. Numerous other areas are scattered throughout the Triassic belt, closely associated with the Penn and Lansdale soils.

Most of the Croton silt loam has been cleared, but some areas still remain in forest. The principal growth is oak, birch, maple, willow, hickory, and dogwood. Practically all the better drained areas are devoted to the general farm crops. Cultural methods and crops grown are practically the same as those on the Penn and Lansdale silt loams. Dairying is an important industry, and many of the poorly drained areas remain in permanent pasture.

When this soil is drained the yields of certain crops are fairly good. Corn and wheat do not produce well, except in the most favorable seasons. The natural tendency of this soil to warm up late and its failure to dry out sufficiently for early working gives all spring-sown crops a late start. Likewise grains and grass sown in the fall are likely to be injured by heaving or by excess water during the winter months. It is difficult to get a good stand of clover on this type, and alfalfa should not even be attempted. Redtop generally succeeds on soils of this kind. This land is fertilized much the same as the Penn silt loam.

This soil, if it is to be successfully farmed, must be underdrained and given liberal applications of lime. The more poorly drained areas may better remain in permanent pasture, as the hardpan layer renders underdrainage difficult and of doubtful value.

MONTALTO STONY LOAM.

The Montalto stony loam consists of a reddish-brown to brownish-red silt loam, which passes at 8 to 10 inches into reddish-yellow or dull-red friable clay loam and at lower depths into reddish-yellow or dull-red clay. Numerous large fragments of trap rock appear on the surface and outcropping ledges of the same rock are not uncommon on the slopes.

This soil is of importance only in the trap ridges of diabase situated north of Princeton and north of Amwell, where it is the predominating soil type and occurs in large bodies. It occupies the steeper slopes, where drainage is well developed. None of this type has been cleared and cultivated. It remains in forest consisting principally of white oak, chestnut oak, hickory, dogwood, and ash.

The topography of this soil, together with its stony condition, discourages agricultural development. There are, however, parts with more nearly level surface, from which the stones could be removed and the land made satisfactory for cultivation. This is a good forest soil.

MONTALTO SILT LOAM.

The typical Montalto silt loam consists of a light-brown or reddish-brown to brownish-red silt loam, 6 to 8 inches deep, overlying reddish-yellow or dull-red friable clay loam, which at about 20 inches passes into heavy clay loam or clay of the same color. This soil is formed of material resulting from the decay of the underlying trap rock, which lies only a few feet below the surface.

There are included within this type as mapped some areas of Montalto clay loam. This soil differs from the Montalto silt loam in having a heavier surface soil and a more level topography.

The Montalto silt loam is not extensive, occupying only 3,008 acres, or with its gravelly phase 4,032 acres. The type occurs on a trap-rock ridge about 2 miles north of Princeton. It occupies the more level or gently sloping parts of the ridge and has adequate drainage.

Owing to its small extent this is not an important agricultural soil in the Trenton area, although practically all of it is under cultivation. General farm crops, such as wheat, corn, rye, oats, and grass, are grown, with yields about the same as obtained from the Penn and Lansdale silt loams. Cultural practices follow those used on other soils of the region. Manure usually is applied to the sod land before plowing, and commercial fertilizers are used for small grains, being drilled in with the seed at the rate of about 100 to 400 pounds per acre. Dairying is of minor importance, and only enough hogs and chickens are raised to supply products for home use.

Land of this type can be bought at relatively low prices, depending largely upon location, improvements, and the soil types with which it is associated. Ordinary prices at this time (1921) range from \$40 to \$100 an acre.

The Montalto silt loam is a strong soil and well adapted to the production of general farm crops as well as fruit. In the Belvidere area of New Jersey this was formerly a highly productive fruit soil. Peaches and apples were grown. There is no apparent reason why more fruit could not be produced economically at the present time on this soil, provided the orchards are cared for in accordance with the best modern practice.

Montalto silt loam, gravelly phase.—The gravelly phase of the Montalto silt loam differs from the typical material in that it carries a large proportion of gravel on the surface and throughout the soil and subsoil. This gravel consists of angular fragments of trap rock (diabase), ranging in size from 2 to 10 or 12 inches in diameter. The soil is usually shallower than the typical Montalto silt loam, the bedrock lying within a few feet of the surface.

This phase is not extensive. It occupies more sloping ground than the silt loam. Drainage is good. The gravel makes the soil more difficult to work and limits to some extent the crops that can be grown successfully. Crops yield less than on the typical silt loam. This phase is well adapted to fruit, the gravel layer on the surface acting as a mulch and materially improving moisture conditions during dry spells.

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

Mechanical analyses of Montalto silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
171063	Soil, 0 to 8 inches.....	2.1	5.2	2.8	8.0	13.1	54.9	13.9
171064	Subsoil, 8 to 36 inches..	1.4	3.8	2.4	6.4	16.3	47.7	22.0

WATCHUNG SILT LOAM.

The Watchung silt loam is a mottled brown and gray or mottled gray and yellow silt loam, which passes below into bluish-gray or blue silty clay with yellow and limonitic-yellow mottling. In many places large fragments of trap rock occur on the surface. Such areas represent inclusions of Watchung stony loam. Yellow concretionary material is present in the lower subsoil in places.

This type is of little importance, having a total extent of a little more than 1 square mile. It occupies imperfectly drained areas adjoining areas of Montalto soils. Practically none of it is under cultivation. It is utilized chiefly as pasture land, for which it is best adapted. It supports a vigorous forest growth, consisting of various oaks, dogwood, ash, and hickory.

This soil should be used for pasture land and forestry. With underdrainage, liming, and, where necessary, the removal of the larger stones, this soil could be improved and made productive, but it is extremely doubtful if the results obtained would warrant the expense.

LEHIGH SHALE LOAM.

The Lehigh shale loam consists of a light-brown to grayish-brown silt loam, 6 to 8 inches deep, overlying mottled light-grayish, yellowish, and bluish silty clay loam to silty clay, compact in the lower subsoil. Bedrock is normally encountered between 15 and 30 inches. Large quantities of grayish and bluish shale fragments occur on the surface and throughout the soil and subsoil. In places, as at Rocky Hill, considerable bluish material is present at depths of 6 to 8 inches.

This is not an extensive type of soil. It occurs in the northwestern part of the area in association with the Lehigh silt loam and the Montalto soils, and has its greatest development north of Princeton and southeast of Hopewell. This type occupies gentle to rather steep slopes and is well drained. The areas adjoin areas of trap rock.

The Lehigh shale loam is not of much agricultural importance, although most of it is farmed. General farm crops, such as wheat, corn, oats, and grass, are grown. Yields are slightly less than those obtained on the Penn shale loam. The farmers consider it a rather inferior soil. It is shallow and during dry seasons crops suffer from lack of moisture. Dairying is an important industry on this type.

LEHIGH SILT LOAM.

The Lehigh silt loam consists of a gray or brownish-gray silt loam (when dry), 5 to 10 inches deep, overlying mottled gray and yellow or pale-yellow silty clay loam to silty clay, which at about 20 inches passes into bluish-gray silt loam or silty clay loam, in places somewhat compact. The degree of mottling in both the upper and lower subsoil varies considerably with the locality. In places small quantities of shale and argillite fragments are present in both the surface soil and subsoil.

This is one of the less extensive soils of the area, occupying a little less than 3 square miles. It occurs in the Triassic belt, chiefly north

of Princeton. It adjoins areas of Montalto soils which are derived from trap rock, the intrusion of which caused metamorphism of the shale and probably accounts for the distinctive colors of the rock giving rise to the Lehigh soils. The Lehigh silt loam occupies nearly flat to gently sloping areas having good drainage, except in some flat places where seepage water accumulates from higher slopes.

Considerable of this type is under cultivation. Corn, wheat, oats, buckwheat, and grass are the crops generally grown. The yields are less than those on the Penn, Lansdale, and Montalto soils.

Cultural methods on the Lehigh silt loam are practically the same as those used on the Penn silt loam. Dairying is also an important industry on this type. This land has a lower value than the Penn, Lansdale, or Montalto soils.

SASSAFRAS SAND.

The typical Sassafras sand consists of light-brown to brownish-gray sand passing at 5 or 6 inches into yellow sand and at 8 to 10 inches into reddish-yellow sand, in many places slightly loamy in the lower subsoil.

This type, as mapped, varies considerably, especially in the color of the surface soil. Along the Delaware River, between Kinkora and Palmyra, where the type is extensively developed, the surface soil is brown to light brown in color and the subsoil is light reddish brown. Near New Egypt and in the wooded areas in the extreme southeastern part of the survey there is developed a variation in which the soil consists of white sand about 1 inch deep overlying a light-brownish sand, which passes quickly into orange-colored sand and at 20 inches into reddish-yellow sand. In other parts of the survey, as near Clarksburg, the surface layer consists of gray sand 3 or 4 inches deep, passing into yellowish-red sand and at 15 to 20 inches into the typical reddish-yellow subsoil. Areas of this soil in the southeast corner of the survey contain considerable coarse sand.

The Sassafras sand is extensively developed along the Delaware River south and southwest of Trenton and in the southeastern part of the survey south of Clarksburg and south and southeast of New Egypt. There are also important areas in the vicinity of Spotswood, Helmetta, and Old Bridge, in the northeastern corner, and scattered areas occur throughout the entire southern half of the survey. In general the type has a level to gently undulating topography. Drainage is always thorough and in many places it is excessive.

The Sassafras sand is an important agricultural soil, especially along the Delaware River southwest of Trenton. In this vicinity practically all of it is cleared and successfully farmed to truck crops and fruit. Near Spotswood and in the southeastern part of the survey most of the type still remains in forest, consisting chiefly of various kinds of oaks and pine. Huckleberry and blueberry are conspicuous in the undergrowth.

Where cultivated this soil gives excellent yields of early peas, sweet potatoes, tomatoes, watermelons, cantaloupes, and other truck crops. Apples and peaches are also produced, the early varieties being especially valuable for commercial production on this soil.

This soil is easily worked and readily prepared for planting early in the spring. The farmers in general recognize the necessity of applying stable manures and commercial fertilizers in liberal quantities in order to obtain the best results. A cover crop, commonly rye, follows the truck harvest, to be plowed under in the late fall or early spring. By this practice the supply of organic matter in the soil is maintained.

Land of this type varies widely in value depending largely upon location and improvements. Improved farms in the southwestern part of the area frequently command prices as high as \$200 to \$300 an acre, while large tracts in forest can be bought as low as \$25 an acre. When set in peaches or apples the land brings \$300 an acre or more, depending on the age and condition of the trees.

The productiveness of this soil can be greatly increased by more liberal applications of stable manure and the more extensive growing of cover crops. The type naturally is deficient in organic matter, and if its fertility is to be maintained, it must be handled in such a way that this deficiency will be overcome. When plowing under organic substances it will be advantageous to apply lime. Applications of 1 to 1½ tons per acre, applied once in a four or five year rotation, would prove highly beneficial.

SASSAFRAS LOAMY COARSE SAND.

The Sassafras loamy coarse sand consists of a brown to yellow loamy coarse sand grading at about 6 to 8 inches into reddish-yellow to yellowish-red loamy coarse sand containing considerable fine gravel. Near Ten Mile Run the surface soil is a yellow loamy coarse sand which passes abruptly into the typical subsoil material. Like other types of the Sassafras series, this soil in virgin forest contains considerable grayish material in the surface layer. Those areas having much gravel are indicated on the map by symbols.

This type, which covers only about 4 square miles, is not extensive enough to be of agricultural importance. It occupies rolling areas, and is well to excessively drained. The more important areas lie in the extreme northeastern part of the survey near South River. Most of this soil still remains in forest. In some places the type is being mined and used in surfacing highways.

SASSAFRAS FINE SAND.

The Sassafras fine sand consists of light-brown or brownish-gray fine sand passing at 8 or 10 inches into orange-colored fine sand, which grades at about 20 inches into yellow or reddish-yellow loose fine sand.

There are included within this type, as mapped, some areas of Sassafras loamy fine sand, which differs from the Sassafras fine sand in being slightly heavier in texture. The subsoil is also slightly heavier.

The Sassafras fine sand is about 7,000 acres in extent. It is associated with the Sassafras sand, and occupies gently rolling to level topographic positions of good surface and internal drainage. About 50 per cent of this type is cleared and under cultivation. It is gen-

erally considered a slightly better soil than the Sassafras sand, being more retentive of moisture and fertilizers. Farming methods are identical on these two soils and prices of farm lands show about the same range on one as on the other.

SASSAFRAS LOAMY SAND.

The typical Sassafras loamy sand consists of light-brown or grayish-brown loamy sand, underlain at about 8 inches by reddish-yellow loamy sand, which in places assumes the texture of a sandy loam or coarse sandy loam at a depth of about 30 inches.

As mapped this type includes some areas of Sassafras sandy loam, deep phase. Such inclusions have a reddish-yellow loamy sand surface soil, grading at 8 to 10 inches into reddish-yellow loamy sand, and at 18 to 24 inches into a yellowish-red to reddish-yellow sandy clay. In many places fragments of ironstone occur in the lower subsoil. Another variation occurs along the Delaware River southwest of Trenton. Here the soil is a dark-brown loamy sand, underlain at about 8 inches by reddish-yellow or orange loamy sand, which changes with depth into light sandy loam of somewhat redder color than typical. In wooded areas, as near Cassville, the surface soil is gray to light grayish brown and passes abruptly at about 4 or 5 inches into the typical subsoil.

The Sassafras loamy sand occupies level to gently rolling areas. The drainage is good. This type is developed in scattered areas throughout the southern half of the Trenton area, commonly in close association with the Sassafras sand. Larger developments occur in the vicinity of Cassville and south and southwest of Burlington. In the latter district this type is highly improved and used for the production of fruit and truck crops. Peaches and apples are grown, and the orchards are interplanted with truck crops, especially early peas.

Throughout the entire area about 50 per cent of this soil is cleared and is farmed in practically the same manner as the Sassafras sand. It is slightly better than the sand type, but the difference is not enough to influence land values. Prices paid depend largely upon location and state of cultivation.

SASSAFRAS GRAVELLY SANDY LOAM.

The Sassafras gravelly sandy loam consists of a layer of brown gravelly sandy loam, 8 to 10 inches thick, underlain by a subsoil of reddish-yellow, friable, heavy sandy loam to sandy clay, and a lower subsoil of reddish-yellow gravel and coarse sand. Well-rounded quartz gravel, with fragments rarely more than 2 inches in longest diameter, is plentiful over the surface and in the soil and subsoil.

In places, especially in forested areas, where the leaf mold is thick, the surface soil of this type consists of gray to yellowish-brown sandy loam passing at about 8 inches into reddish-yellow gravelly loam or sandy loam, which becomes more gravelly and sandy with depth. In other places the surface soil consists of brown gravelly loamy sand, which passes at about 8 inches into the typical material. There are also included with this type some small areas of material having a deep pinkish red gravelly subsoil of high iron content, the

color closely resembling red oxide of iron, as used in the manufacture of paint. Such areas occupy the higher elevations where varying quantities of ironstone occur throughout the soil material.

The Sassafras gravelly sandy loam is developed at relatively high elevations and in many places caps the hills. It is distributed throughout the southern half of the survey. Drainage is everywhere adequate and in places excessive.

This soil occupies 7,296 acres, or about 1.4 per cent of the total area surveyed. About one-half of this is cleared and under cultivation. It receives practically the same treatment as the Sassafras sandy loam, but because of the gravel content is not considered as well adapted to certain crops as the other Sassafras types. This is especially true with respect to potatoes. Apples and peaches, on the other hand, do especially well.

Land of this type can be bought for as little as \$75 an acre, the price depending largely upon location and improvements.

SASSAFRAS SANDY LOAM.

The typical Sassafras sandy loam consists of brown sandy loam, underlain at 8 to 10 inches by yellowish-brown sandy loam, grading at about 10 to 14 inches into reddish-yellow friable sandy clay. In some places where drainage is more or less imperfect faint gray mottlings occur in the lower subsoil. In other places areas mapped with this type consist of reddish-yellow coarse loamy sand, underlain at about 24 inches by yellowish-red coarse sandy clay. Such areas represent inclusions of Sassafras coarse sandy loam.

The Sassafras sandy loam is widely distributed over the Coastal Plain section of the area. It occupies gently rolling to flat country in which the drainage is good. It occurs chiefly in the vicinity of Edinburg, Windsor, Hightstown, and Cranbury.

This is one of the more extensive soils in the area, covering 27,840 acres, or 5.5 per cent of the total area surveyed. It is an excellent general farming soil, and about 75 per cent of it is cleared and under cultivation. It is developed especially in the vicinity of Hightstown. Corn occupies a large acreage, as does also rye, but potatoes constitute the most extensively grown and most important crop on this soil. It seems to be especially well adapted to the Irish Cobbler and other high-quality table varieties. Yields as large as 250 to 300 bushels are not uncommon, and the average is around 175 bushels per acre. Crops of minor importance are peppers, tomatoes, cabbage, and orchard fruits, principally apples and peaches.

Methods of handling this soil are practically the same as those employed in farming the Sassafras loam. Some fall plowing is done, but as a rule the ground is not broken until early spring. The crops on this soil are given the best of care. Cultivations usually follow each rain, and heavy applications of fertilizers are made, especially in growing potatoes. The fertilizer applications for potatoes range from a few hundred pounds to 1,600 or 1,800 pounds per acre. The mixtures vary in composition but are usually of high grades.

Farms composed of the Sassafras sandy loam vary widely in price, depending largely upon location and the condition of land and

buildings. In the more remote sections cleared land of this type can be bought as low as \$50 an acre, but near Hightstown, Allentown, and in other prosperous farming communities where potato culture is of great importance the price ranges from \$200 to \$300 an acre.

This soil, like all the other soils of the area, is naturally deficient in lime. This is especially true where potatoes are grown extensively. In some respects lime is objectionable as a soil amendment on potato land. Nevertheless, in order to maintain fertility and the proper bacterial activity, the lime requirement must be met. Applications of 1 to 1½ tons per acre should be applied following the potato crop. By this practice the danger of increasing scab diseases is reduced to a minimum. Alfalfa would produce well on this soil if lime is applied, and should be more extensively grown, especially on farms where dairying or the production of livestock is important.

SASSAFRAS FINE SANDY LOAM.

The Sassafras fine sandy loam consists of a light-brown to brown fine sandy loam, grading at about 8 to 10 inches into heavy reddish-yellow fine sandy loam and at about 20 inches into reddish-yellow friable fine sandy clay. In the lower part of the 3-foot section coarser material is commonly present.

East of Trenton some areas included with this type consist of a deep surface soil of brown very fine sandy loam, underlain at about 15 to 20 inches by reddish-yellow to reddish-brown fine sandy loam or light fine sandy clay. In other places, generally in the southern half of the area and closely associated with the low greensand content phases of the Collington fine sandy loam, the lower subsoil of the Sassafras fine sandy loam contains minute quantities of greensand marl. In such areas both soil and subsoil are more reddish in color than typical.

The Sassafras fine sandy loam is generally distributed through the central and southwestern parts of the area. It is especially well developed in the vicinity of Wrightstown, southeast of Trenton, north of Hightstown, and near Edinburg and Hamilton Square. The topography is gently rolling to flat and the drainage is everywhere good.

Most of this soil is cleared and is cultivated in much the same manner as the Sassafras sandy loam and Sassafras loam, with which it is closely associated. Practically the same crops are grown with good results. Yields on this type are slightly lower than those obtained on the Sassafras loam but usually better than on the sandy loam.

Land values are relatively high, rarely below \$150 an acre and ranging up to \$250 for improved farms in a good state of cultivation.

The working qualities and productiveness of this soil could be improved by using the methods recommended for the Sassafras sandy loam.

SASSAFRAS LOAM.

The Sassafras loam consists of an upper layer of brown mellow loam, 8 to 10 inches deep, underlain by a reddish-yellow friable silty clay or sandy clay which becomes looser and coarser below

28 to 30 inches. In many places a layer of gravel is encountered between 30 and 36 inches. In other places the surface soil is a light-brown loam underlain by reddish-yellow friable loam, becoming coarser and lighter with depth.

Large areas of this type occur in the vicinity of Hightstown, Cranbury, Prospect Plains, Dutch Neck, Bordentown, and Jacksonville.

Surface and internal drainage of this type is everywhere adequate though not excessive. The topography is level to gently undulating.

The Sassafras loam is the most extensive soil in the area, forming, with its unimportant shallow phase, 14.2 per cent of the total area surveyed. It is of great agricultural importance and practically all of it is under careful cultivation. It is considered the most desirable soil in the area for the production of potatoes. Corn, timothy and clover hay, and rye also are grown extensively. Some alfalfa is produced. Potatoes and rye are frequently grown year after year in the same field. This practice is not to be commended, although yields do not seem to decrease provided the scab is kept under control.

The yield of potatoes ranges ordinarily from 200 to 300 bushels per acre, but on many farms considerably larger yields are obtained. Timothy and clover hay yield from 1 to 2 tons, the average being about 1½ tons per acre. Corn frequently yields over 60 bushels per acre on this type, but the average is around 40 bushels. Rye and wheat do well. This type is also an excellent fruit soil.

Modern cultural methods are followed. Considerable fall plowing is done, but most of the ground is broken in early spring. Careful cultivations follow each rain during the growing season and liberal applications of commercial fertilizer and stable and green manures are consistently made. The methods are especially efficient on the farms devoted to the production of potatoes.

Farms composed of the Sassafras loam are being held at high prices. Land under cultivation and with the usual farm buildings and improvements can seldom be bought for less than \$125 an acre, and \$300 is frequently paid. The average is around \$175 an acre. Practically all the type is cleared and under cultivation.

This type needs rather heavy applications of lime, probably once in every four or five year rotation. Heavy applications of organic matter, in the form of stable manure or green-manure crops, also prove beneficial.

Sassafras loam, shallow phase.—The shallow phase of the Sassafras loam consists of heavy brown loam or silt loam, 6 or 8 inches deep, passing into reddish-yellow or yellowish-red clay without much change below this within the 3-foot section, except that the lower subsoil takes on a slight reddish tinge suggestive of the color of the Penn soils.

This soil is developed over the Triassic rocks in the northern part of the area, especially in the vicinity of Franklin Park and Princeton. It occupies undulating topographic positions where drainage is good.

Practically all of this phase is used in the production of general farm crops. Some potatoes are produced with good results. The

land is handled in much the same way as the Sassafras loam. It usually occurs in small areas and is held for about \$60 to \$100 an acre.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the typical Sassafras loam:

Mechanical analyses of Sassafras loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
30381	Soil, 0 to 7 inches.....	2.4	8.1	6.2	13.2	20.1	40.4	9.6
30382	Subsoil, 7 to 16 inches.....	1.2	5.8	4.8	10.9	18.6	46.6	12.0
30383	Subsoil, 16 to 30 inches.....	.9	4.2	3.7	10.4	23.1	40.9	16.9
30384	Subsoil, 30 to 45 inches.....	6.0	18.2	11.4	18.4	10.7	20.0	15.3

SASSAFRAS SILT LOAM.

The surface soil of the Sassafras silt loam is a brown silt loam. This is underlain at an average depth of about 10 inches by reddish-yellow friable sandy clay, which grades into yellowish-red loam at about 24 inches and this into yellowish-red sandy loam containing some small gravel.

Areas of this type occur principally in the vicinity of South River and Jamesburg. They have a level surface and fair to good drainage.

The Sassafras silt loam occupies about 5 square miles. It is practically all under cultivation, general farming being the prevailing type of agriculture. Potatoes are a specialized crop on some farms. This is a strong soil and produces excellent yields. It is handled in much the same way as the Sassafras loam and commands about the same price. The soil needs lime, which probably should be applied at least once every four or five years.

WOODSTOWN SANDY LOAM.

The Woodstown sandy loam consists of brown sandy loam or brown light loam, passing at 5 or 6 inches into yellowish-brown to yellow heavy sandy loam, which at 20 to 30 inches grades into mottled yellow and gray or bluish-gray sandy loam. The subsoil is variable and in places shows some reddish-yellow color. It is, however, always mottled, owing to imperfect drainage.

This type is generally distributed throughout the Coastal Plain section of the area, except in the southeastern part. It occupies level and depressed areas with imperfectly developed internal drainage. It is closely associated with the Sassafras sandy loam, but is much less productive. Practically the same crops are grown on both types, excepting potatoes, which are not extensively grown on the Woodstown sandy loam. Tillage practices are practically the same as on the Sassafras soil.

Less than half of this type is cleared and under cultivation. The forest consists chiefly of birch, maple, oak, and some pine, with an undergrowth of greenbrier and other vines and shrubs. Land values

on this type are low, unless the areas are very favorably situated. This soil needs underdrainage and liming.

WOODSTOWN LOAM.

The surface soil of the Woodstown loam is a brown to light-brown loam 6 to 8 inches deep. The subsoil is either mottled bluish-gray and yellow sandy clay or pale-yellow friable sandy clay, which passes below 16 to 20 inches into mottled bluish and yellow friable to plastic sandy clay. The subsoil of this type as mapped is quite variable. In places the mottling is bluish gray or drab gray. The lower subsoil, below 30 inches, is frequently lighter and more sandy than the subsoil above. The Woodstown loam is closely associated with the well-drained Sassafras loam and the poorly drained Elkton loam. As mapped it also includes small areas of Elkton loam, Portsmouth loam, Keyport loam, Woodstown sandy loam, and Woodstown silt loam.

This type occupies flat and depressed areas in which internal drainage is imperfectly developed.

The Woodstown loam is distributed generally through the central part of the Trenton area, especially near Old Church. Considerable areas of it remain uncleared. These support excellent stands of oak, hickory, gum, and maple.

Where drained the Woodstown loam produces fair crops of grass, rye, wheat, and sometimes potatoes. It is handled much the same as the Sassafras loam, but because of imperfect drainage conditions can not be worked as early or mature a crop as soon as the well-drained soil. On the other hand, the Woodstown loam is far superior to the more poorly drained Elkton loam.

The fertility of this soil could be greatly improved by underdrainage. Tile drains are preferable to open ditches, although somewhat more expensive. A combination of the two systems often proves satisfactory. Liberal applications of lime are also to be recommended, as this soil is naturally acid.

The table below gives the results of mechanical analyses of samples of the soil and subsoil of the Woodstown loam:

Mechanical analyses of Woodstown loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
171049	Soil, 0 to 10 inches	0.6	5.4	10.1	27.6	17.0	28.6	10.7
171050	Subsoil, 10 to 36 inches	.6	3.4	7.3	21.7	21.3	34.1	11.6

ELKTON SANDY LOAM.

The Elkton sandy loam is a gray to dark-gray sandy loam or light loam, 8 to 10 inches deep, underlain by mottled bluish-gray and yellow sandy loam, which becomes grayer with depth. The color of the subsoil is especially variable, differences depending chiefly upon the drainage conditions. There is some reddish-yellow mottling in places.

This soil is developed principally in the central part of the area, and covers less than 1 square mile. It occupies level or depressed areas with imperfect drainage. During the winter months water frequently stands on the surface for long periods.

The Elkton sandy loam is not important agriculturally. Most of it is in forest, principally oak, maple, and sweet gum. Where drained this type produces fair yields of corn, grass, wheat, and rye. The farmed land is cultivated and fertilized practically the same as the Sassafras and Woodstown sandy loams, with which it is closely associated.

ELKTON LOAM.

The typical Elkton loam consists of gray loam about 10 inches deep, underlain by mottled yellow and bluish-gray loam or silt loam, which at about 20 inches becomes grayer in color and lighter in texture. In places the surface soil is light brown; again it is dark gray, but the typical color is gray, especially when the soil is dry. This type is variable also in the color and texture of the subsoil. It includes in places, as 2 miles southwest of Lawrence, some areas of Elkton fine sandy loam, which consists of a light-gray fine sandy loam, underlain at 6 to 10 inches by whitish fine sandy loam to fine sandy clay, changing in the lower subsoil to bluish-gray fine sandy loam. Owing to their small extent and mode of occurrence, some areas of Elkton very fine sandy loam, Portsmouth loam, and Woodstown loam are also included in this type as mapped.

The Elkton loam occupies flat depressions in which drainage is imperfectly established. It is much more extensive than the Elkton sandy loam, covering nearly 20 square miles. It is distributed in small areas throughout the central part of the survey. The larger developments are in the vicinity of Rancocas, Robbinsville, Cranbury, and Edinburg.

Most of this type remains in forest, but a small part is under cultivation. Fair yields of corn and hay are obtained. Potatoes are not a successful crop. Some cabbage is grown, the soil producing well. Crops are fertilized and cultivated practically the same on this soil as on the Sassafras loam.

The value of land of this type is low. Before it can be cropped profitably it must be improved by drainage. Conditions indicate the need of lime.

ELKTON SILT LOAM.

The surface soil of the Elkton silt loam consists of a gray to ashy-gray silt loam averaging about 10 inches in depth. This is underlain by a section of mottled bluish-gray and yellow silt loam, which passes into a more sandy and mottled section at about 30 inches. This type is quite variable, especially in the color and texture of the subsoil. As mapped it includes areas of Elkton silty clay loam, which consists of mottled pale-yellow and gray silty clay loam grading at about 8 inches into a mottled bluish-gray and pale-yellow stiff clay, with some sand in the lower subsoil.

The total area of this soil is about 11 square miles. It is developed chiefly in the central part of the area, especially in the vicinity of Windsor, northeast of Monmouth Junction, and south of Dayton.

The Elkton silt loam occupies flat, depressed areas of imperfect drainage. A considerable part remains in forest, the principal growth being white oak, sweet gum, maple, birch, alder, and some cedar. Where farmed this type gives about the same yields as the Elkton loam, although because of its heavy texture it is harder to handle. The productiveness of the Elkton silt loam could be improved by drainage and liming.

PORTSMOUTH SANDY LOAM.

The surface soil of the Portsmouth sandy loam consists of a layer of black sandy loam, about 10 inches thick. The subsoil to a depth of 18 or 20 inches is a whitish to grayish sandy loam, and below this a layer of mottled grayish and light reddish yellow sandy loam.

As mapped this type includes areas of Portsmouth fine sandy loam and fine sand. The Portsmouth fine sandy loam consists of a black fine sandy loam 8 inches deep, underlain by whitish fine sandy loam, which at about 15 inches changes to a mottled grayish and reddish-yellow fine sandy loam. The lower subsoil contains considerably more grayish material. The Portsmouth fine sand is a black fine sand 8 to 10 inches deep, underlain by whitish to dingy-gray fine sand, which at about 18 inches becomes mottled reddish yellow and gray.

The Portsmouth sandy loam covers a total area of less than 3 square miles. Areas of this soil are distributed throughout the central and northeastern parts of the survey. It occupies low areas and depressions with poor drainage. It is not an important soil agriculturally and much of it remains in forest, chiefly of oak, maple, and sweet gum.

This soil will become valuable farming land when reclaimed. Drainage is the first essential. When this has been accomplished liming will assist in putting the land in good productive condition. Under such treatment in other sections, notably in the southern part of New Jersey, this type is successfully used in the production of the general farm crops, especially hay and corn, and of tomatoes, strawberries, and other truck crops. It is peculiarly adapted to strawberries.

PORTSMOUTH LOAM.

The typical Portsmouth loam consists of black loam 8 to 10 inches deep, passing abruptly into light-gray or whitish friable sandy clay, which below 20 inches grades into mottled bluish-gray and yellow loam to sandy clay. In places this type includes patches of dark-brown to black silty clay loam, passing at 6 to 8 inches into dark-brown silty clay loam, which is underlain at 12 to 14 inches by mottled bluish and yellow plastic clay, changing in the extreme lower subsoil to a bluish silty clay. Such inclusions represent areas of Portsmouth silty clay loam, which, because of their small extent, are not shown separately on the map. The subsoil of the Portsmouth loam of the Trenton area is widely variable. In some places it has a grayish-green color, such areas tending toward the Keansburg, and some typical patches of Keansburg loam, too small to show on the map, are included with the Portsmouth loam.

The Portsmouth loam has a total extent in the area of 1,920 acres. It is developed only in scattered areas and confined to the central part of the survey. It occupies low, poorly drained flats, and only a small percentage is cleared and farmed. Crops grown include corn, wheat, rye, and grass. Corn does fairly well on this type. Fair yields of cabbage are obtained from the small area planted. The virgin forest consists chiefly of oak, maple, and gum, with a thick undergrowth of greenbrier, shrubs, and grasses and other water-loving plants.

Land values, which in general are low, depend more on the value of the forest than the land itself.

The better drained areas of this soil that are still unreclaimed could be made highly productive if underdrained and skillfully handled.

COLLINGTON SAND.

The surface soil of the Collington sand consists of brown to slightly reddish brown sand 8 to 10 inches deep. The subsoil is a yellow or reddish-yellow loose sand, which at 18 to 20 inches is underlain by reddish-yellow sand containing considerable greensand marl. Some of this marl material is also present in varying quantities in the soil and upper subsoil, the proportion ordinarily increasing with depth. There are included within this type, as mapped, some areas of Collington fine sand, Collington loamy fine sand, and Collington loamy sand.

The Collington sand is developed in scattered areas throughout the marl belt, and also occurs in some terracelike positions along streams flowing through this belt. The areas in general are flat to very gently rolling, and the drainage is good to excessive.

The Collington sand is a soil of moderate extent in the Trenton area, covering, in all, 10,304 acres, or 2 per cent of the area surveyed. Practically all of it is farmed. Trucking is the leading industry. Cultural methods and the yields of crops are much the same as on the Sassafras sand.

This type is lower in price than any other of the Collington soils. It is not usually as favorably situated with respect to markets and transportation facilities as the Sassafras sand, and therefore can be bought for much less, although the agricultural value of these two soils is practically the same.

Collington sand, low greensand content phase.—The low greensand content phase differs from the typical Collington sand principally in that it has a lower content of greensand marl. It resembles the Sassafras sand, but lacks the open structure and lighter texture of the Sassafras subsoil. The phase constitutes a gradational soil between these two types, and generally occurs in close association with the Sassafras sand.

The areas of this phase are well drained and occupy the same topographic positions as the typical Collington sand. They are devoted to the same crops, are farmed by the same cultural methods, and have practically the same land values.

Whether or not the low greensand content phase has a lower agricultural value than the typical Collington sand is an unsettled question. Under the prevailing system of farming, involving the liberal

use of commercial fertilizers, the actual yields produced on these two soils differ very little. However, if the heavy applications of fertilizer were eliminated, it is probable that the soil containing the larger content of greensand marl would prove more productive over a series of years, as the greensand marl contains considerable potential plant food, which is supposed to become slowly available to growing crops.

This phase is shown on the soil map by ruling over the color of the Collington sand. Its area is included in the total given for the typical soil and constitutes about two-fifths of that total. It is developed principally in the vicinity of Riverside, southeast of Trenton, and south of Florence. Small areas are scattered through the region occupied by the Collington sand.

A small area of this phase lying east of New Egypt is imperfectly drained and consequently has a lower value for crop production.

COLLINGTON SANDY LOAM.

The Collington sandy loam consists of a rich-brown sandy loam underlain at about 10 inches by yellowish-brown to light greenish brown sandy loam, this passing at 14 to 20 inches into a greenish friable sandy clay. This soil contains considerable greensand marl, especially in the subsoil, which in places consists largely of this material. This is especially true on sloping ground near exposures of greensand marl.

This type is extensively developed throughout the marl belt of the area. It occurs in large bodies in the vicinity of Georgetown, Manalapan, and Ellisdale. It occupies nearly level to rolling country, particularly those parts in which both surface soil and subsoil are well drained.

Practically all this type, which is one of the most extensive soils of the area, is cleared and under careful cultivation. It is one of the most important farming soils of the area, comparing favorably in productiveness with the Collington fine sandy loam, which is one of the best soils in the area. Yields are slightly lower on the sandy loam, but this is offset somewhat by the earlier maturity of all crops on this land, a decided advantage in growing certain special crops. It is especially adapted to potatoes, which occupy a relatively large acreage. The American Giant does well on this soil, as do also the Irish Cobbler and other table varieties. Yields above 200 bushels per acre are not uncommon when 1,500 to 1,800 pounds of fertilizer is used.

The Collington sandy loam has long been recognized as a valuable soil. Few farms with the usual improvements can be bought at this time for less than \$150 an acre, and in the better developed sections close to the railroad and important local markets much of the land of this type is held at \$200 an acre or more.

Collington sandy loam, deep phase.—In both the Collington sandy loam and Collington fine sandy loam certain areas are recognized as a deep phase. The Collington sandy loam, deep phase, has a surface soil consisting of 8 or 10 inches of brown sand or loamy sand underlain by reddish sand or loamy sand, and this passing at 15 to 20 inches into friable greenish-yellow sandy clay or heavy sandy loam.

The soil and subsurface are thus somewhat lighter than in the typical soil. Greensand material occurs in the lower subsoil.

There is nearly half as much of this phase as of the typical soil, the former covering, in round numbers, 13,000 acres and the latter 32,000 acres. Practically all of it is cleared and farmed. It is closely associated with the Collington sandy loam and like that type occupies nearly level to gently rolling areas with good drainage.

In a number of places the subsoil has a lower content of greensand marl than the average for the phase. Areas of this variation are located as follows: Nearly 1 square mile at and northeast of Manalapan, one-half square mile northeast of Carrs Corners, one-half square mile at Archertown, one-fourth square mile southeast of Tennent, one-fourth square mile southeast of Hornerstown, and a small patch west of Lawrence. Under the methods of farming generally practiced in this region, this variation has essentially the same agricultural value as the rest of the deep phase.

Because of the light surface soil, the Collington sandy loam, deep phase, is used chiefly in the production of truck crops and fruit. It is well adapted to the various truck crops, and especially to cantaloupes and watermelons. Among the orchard fruits, apples and peaches do well. Some potatoes are grown, especially where the surface is a loamy sand. Yields of potatoes are considerably less than on the heavier types, but the crop matures earlier. The light surface soil of this phase has the advantage of warming up early in the spring, while the rather heavy subsoil retains moisture and fertilizer materials more tenaciously than the more sandy soils. For this reason this phase is considered a far better soil than the Collington sand or Sassafras sand, with both of which it is associated.

The surface soil of this phase is naturally low in organic matter, and, to maintain fertility, this should be applied either in the form of stable manure or of green-manure crops.

Collington sandy loam, low greensand content phase.—The low greensand content phase differs from the type mainly in having a lower content of greensand marl. It is a gradational soil and generally occurs in association with the Sassafras sandy loam. It has the same topography and drainage and is used for the same crops as the typical Collington sandy loam, and under the prevailing system of culture it has essentially the same producing power.

The area of this phase is included in the total area given for the typical soil. Probably it occupies about one-fourth of that total. The phase is shown on the soil map by rulings over the color of the type. The largest area lies southeast of Hightstown. A smaller one lies north of Wrightstown. The rest is included in scattered bodies ranging in size from small patches to areas of about one-half square mile.

Collington sandy loam, imperfectly drained phase.—The imperfectly drained phase differs from the typical Collington sandy loam principally in having less perfect drainage owing to the fact that it occurs in level or flat and depressed areas from which the drainage waters do not readily escape. The surface soil is darker than typical. The subsoil is commonly slightly to highly mottled with gray and reddish yellow, and always with green.

The imperfectly drained phase is shown on the map with rulings over the color of the type. It has an area of approximately 1 square mile, which is included in the total area given for the type. It occupies small bodies in the vicinity of Georgetown, Jacobstown, and Ellisdale. One small area near Burlington is on the low greensand content phase of the type.

Agriculturally the imperfectly drained phase is inferior to the typical soil. Grass does well. Wheat, rye, and corn give fair results. This land can be improved by providing better drainage, preferably by means of tile. It requires more lime to correct the acidity of this soil than on the typical Collington sandy loam.

COLLINGTON FINE SANDY LOAM.

The Collington fine sandy loam consists of brown loamy fine sand to fine sandy loam 8 to 10 inches deep, underlain by reddish-yellow friable fine sandy loam, which passes at 12 to 18 inches into reddish-yellow friable sandy clay. This continues to a depth of 28 inches, where a change to lighter texture takes place, the material becoming a loamy fine sand, fine sand, or sand, relatively high in greensand. Varying quantities of greensand marl occur in the soil and subsoil above this depth. Owing to the presence of the marl this soil has a characteristic greasy feel, a peculiarity accented in places, especially near Englishtown and Tennent, by the presence of considerable mica. Some areas contain enough greensand to give the soil a greenish-brown color.

The Collington fine sandy loam occurs through a belt 12 to 15 miles wide running in a general northeast-southwest direction across the area. It is one of the more extensive types of the Trenton area, and occurs in large bodies in the vicinity of Sykesville, Columbus, and south of Crosswicks. Owing to almost imperceptible gradations in texture, it is always difficult to draw a sharp boundary between this type and the sandy loam of the series.

This type has a level to gently rolling surface and good drainage in both soil and subsoil. Practically all this type is cleared and farmed.

This is one of the most desirable soils of the area and one well adapted to the production of general farm crops as well as potatoes. Grass yields ordinarily from 1 to 1½ tons per acre and corn about 40 bushels. Much higher yields are frequently obtained on some farms on this type. When potatoes are grown, the land receives heavy applications of fertilizer, between 1,500 and 1,800 pounds of 4-8-10 or 4-10-8 mixture being used. Even with these large quantities, liberal applications of stable manure also are made. Yields as high as 250 bushels are frequently obtained, but the average is around 175 to 200 bushels per acre. Some American Giant are grown, but Irish Cobbler and other varieties of this type predominate.

Apples, peaches, and pears do well on this soil. Truck crops also do well, but they mature much later than on the more sandy soils of the Sassafras and Collington series. Many dairy farms are located on this soil near Georgetown, Jacobstown, and Juliustown.

On these farms potatoes are a less important crop. Grass and corn occupy relatively large acreages. The dairy herds are commonly of Holstein stock, though some Jersey and Guernsey herds are maintained.

The Collington fine sandy loam is plowed in early spring or sometimes in late fall. Two-horse plows are generally used, although many tractors pulling two gang plows each turning two furrows are in use. Plowing is followed by careful working with spring-tooth harrows or other implements until a good seed bed results. In growing potatoes rye is sown after the harvest. This is plowed under either in the late fall or early spring, usually the latter. Frequently these two crops are grown several years in succession on the same land. A longer rotation consists of potatoes, grass two years, corn, wheat or rye, and then potatoes again. Lime is applied to the fields when the grass or grain crop is seeded in the fall. In this way the lime requirement is met and at the same time the resulting alkaline condition of the soil so favorable for the development of scab injury to the potato crop is as far removed as possible from the time of potato planting.

Farms situated on the Collington fine sandy loam are usually in a high state of cultivation and equipped with modern buildings in good repair. For this reason, together with the recognized productivity of the land itself, it is one of the most highly valued types in the Trenton area. Prices range from \$150 to \$250 an acre, the average being well above \$200 with the usual improvements.

The productiveness of this type could be improved by more careful attention to liming. This soil is naturally acid, and where potatoes are grown the lime requirement is very likely to be neglected. From 1,400 pounds to a ton of hydrated lime should be applied before the grass seeding once in every four or five years. More careful attention to the growing of leguminous crops also would aid in improving the land, nitrogen and organic matter being constituents that need replenishment. Alfalfa would produce well on this soil if inoculated and limed. It is an especially valuable crop where dairying is practiced.

Collington fine sandy loam, deep phase.—The deep phase of the Collington fine sandy loam differs from the typical material in having a much lighter surface soil of light-brown or brown fine sand or loamy fine sand, which passes at 18 to 20 inches into reddish-yellow loamy fine sand. This layer is only a few inches thick, and is underlain by reddish-yellow or greenish-yellow fine sandy loam or friable sandy clay. Greensand is present in large quantities in the lower subsoil.

In two areas of this phase the content of greensand marl in the subsoil is lower than the average. The areas of this variation lie northwest of Manalapan and east of Cookstown. They include about one-half square mile of land, which appears to have the same value for crops as the rest of the phase.

This phase is not extensive, covering less than 2,000 acres. It is developed in areas scattered through the greensand belt. The surface is nearly level to gently rolling and the drainage good.

Owing to the light surface soil, land of this phase is utilized chiefly in the production of truck crops, such as peas, tomatoes,

watermelons, cantaloupes, and sweet potatoes. A little fruit also is grown.

Practically all this soil is cleared and under cultivation. It has a slightly higher value than the Collington sand, as it is somewhat more productive, especially during dry seasons.

Collington fine sandy loam, low greensand content phase.—The low greensand content phase is a gradational soil between the Collington and the Sassafras types. It contains some greensand marl, but the proportion is lower than in the typical Collington fine sandy loam. In all other features it is essentially equivalent to the type.

This phase is distinguished on the map by rulings over the color of the type. It occupies approximately one-sixth of the total area given for the typical soil. The largest developments are northwest and southwest of Perrineville. The rest of the phase occurs in areas ranging in size from small patches to one-half square mile and scattered throughout the region of the Collington soils.

Collington fine sandy loam, imperfectly drained phase.—The imperfectly drained phase occupies flat or depressed areas that do not favor the ready escape of drainage waters. Consequently the phase is less well drained, the soil is darker colored than typical, and the subsoil is more or less mottled.

This phase occupies a number of small bodies of land near Groveville, which are included in the total area given for the typical soil. It is distinguished on the map by rulings over the type color. One small body of the low greensand content phase lying south of Chesterfield is also poorly drained.

Land of this phase does not have the same crop adaptations as the typical Collington fine sandy loam. It is, however, well suited to grass and produces moderate yields of corn, wheat, and rye. Potatoes do fairly well after the land has been improved by tile drains.

COLLINGTON LOAM.

The typical Collington loam consists of a brown or reddish-brown loam, 10 inches deep, underlain by reddish-yellow loam or friable sandy clay, which passes at 20 to 28 inches into yellowish-brown to greenish-brown friable sandy loam or loamy sand. Greensand is present throughout the 3-foot section, being more abundant in the subsoil.

There are included with this type, as mapped, some areas of Collington silt loam, in which the soil consists of a light-brown to reddish-brown silt loam, underlain at 8 to 10 inches by brownish-yellow friable fine sandy clay and passing at 18 to 20 inches into reddish-yellow to greenish-yellow fine sandy clay. Both soil and subsoil contain abundant quantities of greensand marl.

The Collington loam is a soil of large extent in the Trenton area, covering in all some 22,500 acres. It is developed in fairly large bodies in the vicinity of Manalapan, Cream Ridge, Jacobstown, Chesterfield, and Crosswicks. The surface ranges from flat to very gently rolling. The surface drainage and internal drainage are good.

This is one of the strongest soils of the area. It is well adapted to the production of general farm crops as well as potatoes. Yields of corn frequently reach 75 bushels, but the average is probably close to 50 bushels. Timothy and clover yield from 1½ to 2½ tons of hay per acre, depending on the amount and distribution of the rainfall. The potato yield is large. Methods of cultivation and the use of fertilizer are also practically the same as on the fine sandy loam. Some dairying is practiced on farms on this type of soil, especially in the vicinity of Cream Ridge. Holstein cattle predominate in the dairy herds.

The Collington loam has a recognized high value, though the price varies somewhat with location. Few farms with average improvements can be bought at this time (1921) for less than \$150 an acre. The buildings on this type are usually modern, well kept, and of large size.

If limed and inoculated, this soil would produce excellent results with alfalfa, and this crop should be seeded more extensively, especially where cattle are kept. The soil needs lime. It might be profitable to lime at the rate of about 1,500 pounds per acre once during a five-year rotation. Where potatoes are grown in such a rotation, liming should follow the potato crop. By this practice the danger of increasing scab injury is greatly reduced.

Collington loam, low greensand content phase.—The low greensand content phase is essentially like the typical Collington loam, except that it contains a lower proportion of greensand marl. It grades toward the Sassafras loam and is more or less closely associated with the Sassafras types. In topography, drainage, use, and agricultural value under the farming practices that prevail, the phase is practically equal to the typical Collington loam.

This phase is included in the area given for the typical soil. It occupies about one-fifth of that area, and is shown on the map by means of distinctive rulings. It occurs in many scattered bodies of land, ranging from small patches to nearly a square mile in size, throughout the belt of Collington soils.

Collington loam, imperfectly drained phase.—The soil of the imperfectly drained phase is darker in color than the typical Collington loam, the subsoil is usually mottled with gray, reddish yellow, and green, and the drainage is not well established. These characteristics are due to the fact that the phase is developed in level or depressed situations from which drainage waters escape very slowly.

The areas of this phase are shown on the map by a distinctive ruling over the color of the type. The total area of imperfectly drained land in the Collington loam, which probably does not exceed 2 square miles, is included in the total area given for the typical soil. It occurs in many scattered bodies varying from areas of one-fourth square mile to mere patches.

The imperfectly drained phase has a lower agricultural value than the well-drained Collington loam. It can be made to produce fair to good yields of potatoes, provided it is thoroughly drained by means of ditches or tile, preferably the latter. Wheat, corn, and rye produce fair yields, and grass does well.

COLTS NECK SANDY LOAM.

The surface soil of the Colts Neck sandy loam consists of reddish-brown sandy loam 8 to 10 inches deep. This is underlain by heavy brownish-red sandy loam to sandy clay of a friable nature, which at about 24 inches passes into greenish-yellow or greenish-brown heavy sandy loam to friable sandy clay, containing considerable greensand marl. The depth at which this greenish-yellow material is found ranges from 24 to 30 inches. Frequently considerable quantities of platy fragments of ferruginous rock appear on the surface and mixed with the soil and subsoil throughout the 3-foot section.

Included with this type, as mapped, are small scattered areas of a deep phase of the sandy loam type, as well as areas of Colts Neck fine sandy loam. These areas are not of sufficient extent or importance to warrant separation.

Areas of the Colts Neck sandy loam lie in the vicinity of Red Valley in the southeastern part of the survey and at Oakland Mills in the east-central part. They have a rolling topography and are well to excessively drained. In places, especially on the steeper slopes, this type erodes somewhat.

Practically all this type is farmed, but as there is somewhat less than 4 square miles of it in the area, it has little influence on the agriculture. Good yields of corn, rye, timothy and clover hay, alfalfa, and potatoes are obtained. Where well situated the price of this land is about the same as for similarly situated Sassafras sandy loam and Collington sandy loam lands.

Colts Neck sandy loam, light-textured phase.—The Colts Neck sandy loam, light-textured phase, consists of 8 or 10 inches of reddish-brown loamy sand, overlying brownish-red loamy sand to deep-red loamy sand extending to a depth of 3 feet or more. Usually in the lower subsoil, at depths of 30 to 36 inches, there is enough greensand present to give a greenish cast to the soil material. There is included with this phase, as mapped, a very small acreage of the Colts Neck loamy fine sand.

The Colts Neck sandy loam, light-textured phase, covers an area of a little more than 1 square mile. It is developed chiefly northwest of Clarksburg in the east-central part of the area. It has a rolling topography and good to excessive drainage.

The Colts Neck sandy loam, light-textured phase, is a soil of good agricultural possibilities, especially in the production of truck crops and fruit. In the Freehold area to the west it is used very successfully for the production of watermelons, cantaloupes, tomatoes, and sweet potatoes. It is also highly prized for asparagus and peaches and extensively used for these crops. In the Trenton area a considerable part of the type is in forest.

Commercial and organic fertilizers are especially beneficial to this soil. Organic materials such as stable manure, increase the water-holding capacity of the soil and enable it better to retain fertilizing materials. Lime also gives good results.

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

Mechanical analyses of Colts Neck sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
171019	Soil, 0 to 10 inches....	2.4	24.1	23.5	20.4	4.8	12.6	12.0
171020	Subsoil, 10 to 36 inches.	2.0	22.8	24.0	20.2	5.4	12.7	13.0

COLTS NECK LOAM.

The typical Colts Neck loam consists of a brownish-red or reddish-brown loam 6 to 8 inches deep, overlying reddish-brown friable clay which grades abruptly into a friable reddish-brown or reddish-yellow clay or sandy clay. The middle or lower subsoil is in many places greenish yellow, but this color may grade down into a more reddish sandy section. In places the subsoil is a deep red, of brownish or rusty shade. Greensand marl is encountered in the lower subsoil in places, as are also angular fragments of ferruginous rock.

Included with this type, as mapped, are some areas of Colts Neck clay loam. In these the surface soil consists of a brownish-red clay loam, 4 or 5 inches deep, passing into a dark brownish red friable clay, which at about 20 inches grades into a greenish-yellow friable clay with a high content of partly decomposed greensand marl.

The Colts Neck loam covers a total area of less than 3 square miles. It occurs principally in the vicinity of Red Valley and Imlaystown. It occupies gently rolling slopes, which insure good drainage. Practically all this type is under cultivation. Good crops of corn, wheat, rye, timothy and clover hay, and potatoes are produced.

Because of its heavy texture, care must be exercised in plowing this soil. If broken when either too wet or too dry, a poor physical condition results and it becomes very difficult to prepare a suitable seed bed.

Prices of farms situated on this soil compare favorably with those on the Collington loam.

The results of mechanical analyses of samples of the soil and subsoil of the Colts Neck loam are given in the following table:

Mechanical analyses of Colts Neck loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
171021	Soil, 0 to 10 inches....	2.2	11.6	11.4	20.6	9.0	26.0	19.1
171022	Subsoil, 10 to 36 inches	2.3	9.8	9.9	19.8	9.2	23.8	25.4

SHREWSBURY SANDY LOAM.

The typical Shrewsbury sandy loam consists of a dark-brown to brownish-gray or gray sandy loam, 10 to 12 inches deep, passing into

light-gray to gray sandy clay, which is underlain at 18 to 20 inches by a mottled greenish-gray, green, and reddish-yellow sandy loam or sandy clay. The degree of mottling depends upon the drainage, the better drained areas showing less mottling than those in which the drainage is poorer. The greenish colors are due to the admixture of greensand marl. There are included within this type some areas of Shrewsbury fine sandy loam.

There are 8,064 acres of the Shrewsbury sandy loam in the Trenton survey. The type is developed only in the marl belt, where it is closely associated with the Collington soils. The largest areas are in the vicinity of Red Valley, west of Manalapan, and south of Englishtown. This soil occupies depressed flats and has imperfect drainage.

The greater part of the Shrewsbury sandy loam is cultivated, the rest being forested with oak, maple, and some sweet gum. The soil is easily tilled, and with proper treatment returns good crops of grass, corn, wheat, and rye. Some potatoes are produced on the better drained areas, but the yields are much lower than on the Collington and Sassafras sandy loams. The Shrewsbury sandy loam seems especially adapted to corn, yields frequently being more than 50 bushels per acre. Wheat produces about 20 bushels per acre, and yields of 1 to 2 tons of hay are common. Heavy applications of commercial fertilizers are made, especially when potatoes are grown.

Land of this type ranges in price from \$75 to \$175 an acre, depending upon location, improvements, and the other soils occurring in the particular farm. Agriculturally the Shrewsbury sandy loam is inferior to the imperfectly drained phases of the Collington or Sassafras soils. The crop adaptation is more restricted, owing to poor drainage conditions. This soil is in need of lime, as well as underdrainage.

SHREWSBURY LOAM.

The surface soil of the Shrewsbury loam is a brown to brownish-gray loam, 5 or 6 inches deep. Below this appears a bluish-gray and yellowish-brown mottled silty clay loam, which at 15 to 20 inches passes into reddish-yellow and greenish-yellow mottled clay. The extent of the mottling of the subsoil depends upon the drainage. A high content of greensand marl intensifies the greenish shade.

The Shrewsbury loam occupies flat depressions having imperfect drainage. It is closely associated with the Collington soils in the central part of the area. The total area mapped is 5,312 acres.

Practically all this type is under cultivation to the general farm crops. Corn yields fairly well, as do also grass, rye, and wheat. Potatoes are grown on the better drained areas, but the yields are only fair.

This soil is not easily worked, and care must be taken to plow it when moisture conditions are right in order to avoid puddling or clodding. Tile drainage would greatly improve the land, and liming is also recommended, the soil being naturally of an acid nature.

The table following shows the results of mechanical analyses of samples of the soil and subsoil of the Shrewsbury loam.

Mechanical analyses of Shrewsbury loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
171033	Soil, 0 to 10 inches.....	<i>Per cent.</i> 0.0	<i>Per cent.</i> 4.1	<i>Per cent.</i> 4.8	<i>Per cent.</i> 10.7	<i>Per cent.</i> 14.2	<i>Per cent.</i> 46.6	<i>Per cent.</i> 19.7
171034	Subsoil, 10 to 36 inches	.6	5.4	7.3	16.8	14.6	32.3	22.9

SHREWSBURY SILT LOAM.

The typical Shrewsbury silt loam consists of a brown heavy silt loam, 6 to 8 inches deep, underlain by bluish-gray and reddish-yellow mottled clay, which at 15 to 20 inches passes into mottled bluish-gray, greenish-gray, and green, rather plastic clay.

This type occurs principally in the vicinity of Jacksonville, and occupies, like the other types of the series, low depressions of imperfect drainage. The area mapped is slightly less than for the loam, the exact figure being 4,672 acres. About 75 per cent of the silt loam is farmed, much in the same manner as the loam. Even greater care must be exercised in tilling this heavier soil.

The Shrewsbury silt loam is not of great agricultural importance, and because of its heavy nature its crop adaptation is restricted. Corn and grass are the leading crops. Some wheat and rye are grown, but there is great danger of winterkilling. Potatoes do not do well.

This soil brings much lower prices than the associated Shrewsbury loam and sandy loam. This difference, however, is due in part to less desirable location.

KEANSBURG SANDY LOAM.

The surface soil of the Keansburg sandy loam consists of a black mucky sandy loam, 8 to 10 inches deep. This overlies mottled gray and yellow sandy loam, which in the lower subsoil becomes more sandy and mottled with grayish green, green, and reddish yellow. The lower subsoil contains varying quantities of greensand marl. Small areas of Keansburg fine sandy loam and Keansburg fine sand are included with this type. There are about 3 square miles of this soil in the Trenton area.

The Keansburg sandy loam occurs in scattered areas in the marl belt in close association with the Shrewsbury and Collington soils. It occupies depressed areas with poor drainage.

Some of this soil is cleared and cropped. It is farmed in much the same manner as the Shrewsbury sandy loam. The forest consists of a good growth of oak, gum, and pine.

This type, like the Keansburg loam, has excellent agricultural possibilities under skillful treatment. In the Freehold area, adjoining the Trenton area on the east, this type when drained produces good crops of corn, small grains, and grass. Potatoes do better in dry seasons.

The results of mechanical analyses of samples of the soil and subsoil of the Keansburg sandy loam are given in the table following.

Mechanical analyses of Keansburg sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
171075	Soil, 0 to 8 inches.....	0.5	10.1	22.6	47.5	4.3	7.6	7.1
171076	Subsoil, 8 to 36 inches..	.8	7.1	8.1	13.7	9.8	24.2	36.3

KEANSBURG LOAM.

The surface soil of the Keansburg loam is a black, somewhat mucky loam about 12 to 14 inches deep. This is underlain by a mottled yellow and greenish-yellow clay, which passes abruptly downward into greenish clay, sandy clay, or heavy sandy loam. In some places the deeper subsoil is considerably lighter and contains fine gravel and coarse sand. As mapped, both the color and texture of the lower subsoil vary considerably, but greenish shades are always present, owing to the influence of greensand marl.

This type is moderately extensive in the marl section, some 5,300 acres being mapped in this area. It is most largely developed in the vicinity of Jobstown and Sharon. It always occupies flat, depressed areas of poor drainage. About 75 per cent of it is cleared and is farmed in much the same manner as the Shrewsbury loam with which it is associated. It is an especially strong corn soil. Grass does well on land that has been limed. Potatoes are not successfully grown on this type.

The Keansburg loam has a relatively low valuation; some tracts can be bought as low as \$75 an acre. Prices depend largely upon location, improvements, and character of the associated soils.

When drained, either with tile or open ditches, this soil makes excellent land for general farming. It is naturally high in organic matter and organic nitrogen, which, if properly treated with lime, becomes readily available to plants. Celery, cabbage, and onions would grow well on this soil, as would also late strawberries.

KEANSBURG SILT LOAM.

The typical Keansburg silt loam consists of black silt loam, overlying at about 8 inches mottled yellow, reddish-yellow, and greenish-yellow plastic, sticky clay, which grades at about 20 inches into a mottled brownish-red, bluish-green, and green plastic clay. Below this depth the subsoil becomes lighter, containing some coarse sand and fine gravel and much greensand marl.

There are included within this type, as mapped, some small areas of Keansburg silty clay loam, the surface soil of which is somewhat heavier than that of the Keansburg silt loam.

There is less than 1 square mile of the Keansburg silt loam in the Trenton area. It occurs in scattered areas in the central part of the area, occupying low, flat areas or depressions having poor drainage.

Some of this type is farmed, but it must be carefully handled to obtain satisfactory results. Corn does well on properly drained land, but matures late. To be successfully farmed, the Keansburg silt loam requires underdrainage and liming.

KEYPORT SANDY LOAM.

The surface soil of the Keyport sandy loam consists of grayish-brown light loam to sandy loam 6 to 8 inches deep. This rests on yellow friable sandy loam which passes at about 10 to 12 inches into reddish-yellow friable sandy clay loam and, becoming stiffer with depth, into brownish-yellow, heavy, plastic clay with dark-gray mottlings at 20 to 24 inches. In many places mica flakes are present in the lower subsoil.

Some small areas of a deep phase of this type are included. Such areas have a brown sand or loamy sand surface soil underlain at 15 to 20 inches by the typical Keyport sandy loam subsoil. A few areas of Keyport fine sandy loam also are included. This soil differs from the sandy loam only in its larger content of fine sand in both soil and subsoil.

The Keyport sandy loam is not an extensive type, the total area mapped being less than 4 square miles. It is confined principally to the northeastern part of the area in the vicinity of Matchaponix, where it occupies nearly level to gently rolling areas. The type is characterized by good drainage.

Practically all this type is under cultivation. It is easily worked and well adapted to the production of general farm and late truck crops. A part of the land is devoted to the production of potatoes, which do well. This type is slightly inferior to the Keyport loam in productiveness. The price paid for this land ranges from \$75 to \$150 an acre.

KEYPORT LOAM.

The typical Keyport loam consists of a brown silty loam surface soil, underlain at about 8 inches by a yellowish-brown friable silt loam grading at 12 to 14 inches into yellow or reddish-yellow friable silty clay loam. At about 20 inches there appears a mottled yellow or reddish silty clay loam and below 30 inches a stiff clayey material, mottled with dark gray and reddish or rusty brown. Mica flakes are noticeable in the lower subsoil of some areas.

Between 3 and 4 square miles of this soil is mapped. It occurs in the vicinity of Fieldsboro and Matchaponix. It occupies nearly level to slightly rolling country and the surface drainage and subsoil drainage are good.

Practically all this type is under cultivation. It receives much the same treatment as the Sassafra loam, but the yields are not so high. The deficiency is especially noticeable in wet seasons, during which the impervious nature of the lower subsoil tends to hold the moisture and retard plant growth. On the other hand, this same power of holding moisture is an advantage during dry seasons. Corn, wheat, and grass all do well on this type.

Farms with improvements situated on the Keyport loam command prices ranging from \$75 to \$150 an acre.

The table following gives the results of mechanical analyses of samples of the soil and subsoil of the Keyport loam.

Mechanical analyses of Keyport loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
171007	Soil, 0 to 10 inches.....	1.0	1.6	3.2	16.7	26.4	39.9	11.2
171008	Subsoil, 10 to 36 inches	2.2	1.2	2.6	9.7	2.4	41.4	39.8

LAKEWOOD SAND.

The typical Lakewood sand consists of light-gray to white loose sand, 8 to 20 inches deep, overlying orange-colored or reddish-yellow sand extending to a depth of 36 inches or more. The immediate surface soil often is quite gray owing to an admixture of vegetable remains. In some places the subsoil varies, the material having a strong reddish yellow color. In other places the type consists of a white sand, 2 to 5 inches deep, underlain by orange-colored sand to about 20 inches, where reddish-yellow sand appears. Such areas represent inclusions of a shallow phase of the Lakewood sand.

This soil is confined to the southeastern part of the area, where it occurs in extensive bodies, especially in the vicinity of Head of Woods, Success, and south of Brindle Park. Typically this soil has a hummocky topography, but in the Trenton area it is nearly level to gently rolling. Drainage is always good and, because of the extremely open texture of the material, frequently excessive.

Practically all of the Lakewood sand remains in forest, little effort having been made to bring it under cultivation. The native growth consists of scrub oak and pine, with a rather thick undergrowth of huckleberry and other shrubs.

This is one of the least productive soils of the Trenton area, and in fact of the entire State of New Jersey. It is deficient in organic matter and mineral plant food and has a low water-holding capacity. For these reasons the agricultural development of this type is not recommended, at least for the present, although at some future time it may be utilized and made to produce by heavy fertilization certain special crops, such as blackberries and sweet potatoes. For the present, however, it is serving its best purpose in remaining a forest rather than an agricultural soil.

Land of this type can be bought for \$4 to \$25 an acre, depending on the character of the timber and the location.

LAKEWOOD FINE SAND.

The Lakewood fine sand consists of an upper layer of white fine sand, 10 to 20 inches deep, and a lower layer of orange-yellow fine sand. This continues to 36 inches or more without change in texture, but changes to a reddish-yellow color at 25 to 30 inches. In many places on knolls the lower subsoil contains some small quartz gravel. In the lower flatter areas a thin layer of yellowish-brown or light coffee brown fine sand may appear in the upper subsoil. This is apparently due to a slight deficiency in drainage. Included with this type as mapped are some small areas of a shallow phase of the Lakewood fine sand. This differs from the typical soil in having a surface soil whose depth is only 3 to 5 inches.

The total area of the Lakewood fine sand is about 6 square miles. Areas are mapped in the southeastern part of the survey, especially south and southwest of Smithburg. They have a gently rolling to level topography and good drainage.

Like the Lakewood sand, practically all this soil remains in forest. Agriculturally the fine sand is slightly better than the sand. This difference is due mainly to its greater power to hold water and fertilizer. For the present, however, this soil may be regarded as non-agricultural or at least better suited to the production of timber than to cultivated crops.

LEON FINE SAND.

Typically the Leon fine sand consists of light-gray to white fine sand, 10 to 16 inches deep, overlying a coffee-brown layer of fine sand, slightly compact, which passes at 18 to 20 inches into orange-yellow fine sand extending to a depth of 3 feet or more.

Some variations from the above description are noted. In places an inch or so of dark-gray to black fine sand forms the immediate surface. In other situations, as about 3 miles north of Vanhiseville, the soil is a white fine sand grading into white gravelly sand and at 30 inches into compact coffee-brown sand. The thickness and compactness of this coffee-brown layer seems to depend upon the drainage, the more nearly level, poorly drained areas having the thickest and most compact layer. There are also included with this type some areas of Leon sand.

The Leon fine sand is extensive only in the southeastern part of the survey, where it occurs in low flats of imperfect drainage. In many places it lies about the heads of streams, and it is especially well developed in the vicinity of Vanhiseville, northeast of Cassville, and southeast of Colliers Mills.

Agriculturally this is an unimportant type, and practically all of it is in forest. The growth consists of scrub oak, scrub pine, swamp maple, and birch, with an undergrowth of greenbrier, laurel, huckleberry, and bracken. In its natural condition it is of little agricultural value, but if diked and drained it could be utilized as cranberry bog provided sufficient water for flooding is available.

The value of this land depends largely upon the character of the timber growth; most of it can be bought in large tracts for less than \$10 an acre.

ST. JOHNS SAND.

The St. Johns sand consists of very dark gray or black sand, 8 to 10 inches deep, overlying light-gray sand, which at 15 to 20 inches is underlain by a layer of coffee-brown compact sand from 1 to 5 inches thick. Below this layer the subsoil is a mottled grayish and yellowish sand. The compact coffee-brown layer closely resembles a hardpan. It retards the free movement of moisture and makes artificial drainage difficult.

This type is developed in relatively large bodies in the southeastern part of the survey and in smaller areas scattered generally throughout the Coastal Plain section. The total area mapped amounts to 7,424 acres. It occurs mainly about the heads of slow sluggish

streams or swamps or in relatively narrow belts adjoining such situations. The surface is flat and the drainage poor.

In the Trenton area this soil is used only in the production of cranberries, for which it is well adapted. The land must be ditched and diked to prepare it for such use. Established bogs have a high value. The rest of this soil is in forest like that on the Leon fine sand.

Forest areas of this type can be bought very cheaply, unless the growth includes considerable merchantable cedar. In such cases the price may range from \$150 to \$500 or more an acre. Cranberry bogs developed and in bearing bring even higher prices. Ordinary land without valuable timber or other development can be bought for \$3 to \$10 an acre.

ST. JOHNS FINE SAND.

The St. Johns fine sand consists of dark-gray to black fine sand, 5 to 8 inches deep, overlying dingy-gray to white fine sand, which at depths varying from 15 to 30 inches is underlain by a compact coffee-brown fine sand, changing to looser, lighter brown and in the lower subsoil to orange-colored fine sand.

An important inclusion consists of areas of St. Johns loamy fine sand. This is developed near Archertown in the southeastern part of the area. Here the surface soil consists of a black loamy fine sand, 8 to 10 inches deep, below which appears a whitish loamy fine sand, changing at about 20 inches into a compact coffee-brown hardpan layer. The lower subsoil is mottled grayish and reddish-yellow fine sand. Some patches of this soil contain small quantities of greensand marl in the lower subsoil.

The St. Johns fine sand is an unimportant soil in the Trenton area. Only the more loamy areas are under cultivation. These have been reclaimed by the installation of tile drains, and give fair returns of late truck crops and corn. The rest of the land is forested with a growth similar to that on the St. Johns sand, or has been converted into cranberry bogs.

Land values show the same range as those of the St. Johns sand and depend on the same conditions.

BIRDSBORO FINE SANDY LOAM.

The Birdsboro fine sandy loam consists of a brown fine sandy loam, underlain at about 12 inches by yellowish-brown sandy loam, which at about 20 inches passes into somewhat reddish sandy loam. In places cobblestones and gravel are scattered over the surface. The color and texture of the surface soil of this type varies somewhat. In places it is a sandy loam or heavy loamy sand in which reddish shades replace the brownish colors.

There is less than 1 square mile of this type in the area. It is mapped northwest and southwest of Kingston in terrace positions along the Millstone River. It is well drained. Practically all of it is farmed. General farming, dairying, and truck growing are the principal interests. The crop yields are good.

CHENANGO LOAMY SAND.

The typical Chenango loamy sand is a brown sand or slightly loamy sand, 8 to 10 inches deep, underlain by yellow to brownish-

yellow loamy sand extending to 3 feet or more. Fine gravel is frequently encountered in the lower subsoil.

As mapped this type is highly variable, including patches of Chenango very fine sand, fine sand, sand, very fine sandy loam, and loamy fine sand. In places small quantities of greensand marl are present in the subsoil. This is particularly noticeable in developments northeast of Trenton, where the soil consists of a brown loamy sand, 12 to 14 inches deep, underlain by yellowish-brown loamy sand extending to a depth of 36 inches or more, with some greensand marl in the lower subsoil.

The Chenango loamy sand has a total area of 6,464 acres. It has its greatest development east, northeast, and south of Trenton near the Delaware River. It occupies level, nearly flat terraces adjacent to or near streams. It is well drained. Practically all of it is under cultivation. It is easily tilled and produces good yields. Truck crops, corn, potatoes, and small grains are among the more important products. Crops mature from one to three weeks earlier than those grown on the heavier adjoining soils, and for this reason more truck crops and less corn and wheat should be grown. A ready market for vegetables exists in Trenton and excellent roads make transportation easy and quick.

BERMUDIAN SILT LOAM.

The Bermudian silt loam is a reddish-brown or chocolate-brown silt loam which shows little variation in color throughout the 3-foot section. In places, however, especially in the more imperfectly drained situations, the subsoil below 28 to 30 inches is mottled with yellowish and grayish colors. Where this type lies adjacent to or near large areas of Lansdale or Montalto soils the surface soil is light brown and underlain by a yellow subsoil, which in very poorly drained spots is mottled with yellowish, grayish, and grayish-brown colors in the deeper subsoil.

This type occupies first bottoms along streams in the Triassic rock belt. It has imperfect drainage, but is well suited for pasture. In some places corn and other crops are grown. There is great danger of loss by floods, however, as they may occur not only in spring but often well into summer. This type is therefore best adapted to permanent pasture.

FRENEAU LOAM.

The typical Freneau loam consists of a dark-brown loam mottled with rusty brown, quickly passing below into dark-bluish loam or heavy fine sandy loam, mottled with rusty brown and containing considerable glauconite material. The lower subsoil of this type varies considerably both in color and texture, but is usually sandy and always contains greensand marl and greenish or bluish-green sandy material.

This type is developed in first bottoms built up of material washed from the upland soils containing greensand marl. The drainage is poor, and practically none of the soil is farmed. It is valued as pasture land.

MEADOW.

Meadow includes alluvial material occurring along streams, and varies widely in texture and color from place to place and through the soil and subsoil sections. It includes locally colluvial wash from the adjacent slopes along the margins away from the streams. The drainage is poor, much of the land being saturated throughout the year, or through the greater part of the year. Some of it is decidedly swampy in character, but in general it is somewhat better drained and less swampy than the areas mapped as Swamp, and more available for use as pasture or reclamation by ditching.

An examination of Meadow along the bottoms of a small stream entering the Tidal marsh on the southern side of Burlington revealed a brown to mottled brown and bluish silt loam grading down into bluish-gray silt loam or loam showing yellowish-brown mottling, and this passing down into dark-blue sandy loam or loamy sand containing some greensand material. Birch, willow, ash, maple, and sycamore are the principal trees seen here. Ferns and alder are of frequent occurrence. A quarter of a mile north of Princeton Junction, a rather swampy patch of Meadow consists of brown silt loam passing at depths of 10 to 15 inches into black muck, which is underlain at about 30 inches by brown peaty material. Water was standing on the surface in pools over this area. Maple, fern, and skunk cabbage were abundant here. Across the road from this area, in a clearing used for pasture, the soil consists of black silt loam underlain at 10 to 15 inches by a black muck with peaty material at about 36 inches and bluish sandy loam coming in at about 30 inches. In this clearing, which is of a decidedly wet nature, there are many tussocks of grass. In many places the soil is sandy and also shows interstratified layers of sandy, silty, and loamy material from the surface down.

MUCK.

Muck consists of black decomposed organic matter ranging in depth from 20 to 36 inches or more. The surface soil for 10 inches or more always consists of jet-black finely divided organic matter, but below this depth brownish peaty material is encountered in many areas, and below 20 inches bluish loam, sandy clay, or fine sandy clay is often present. In such areas as that one-half mile northwest of Lawrence, the black organic material is less than 20 inches deep. Such areas represent inclusions of a shallow phase of Muck.

Muck is not extensive, covering a total area of a little more than 1,000 acres. It occurs in scattered areas throughout the central part of the survey, and has its greatest development southwest of Lawrence and $1\frac{1}{4}$ miles northeast of Dayton. It occupies low flat areas having very poor drainage. Practically none of this type is under cultivation. It supports a forest of maple, birch, and gum, with a thick undergrowth of greenbrier, fern, bay, and other water-loving flora. The Muck is of high agricultural value when reclaimed.

SWAMP.

Swamp, as recognized and classified in the Trenton area, includes low, level, very wet areas about the heads and along the courses of

sluggish streams. The soil of the Swamp consists of a black mucky material ordinarily extending to considerable depths, though in places it is relatively shallow, and underlain by a dark-colored sand, containing some gravel. Areas of Swamp are very wet, being covered with water during the winter months and well into the spring, and some areas are saturated throughout the year.

Part of the Swamp in the southeastern part of the area has been cleared, diked, and drained, and is being utilized to produce cranberries. It is a valuable soil for this purpose. Where in timber the growth consists chiefly of cedar, pine, beech, gum, magnolia, and maple. When this growth consists largely of good stands of cedar the land is valued from \$150 to \$400 or more an acre, depending upon the size and condition of the trees. Cranberry bogs have even greater value.

TIDAL MARSH.

Tidal marsh consists of areas adjoining the larger tidal rivers and subject to inundation at high tide. The soil material varies widely, but ordinarily consists of dark-brown, oozy, silty material, containing more or less organic matter.

In its natural condition Tidal marsh is nonagricultural land. It supports a growth of marsh grasses, calamus, and other plants. Some areas of this type have been reclaimed by dikes and ditches and are now under cultivation. These areas are shown on the soil map by symbol. Only a small acreage is farmed in the Trenton area, but in the Millville area to the south, excellent yields of hay, corn, oats, strawberries, late potatoes, and tomatoes are obtained on reclaimed land of this type.

CLAY PITS.

In certain sections of the survey the soil has been removed over small areas in the process of mining clays for the manufacture of chinaware, bricks, drain tile, sewer pipe, etc. These areas, designated clay pits, are indicated on the soil map. The total extent of such areas is about 832 acres.

SUMMARY.

The Trenton area is situated on the Delaware River in the west-central part of New Jersey. It has an area of 794 square miles, or 508,160 acres.

The topography ranges from level to hilly, with elevations ranging from sea level to nearly 600 feet. The area embraces parts of two distinct physiographic provinces, the Piedmont Plateau and the Atlantic Coastal Plain. The area as a whole is well drained by the Delaware River and its tributaries, as well as by other streams which eventually flow into the Atlantic Ocean.

The region was first settled many years before the American Revolution. Agriculture has always been an important industry, although at the present time over one-half of the inhabitants reside in towns having populations exceeding 2,500. Trenton, with a population of 119,289, is the largest city of the area and also the

capital of New Jersey and county seat of Mercer County. Burlington, South River, and Princeton are other towns of importance.

Excellent transportation facilities are available. There are also many improved highways ideal for transportation by motor truck. Telephone service is available throughout the area and many farms have electric power. New York, Philadelphia, and Trenton are the principal markets for farm products.

The climate is moderate and healthful. There is ample rainfall and it is well distributed. At Trenton the length of the average growing season is 195 days.

The systems of farm practice are general farming in conjunction with dairying, or potato growing and fruit in conjunction with early and late truck crops. The natural adaptations of the soil to certain crops are well understood and followed to a considerable extent in cropping the various soils. Rotations are extensively used, except when truck crops are grown. Cover crops are in general use. Commercial fertilizers and farm manures are used liberally. The supply of farm labor is ordinarily sufficient to meet the needs. The scale of wages is very high. Land values vary greatly, ranging from as little as \$50 to as much as \$300 an acre for improved land.

The soils of the Trenton area are in part residual and in part transported, about four-fifths of the area being occupied by the latter. The residual soils are derived from the underlying sandstones, shales, and trap rocks of Triassic age and the transported soils from unconsolidated beds of clay, sand, gravel, and greensand marl of Cretaceous and Tertiary age.

Of the residual soils those of the Penn series are the most important. They are derived from red sandstone or shale and have chocolate-red or chocolate-brown surface soils overlying chocolate-red subsoils. The Lansdale series includes types with brown surface soils underlain by brownish-yellow subsoils. They are derived from dense grayish argillite or grayish sandstone or shale. The Croton soils, also residual from sandstone and shale, have grayish-brown or gray surface soils and mottled subsoils, very compact in the lower depths. They are badly in need of underdrainage. Another residual series, the Lehigh, owes its origin to metamorphosed sandstones, shales, or argillite. The Croton and Lehigh soils are relatively poor farming lands.

The Montalto soils are well-drained types derived from a dense trap rock. They produce well and seem especially adapted to fruit. The Watchung soils, with the same derivation as the Montalto, are unimportant agriculturally, being poorly drained.

Among the Coastal Plain soils those of the Sassafras series are the most important. They have brown surface soils and reddish-yellow subsoils. The heavier types have comparatively mellow surface soils and are easily worked. The lighter types are well adapted to the raising of fruit and truck. Nine types, ranging from silt loam to loamy coarse sand, are recognized in the Trenton area. The Sassafras soils are very productive and well drained. The loam and fine sandy loam types are especially adapted to potatoes.

Soils of the Woodstown series occur closely associated with the Sassafras soils. They have imperfect drainage and are of inferior quality.

The Elkton and Portsmouth soils are poorly drained depression types. The heavier types are difficult to handle, especially in very wet seasons.

The Collington soils contain greensand marl (glauconite) in varying quantities. The surface soils are brown or reddish brown and the subsoils of greenish-brown or greenish-yellow color. They are very productive, well drained, and of great importance.

The Colts Neck soils are reddish or brownish red in the surface layer and reddish brown to greenish yellow or greenish brown in the subsoil. Two types and one phase of the series are mapped, but they are inextensive and of minor agricultural importance.

The Shrewsbury and Keansburg soils have imperfect drainage. They are closely associated with the Collington soils, and like them contain greensand marl, especially in the subsoil. These soils need lime and underdrainage. They seem especially adapted to corn and grass, but potatoes do not yield well.

The Keyport soils are not extensive or of agricultural importance. They are characterized by the brownish color of the surface soil and by a mottled, stiff subsoil.

The Lakewood soils are practically nonagricultural types. The surface soil is light gray to white and the subsoil reddish yellow. They are excessively drained and low in organic matter and mineral plant food. Practically no attempt has been made to bring these soils under cultivation.

The Leon and St. Johns soils are poorly drained depression soils. They are extensive only in the southeastern part of the Trenton area. They are very unproductive for farm crops or truck. When reclaimed they make good cranberry bogs, provided water is available for flooding.

The Birdsboro and Bermudian soils are all laid down by water from materials of Triassic age. They are unimportant agriculturally in the Trenton area and of small extent.

The Freneau loam is a first-bottom soil in the greensand belt. It is poorly drained and valued chiefly for pasture.

The Chenango soils are of minor extent and importance. They occur principally on terraces along the Delaware River in the vicinity of Trenton. The Chenango soils are well drained and produce good crops. They offer opportunity for the intensive production of truck crops.

Miscellaneous types include Meadow, Muck, Swamp, and Tidal marsh. Meadow and Swamp are moderately extensive, but all of these are of little agricultural value.

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