Series 1936, No. 25 Issued October, 1946

Soil Survey

Bucks County Pennsylvania

By
R. T. A. BURKE
United States Department of Agriculture, in Charge
and
R. K. CRAVER, R. B. ALDERFER, and E. C. DUNKLE
Pennsylvania State College

UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Administration
Bureau of Plant Industry, Soils, and Agricultural Engineering
In cooperation with the
Pennsylvania State College
School of Agriculture and Experiment Station

HOW TO USE THE SOIL SURVEY REPORT

SOIL SURVEYS provide a foundation for all land use programs. This report and the accompanying map present information both general and specific about the soils, the crops, and the agriculture of the area surveyed. The individual reader may be interested in the whole report or only in some particular part. Ordinarily he will be able to obtain the information he needs without reading the whole. Prepared for both general and detailed use, the report is designed to meet the needs of a wide variety of readers of three general groups: (1) Those interested in the area as a whole; (2) farmers and others interested in specific parts of it; and (3) students and teachers of soil science and related agricultural subjects. Attempt has been made to meet the needs of all three groups by making the report comprehensive for purposes of reference.

Readers interested in the area as a whole include those concerned with general land use planning—the placement and development of highways, power lines, urban sites, industries, community cooperatives, resettlement projects, and areas for forest and wildlife management and for recreation. The following sections are intended for such users: (1) Description of the County Surveyed, in which location and extent; physiography, relief, and drainage; vegetation; early history; population, organization, and industries; and transportation, markets, and other facilities are discussed; (2) Agriculture, in which a brief history and the present status of the agriculture are described; (3) Estimated Yields and Physical Land Classification in which the estimated yields of the soils are given and a grouping of soils according to their relative physical suitability for agricultural use are presented; and (4) Land Uses, Soil Management, and Agricultural Practices, in which the present uses of the soils are described, their management requirements are discussed, suggestions made for improvement, and other information as to agricultural practices is given.

Readers interested chiefly in specific areas—as some particular locality, farm, or field—include farmers, agricultural technicians interested in planning operations in communities or on individual farms, and real estate agents, land appraisers, prospective purchasers and tenants, and farm loan agencies. These readers should (1) locate on the map the tract with which concerned; (2) identify the soils on the tract by locating in the legend on the margin of the map the symbols and colors that represent them; and (3) locate in the table of contents in the section on Soils and Crops the page where each type is described in detail and information given as to its suitability for use and its relations to crops and agriculture. They will also find useful specific information relating to the soils in the sections on Estimated Yields and Physical Land Classification and Land Uses, Soil Management, and Agricultural Practices.

Students and teachers of soil science and allied subjects—including crop production, forestry, animal husbandry, economics, rural sociology, geography, and geology—will find their special interest in the section on Morphology and Genesis of Soils. They will also find useful information in the section on Soils and Crops, in which are presented the general scheme of classification of the soils of the area and a detailed discussion of each type. For those not already familiar with the classification and mapping of soils, these subjects are discussed under Soil Survey Methods and Definitions. Teachers of other subjects will find the sections on Description of the County Surveyed, Agriculture, Estimated Yields and Physical Land Classification, and the first part of the section on Soils and Crops of particular value in determining the relations between their special subjects and the soils of the area. Soil scientists and students of soils will find special interest in the section on Morphology and Genesis of Soils.

This publication on the soil survey of Bucks County, Pa., is a cooperative contribution from the—

BUREAU OF PLANT INDUSTRY, SOILS, AND AGRICULTURAL ENGINEERING
ROBERT M. SALTER, *Chief*

Division of Soil Survey
CHARLES E. KELLOGG, *Head Soil Scientist, in Charge*

PENNSYLVANIA STATE COLLEGE
School of Agriculture and Experiment Station
S. W. FLETCHER, *Director*
C. F. NOLL, *Head, Department of Agronomy*

Series 1936, No. 25 Issued October, 1946.

SOIL SURVEY OF BUCKS COUNTY, PENNSYLVANIA

By R. T. A. BURKE, Division of Soil Survey,[1] Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, in Charge, and R. K. CRAVER, R. B. ALDERFER, and E. C. DUNKLE, Pennsylvania State College, School of Agriculture and Experiment Station

Area inspected by JAMES THORP, Principal Soil Scientist, Division of Soil Survey

United States Department of Agriculture in cooperation with the Pennsylvania State College, School of Agriculture and Experiment Station

CONTENTS

[1] The field work for this survey was done while the division of Soil Survey was a part of the Bureau of Chemistry and Soils.

489603—46——1

BUCKS COUNTY lies principally within the Piedmont province, but a small part is in the Coastal Plain and in the Delaware River terraces. In general the climate is continental, and the soils are suitable for a variety of crops. The great variation can be attributed in a large measure to the location of the county in relation to its markets. It is in close proximity to a number of towns and cities. Soils of the Piedmont province are used chiefly for dairying, general farming, and poultry raising; those of the stream terraces and bottoms principally for market gardening; and those of the Coastal Plain for both purposes. Dairying is the most important source of farm income, poultry raising ranks second, and truck crops third. General farming, which is usually associated with dairy farming, is characterized by a greater diversification of interests and is likewise influenced by the proximity of large cities. Corn, oats, wheat, and hay are usually grown, but there is some acreage in potatoes, canning crops, vegetables, and fruits, and some land is used for dairy and poultry farming and raising cattle, hogs, sheep, and goats. To provide a basis for the best agricultural uses of the land a cooperative soil survey was begun in 1936 by the United States Department of Agriculture and the Pennsylvania State College, School of Agriculture and Experiment Station. The essential features may be summarized as follows:

SUMMARY

Bucks County comprises an area of 610 square miles in the extreme southeastern part of Pennsylvania. The elevation rises from the south to the north and northwest. The topography throughout the central part is characterized by a gentle gradient from tidewater on the Delaware River across the terraces and Coastal Plain and the lower part of the Piedmont to the series of steps with seaward-facing slopes that rise to a maximum elevation of 960 feet above sea level.

The climate may be described as continental, although it is likely that the Atlantic Ocean, which is less than 100 miles away, may be responsible for the lack of extreme temperatures in winter and summer. The yearly mean temperature is 50.2° F. The average annual rainfall of 46.93 inches is ample and well distributed throughout the year, with 27.73 inches for the driest year and 68.92 inches for the wettest year. The average snowfall is 36.0 inches. The average interfrost period of 155 days is ample for the production of a wide range of crops.

Bucks County borders on Philadelphia, Pa., and Trenton, N. J., and is about 75 miles from New York City. There is some variation in the agriculture from one part of the county to another, due in large measure to the proximity of the area to larger centers of population, the market demands of which are probably responsible for the kinds of crops produced and the blending of agriculture with industry. The kinds of farming in Bucks County consist of dairy, general, truck, and poultry farming, supplemented to a limited extent by the growing of flowers, greenhouse products, seeds, and nursery products. Some of the major farms also depend upon the raising of cattle, chickens, swine, and sheep.

Dairying is the most important source of farm income. Most of the milk is marketed in the form of fluid milk in the nearby large cities. Whole milk delivered at a local station near Philadelphia commands a higher price than that obtained 50 to 60 miles away. Farmers are said also to get special premiums and ratings not available to remote shippers. This differential is greater for milk than for any other product and is probably responsible in part for the specialization and expansion of dairy farming. The proximity of nearby cities is not entirely responsible for this favorable condition, as there is much land in Bucks County suitable for the production of field crops and pasture, which are a necessary complement to dairy farming, and a large proportion of the Bucks, Chester, Duffield, Washington, Lansdale, Chalfont, Lehigh, and Montalto soils are used for this purpose.

General farming is usually associated with dairy farming. It is characterized by a greater diversification of interests and is likewise influenced by the proximity of large cities. Corn, oats, wheat, and hay are usually grown, but there is some acreage in potatoes, canning crops, vegetables, and fruits, and some land is used for dairy and poultry farming and the raising of cattle, hogs, sheep, and goats. Labor is a problem on most of these farms, since wages are higher than in most agricultural sections. Another factor is that so many city people buy farms for summer homes, increasing the realty value to a point where intensive farming must be practiced in order to meet interest and taxes. Much of the land of Bucks County is well adapted to general farming, and it is important on the Penn, Bucks, Chester, Neshaminy, Lansdale, Duffield, Washington, Sassafras, Unadilla, Elsinboro, Chenango, Montalto, and Springtown soils.

Poultry ranks second as a source of income to the farmers of Bucks County. The average poultry flock is a side line to dairy and general farming, partly because a high percentage of the scratch grains are grown on these farms. Another reason contributing to the growth of this type of farming near the larger centers of population is that there is a greater demand for local eggs and poultry products than for those shipped from a distance.

Truck crops rank third as a source of income, although truck farming is limited to a comparatively small area. The principal truck crops are sweet corn, tomatoes, rhubarb, asparagus, beets, carrots, spinach, beans, rutabagas, and celery. The situation in regard to labor is said to be different in the truck section. Farmers have no difficulty in getting the foreign element in the cities to work in the truck fields. Most of the truck crops are grown on the Tioga, Unadilla, Chenango, and Sassafras silt loams. Proximity to nearby markets is of paramount importance to the truck-farming interests, and this may be the reason for the development of this type of agriculture, since Bucks County is located conveniently to Philadelphia and Trenton.

In the same general part of the county, although not entirely confined to it, there is a considerable concentration of greenhouses, flower plots, and plots producing seed and nursery products. These are mostly located on the Unadilla and Sassafras soils.

The general indications are that there will be a material expansion in dairy, general, and truck farming. It seems probable that the

production of potatoes and canning crops, as well as of fruits and vegetables in general, will continue to increase in importance. Roadside markets have given a considerable impetus to the orchard industry, and it seems likely there will be a material increase in the acreage of apples, cane fruits, and strawberries.

The soils of Bucks County as surveyed comprise 51 soil types, 29 phases, 1 complex, and 6 miscellaneous land types. These are grouped in the section on Soils and Crops, according to character of parent materials and physiographic province or topographic position. The three principal categories are soils of the Piedmont Plateau, soils of the Coastal Plain, and soils of the stream terraces and bottoms.

In the group of soils of the Piedmont Plateau, the Bucks and Penn soils are developed from Indian-red shales and sandstones; the Lansdale, Steinsburg, and Lehigh soils are developed from gray and yellow shales and sandstones; the Chester, Neshaminy Manor, Edgemont, Brandywine, Buckingham, and Califon soils are developed from a rather complex belt of rocks consisting of gneisses, arkoses, quartzites, conglomerates, and schists; the Duffield, Chalfont, Doylestown, Greer, and Captina soils are developed from dolomitic limestones and shales; the Montalto and Watchung soils are developed from intrusive rocks consisting of diabase and gabbro; and the Springtown, Annandale, and Washington soils are presumably developed from old glacial till of Jerseyan age.

The soils of the Coastal Plain consist of members of the Sassafras, Woodstown, Fallsington, and Elkton series.

The soils of the terraces are classified in the Chenango, Unadilla, Elsinboro, and Braceville series, whereas those of the bottom lands are included in the Tioga, Bermudian, Codorus, Bowmansville, Wehadkee, and Melvin series.

The miscellaneous land types include three kinds of rough stony land, based on the character of the parent rock; tidal marsh; marsh; and alluvial soils, undifferentiated.

Each one of these soil and land units shown on the soil map of Bucks County is described and its relation to agriculture discussed. Estimated yields of corn, wheat, oats, mixed hay, and potatoes on each soil on which they are commonly produced are given; and in the section on Estimated Yields and Physical Land Classification the soils are classified in six groups on the basis of physical suitability for use.

The section of the report on Morphology and Genesis of Soils deals more strictly with the soils from the point of view of the soil scientist, particularly in connection with soil classification. The regional soil profile of Bucks County is that of the Gray-Brown Podzolic zonal soils. The various soils of the county exhibit various degrees of development of this regional profile, except those that are intrazonal and azonal in character.

DESCRIPTION OF THE COUNTY SURVEYED

LOCATION AND EXTENT

Bucks County is in the southeastern part of Pennsylvania (fig. 1). Lehigh and Northampton Counties form the northern boundary of the county, the Delaware River the eastern and southern, and Phila-

delphia and Montgomery Counties the western boundary. The total land area is 610 square miles, or 390,400 acres. The county is nearly rectangular in outline. Its greatest length is about 42 miles in a northwest and southeast direction.

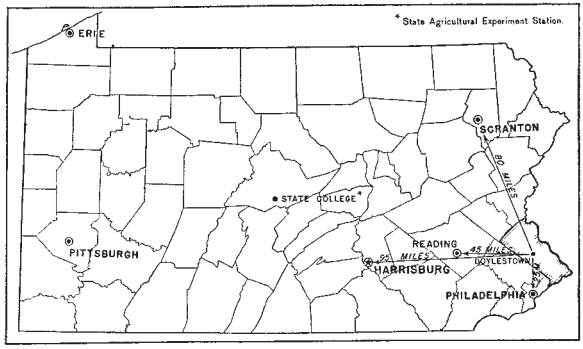

FIGURE 1.—Location of Bucks County in Pennsylvania.

Doylestown, the county seat, situated near the central part of the county is 25 miles by highway from Philadelphia, 27 miles from Allentown, 25 miles from Trenton, N. J., and 75 miles from New York City.

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

Bucks County lies principally within the Piedmont province, but a small part is included in the Coastal Plain. In places both of these major divisions are flanked by the bottoms and terraces of the Delaware River.

The Piedmont province is a rolling plateau lying between the eastern foot of the Appalachian Mountains and the Coastal Plain. It consists of two subdivisions, the Piedmont Upland and the Piedmont Lowlands, which form belts of land from the southwest to the northeast. Except for the southern part, which merges with the Coastal Plain, Bucks County belongs to the Piedmont Lowlands division. The Piedmont province consists of a series of steps rising toward the northwest. It is thought that these steps represent various stages in the geological erosion of the region. On each step the land was presumably leveled by geological erosion, and the plains thus formed were subsequently uplifted and cut by streams to form the present valleys and intervening ridges and hills.

In general the relief of the land has been determined largely by the geologic structure and the kinds of bedrock present. The rates of weathering and geological erosion differ with the different kinds of rocks, as differences in the character of the rocks determine the various degrees of resistance offered to these forces. The principal rocks are diabase, gabbro, granite, gneiss, quartzite, quartzite conglomerate, arkose, sandstone, shale, dolomite, and limestone. The larger valleys have been formed in belts of softer rocks including the more soluble limestones. Three ridges that extend in a northeasterly direction across the northern half of the county are dominant topographic features. The highest ridge is along the northern boundary of the

county and attains an elevation of 960 feet above sea level, which is the maximum for the county. The next highest ridge, which ranges in elevation from 700 to 800 feet above sea level, is in the vicinity of Rock Hill and Smoketown. Separated by valleys from this ridge but to the northeast is Haycock Mountain, which also attains the maximum elevation. The third ridge, which has an elevation of 500 to 600 feet, is dissected by very narrow parallel valleys.

The general slope of the land from north to south is more gradual. The following towns and approximate elevations are within the Piedmont province: Quakertown, 500 feet; Perkasie, 400 feet; Doylestown, 400 feet; Newtown, 200 feet; and Langhorne, 200 feet. Eastward the general slope is more pronounced and hills and small ridges rise 200 to 300 feet above the surrounding land. Buckingham Mountain, 500 feet high; Solebury Mountain, 480 feet; and Jericho Mountain, 420 feet, are among the highest elevations.

With a range in elevation from 160 to 960 feet within the Piedmont province, there is considerable variation in local surface relief, yet there is comparatively little rough, hilly country. Most of the land north of Ridgewood might be described as gently rolling with deep and variable-sized valleys. To the south the ridges broaden out and the land is less rolling, and as it approaches the Coastal Plain it is undulating with low divides and shallow stream valleys.

Most of the rough areas are restricted to the steep valley slopes and the sides of mountains. In places in the northeastern part of the county the areas adjacent to the river bluffs have been deeply cut and dissected by streams. In some places along the old Pennsylvania Canal and the Delaware River in the northern half of the county the river bluffs and slopes are almost precipitous.

The Coastal Plain occurs to the south of Trevose and Langhorne and to the east and south of Newtown and Langhorne. It includes the towns of Langhorne Manor, Bensalem, Roelofs, Edgewood, and Fallsington and parts of Morrisville and Yardley. The Coastal Plain ranges from 60 to 160 feet above sea level. The highest altitude is at the most northerly point.

The surface relief ranges from almost level to undulating and is characterized by shallow valleys. The high bottoms and terraces of the Delaware River are most extensive in the southeastern part of the area, and to a less extent in the eastern part, particularly near Washington Crossing, Upper Black Eddy, and Riegelsville.

The high bottoms represent the river areas that were covered by the floodwater of 1936. The flood of 1903 covered much of the area now classified as river terraces.

The surface of most of the high bottoms and river terraces ranges from almost level to slightly undulating. The bottoms are dissected in places by very shallow channels or depressions formed during flood periods. The high bottoms and terraces of the Delaware River include some of the best farm land in the county. Some of the islands and bars in the Delaware River are subject to frequent overflow and, like many stream bottoms throughout the county, have very little agricultural value at present.

The county is drained by the Delaware and the Schuylkill River systems. The former drains more than three-fourths of the total

area. The drainage in general is eastward and southward toward the Delaware River and southwestward toward the Schuylkill. Streams flow in all directions, however, as a result of the variable resistance offered to erosion by the underlying rocks. The principal contributing streams to the Delaware are Durham, Tohickon, Neshaminy, and Poquessing Creeks and their tributaries. These streams are actively deepening their channels and are extending their heads farther and farther back into the uplands. The drainage by the Schuylkill River is more indirect and is effected by the northeast branch of Perkiomen Creek and by Unami Creek. These streams receive the surplus waters of the western and northwestern parts of the county. In the southern and southeastern parts the Delaware River is affected as far as Morrisville by the rise and fall of marine tides.

VEGETATION

The original forest was a heavy growth of pine, and various hardwoods, of which chestnut oak and tuliptree (yellow poplar) were prominent species. There are no heavy forests here now, but there is a light growth of various species of oak, hickory, maple, beech, and poplar scattered throughout the county. Formerly there was a considerable growth of chestnut on some of the higher ridges, but this has largely been killed by blight. Most of the forest at present is in the northern part between Finland and Haycock Mountains, to the east and southeast of Ferndale, near Shelly, and to a limited extent along the banks of Little Neshaminy Creek. There are scattered areas of brush, woods, or wood lots in all parts of the county, but especially near the watercourses.

EARLY HISTORY[2]

The first settlements in what is now Bucks County were made by the Dutch in 1624, near the present site of Morrisville, along the Delaware River. The area was taken over by the Swedes in 1638 and by the English in 1640. It was a part of the purchase by William Penn from the Indians in 1681, and it came to be the home of many English Quakers.

Bucks County was separated from Philadelphia and Chester Counties in 1683, at the first meeting of William Penn's Provincial Assembly.

At a later period many Irish and Germans settled in this section. In more recent years some Poles and Austrians have come to the county. Most of these latter people came from industrial centers and have drifted back to agriculture.

The oldest flour mill in the area now forming Bucks County was built at Holmesburg in 1679, and the first school was opened in Bensalem in 1678.

In the early days practically all travel was done on foot or on horseback. The building of the Kings Road between Philadelphia and Morrisville was started in 1667, but the road was not completely cleared of logs and stumps until 1700. The Bristol road was completed in 1683, the Durham road in 1693, and the old York road in 1694. The Delaware

[2] Historical data obtained mainly from the following publication: DAVIS, W. W. HISTORY OF BUCKS COUNTY, PENNSYLVANIA. 3 v. Chicago. 1876.

Division of the Pennsylvania Canal was built along the Delaware River between 1828 and 1832, and the canal superseded the river for the transportation of freight. The first railroad in the county was built in 1832, connecting Philadelphia and Trenton; and the North Pennsylvania Railroad, between Philadelphia and Bethlehem, was completed in 1853.

POPULATION, ORGANIZATION, AND INDUSTRIES

According to the Federal census of 1940 the population of the county is 107,715, of which 31,635 is listed as urban. Many of these people are descendants of the early settlers. A large number of persons who have their homes in the county are employed in nearby cities, such as Philadelphia, Trenton, Easton, Bethlehem, and Allentown. Many camps and summer homes have been established along the Delaware River and the larger streams, and the population increases greatly during the summer season.

The principal towns of the county are Doylestown (the county seat), Bristol, Quakertown, Perkasie, Sellersville, Langhorne, Newtown, Yardley, Morrisville, and New Hope, besides which there are several other smaller but important places. Most of these towns are progressive manufacturing centers that turn out a variety of products. The industries throughout the rural districts consist principally of the working of shale, dolomite, and diabase for road material. Formerly there were many limekilns where limestone or dolomitic limestone was burned for agricultural and other purposes. One near Lahaska and another near Solebury were operating at the time of this survey (1936).

In the southern part of the county, on the river terraces and bottoms of the Delaware River, the removal of sand and gravel is an important industry. Some large lakes and ponds have been developed as a result of these operations.

TRANSPORTATION, MARKETS, AND OTHER FACILITIES

Bucks County has excellent railroad facilities, supplemented by bus and truck service for passengers and freight. The principal railroads are the Pennsylvania and branches of the Reading. All the electric railway lines in the county have been discontinued except that of the Lehigh Valley Transit Co. between Allentown and Philadelphia.

An excellent system of roads extends to all parts of the county. Main highways of concrete traverse the area in all directions. Secondary roads are surfaced with gravel and treated with tar. Earth roads are kept in condition by road machines and by labor from nearby farms. Nearly all farms are within short distances of good roads. The manufacturing towns afford convenient local markets for dairy products, poultry, fruit, and vegetables as well as for beef, pork, and lamb. Most of the excess farm products are hauled to or shipped from nearby cities for distribution.

The old Pennsylvania Canal along the Delaware River was formerly used for hauling freight, but it is no longer used for this purpose and is now maintained only for its scenic and recreational value.

Churches and schools are conveniently located in all parts of the county. Many of the one-room schools have been abandoned, and the pupils are transported by bus to consolidated schools.

Telephone lines and the rural free delivery of mail extend to all parts of the county. Power transmission lines traverse the county, and feeder lines from these transmit power and light to towns and to many farms.

CLIMATE

The climate of Bucks County may be characterized as continental, although it is likely that some influence is felt from the Atlantic Ocean, which is only about 100 miles away. It may be described as quite temperate, as it lacks the extremes of winter and summer temperatures.

The winters are not continuously cold, as the temperature fluctuates within wide limits; but there is considerable snow. Spring (March, April, and May) is more often characterized by extremes in temperature than the fall season and is generally colder and more uncertain. The summers are usually mild and pleasant. There are occasional hot spells when the weather is rather oppressive, but these are generally of short duration. The approach from summer to fall is generally gradual, and the fall season is one of the most pleasant parts of the year. Although the weather in November may be cold, it is bracing and invigorating.

The average snowfall for the year is given as 36.0 inches, and this is restricted to the late fall, winter, and early spring months. The mean precipitation for the year is reported as 46.93 inches, with a low of 27.73 inches for the driest year (1875) and a high of 68.92 inches for the wettest year (1889). According to some of the older residents, there has been less water in the major streams of the county during the last 15 years, particularly in Neshaminy, Perkiomen, and Tohickon Creeks. They also report that the general water table has been lowered and that crops are not generally so good as formerly. The water supply of the farms is drawn from shallow and deep drilled wells. The water supply of the towns comes from streams, and the water is pumped, filtered, and treated with chlorine.

May 29 is given as the date of the latest frost recorded in spring, and September 15 as the earliest in fall. The average dates, which represent more normal conditions, are May 3 and October 5, and give an interfrost period of 155 days, which is ample for the production of a wide range of crops.

Local periods of drought are not uncommon, and protracted dry spells cause considerable loss in production, especially on well-drained lands, but more particularly on the thin, shallow soils.

It is reported that in the spring of 1903 the floodwaters of the Delaware River covered most of the terraces and bottoms. The flood of the spring of 1936 was not quite so bad, but it covered much land. Levees had been built along the river in some places in the southern part of the county, particularly near the towns; and although some of these were washed out, they are said to have afforded considerable protection. Both of these floods might be considered unusual, as there was a flood-free period of 33 years. Plans are being considered to place catch basins in the uplands and to place dams in creeks and branches, to retard the too rapid drainage of the county.

Most of the small stream bottoms are subject to frequent overflows and inundation, and this condition is a limiting factor in their agricultural use. On the river terraces and high bottoms, however, floods are very rare and crops in general can be produced with confidence.

Table 1, compiled from records of the United States Weather Bureau station at Quakertown, gives the salient facts concerning the climate.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Quakertown, Bucks County, Pa.*

[Elevation, 480 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year (1875)	Total for the wettest year (1889)	Average snowfall
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December	31.4	66	−9	3.96	2.39	2.43	5.6
January	26.9	65	−20	3.82	.50	4.58	10.6
February	28.8	80	−15	3.31	4.44	2.38	10.6
Winter	29.0	80	−20	11.09	7.33	9.39	26.8
March	37.5	84	−3	3.79	3.25	3.47	6.3
April	48.5	92	10	4.06	1.50	4.83	1.5
May	59.5	95	24	3.36	1.84	5.45	0
Spring	48.5	95	−3	11.21	6.59	13.75	7.8
June	68.4	100	37	3.91	1.87	7.31	0
July	72.6	105	42	4.68	2.25	11.54	0
August	70.5	105	37	5.09	1.69	4.76	0
Summer	70.5	105	37	13.68	5.81	23.61	0
September	64.0	97	29	3.89	.90	8.06	0
October	52.3	91	20	3.92	2.90	5.23	.1
November	41.4	78	5	3.14	4.20	8.88	1.3
Fall	52.6	97	5	10.95	8.00	22.17	1.4
Year	50.2	105	−20	46.93	27.73	68.92	36.0

AGRICULTURE

EARLY AGRICULTURE[3]

The early settlers adopted agricultural methods and practices suitable to their needs and to the climate and soils of Bucks County. The early agriculture consisted largely of patch farming and was mainly of a subsistence type. The lack of tools and equipment was a serious handicap. The first tools were rather primitive and consisted of plows and harrows made entirely of wood. The principal field crops were corn, oats, wheat, and hay. Rye, barley, and buckwheat were also grown, and there were small patches of flax and hemp. The field crops were supplemented by home gardens and orchards. Peas, beans, turnips, and potatoes were among the vegetables grown. The corn, oats, and hay were used principally for livestock feed.

Nearly 100 years elapsed before any crops were exported. In 1767 some wheat was shipped to France and corn to the West Indies. The first wheat failure was recorded in 1780 and was caused by the hessian fly. The acreage cleared for agriculture was gradually increased until 1840, when some of the farmers had as much as 70 to 80 acres in wheat alone. The yields at that time are reported to have ranged from 20 to 30 bushels an acre. At that time the number of cattle had also increased greatly, and it is reported that some of the farmers had

[3] See footnote 2, p. 7.

40 to 60 head on their farms. Land values are reported to have varied directly with the price of wheat. When wheat was selling for 33 cents a bushel, the land value was $6.67 an acre; when wheat sold for $1.12 a bushel, land value increased to $26.60 an acre. About this time beef and pork sold for 2½ cents a pound.

TRENDS SINCE 1879

Table 2, compiled from United States census reports, gives the acreage of the leading crops and shows the general trend of agriculture in Bucks County from 1879 to 1939.

TABLE 2.—*Acreage of principal crops and number of bearing fruit trees and grapevines in Bucks County, Pa., in stated years* [1]

Crop	1879	1889	1899	1909	1919	1929	1939
Corn:	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
For grain	51,068	46,495	53,618	47,969	50,069	28,760	32,405
For silage					3,674	4,159	4,416
Hogged or grazed or cut for fodder			[2] 298	[2] 1,033	16,128	1,362	894
Wheat	34,755	30,205	34,479	28,077	30,894	24,431	21,334
Oats	36,825	34,648	25,169	23,690	28,372	14,649	14,518
Rye	14,556	16,726	13,962	13,752	12,973	2,623	1,000
Barley	23	23	214	38	281	359	2,995
Buckwheat	753	116	545	1,050	1,252	352	302
Dry beans			52	16	32	[3] 1,063	[4] 900
Potatoes	5,300	6,959	9,265	8,745	7,241	3,505	2,166
Vegetables harvested for sale					[5] 3,284	8,907	19,181
Tobacco	934	330	60	2	2		
All hay	97,432	106,999	92,853	87,616	77,638	46,842	47,694
Timothy or clover, alone or mixed				77,293	61,450	39,903	28,813
Clover alone			4,740	1,151	4,589	1,356	1,359
Alfalfa				100	905	1,817	7,013
Small grain hay			636	273	440	121	618
Annual legumes					292	731	4,993
Other tame hay			87,465	7,101	9,339	2,842	4,034
Wild hay			12	1,698	623	72	864
	Trees	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*
Apples		246,078	302,409	182,358	120,980	103,284	72,387
Peaches		82,847	90,043	57,275	142,936	44,208	17,368
Pears		12,852	39,058	28,475	26,448	13,597	3,846
Cherries		9,614	25,416	29,425	18,120	7,304	3,794
Plums		897	10,126	8,076	7,746	3,814	514
	Vines	*Vines*	*Vines*	*Vines*	*Vines*	*Vines*	*Vines*
Grapes			40,074	18,910	19,761	33,026	14,672

[1] Trees and vines are as of census years, 1890 to 1940, inclusive.
[2] Includes kafir and sorghums.
[3] Mostly soybeans, for all purposes.
[4] Soybeans.
[5] For sale and home use.

It will be noted from the table that the reports for the more recent decades are given in greater detail.

The acreage in corn for grain was maintained from 1879 to 1919 at about the same level. It reached a maximum of 53,618 acres in 1899 but was greatly curtailed in 1929 to 28,760 acres. The combined acreage in corn for all purposes reached a high point of 69,871 acres in 1919 but dropped to 37,715 in 1939.

Wheat attained its maximum acreage in 1879 with 34,755 acres, but the acreage was fairly consistent between 1879 and 1919 with the exception of 1909. As with corn, there was a conspicuous reduction in 1939, when wheat fell to 21.334 acres. Oats declined from 36,825 acres in 1879 to 14,518 in 1939. Rye attained a maximum of 16,726 acres in 1889, but after 1919 it showed a great reduction, reaching a low of 1,000

acres in 1939. Barley in the last decade showed a marked rise to 2,995 acres in 1939. Buckwheat is a minor crop.

Hay (mainly timothy and clover) has always been an important product of the farms of Bucks County, though the acreage has declined to about half of its former proportions in the last 50 years—from 106,999 acres in 1889 to 47,694 acres in 1939. Alfalfa, although one of the minor crops, increased from 100 acres in 1909 to 7,013 in 1939.

Potatoes reached a maximum of 9,265 acres in 1899 but declined to 2,166 in 1939.

Tobacco, grown on 934 acres in 1879, reached a negligible point (2 acres) in 1909 and has since disappeared from the crops of Bucks County.

Vegetables show a considerable increase since 1919. In that year vegetables for sale and for home use were grown on 3,284 acres, and in 1939 vegetables for sale (exclusive of potatoes and sweetpotatoes) were grown on 19,181 acres, of which there were 3,813 acres in tomatoes, 3,300 in spinach, 3,137 in sweet corn, 2,230 in beans (snap, string, or wax), and 1,120 in asparagus, with smaller acreages in cabbage, carrots, broccoli, beets, lima beans, and celery.

The census reports show a heavy decrease in bearing fruit trees in recent decades. Apples are the dominant fruit. They declined from 302,409 trees in 1900 to 72,387 in 1940. The number of peach trees decreased from 142,936 in 1920 to 17,368 in 1940; pear trees from 39,058 in 1900 to 3,846 in 1940; cherry trees from 29,425 in 1910 to 3,794 in 1940; plum trees from 10,126 in 1900 to 514 in 1940. Grapes also show a decline from 40,074 vines in 1900 to 14,672 in 1940.

Of the small fruits, strawberries increased from 82 acres in 1909 to 94 acres in 1939. Raspberries and blackberries or dewberries have not changed much; in 1939 the former had an acreage of 31 and the latter 6.

According to the census, the number of farms in the county decreased from 6,493 in 1880 to 4,299 in 1940. The total area in farms also decreased from 94.9 percent of the county area in 1880 to 65.0 percent in 1940, while the average size of farms increased from 57 acres in 1880 to 59.7 acres in 1940. The improved land in farms decreased from 88.0 percent in 1879 to 77.1 percent in 1939. There was also a slight reduction in the area of improved land per farm from 50 acres in 1879 to 46.1 acres in 1939.

PRESENT AGRICULTURE

The agriculture of Bucks County consists of general, dairy, and truck farming, supplemented by poultry, vegetables, and fruits. Frequently interests are combined or particular features are emphasized. The great variation that prevails here can be attributed in a large measure to the location of the county in relation to its markets. It is in close proximity to a number of towns and cities. Philadelphia and Trenton are on its borders; Easton and Allentown are only 8 miles from the northern border; and New York City is about 75 miles to the east.

Even in the early days the proximity of Philadelphia and other cities made possible the ready exchange of agricultural and industrial products. The demand for milk alone has been great enough to establish the dairy industry. A price differential, however, may have had

something to do with this. In 1932 this differential amounted to 7 cents a hundred pounds of milk. There has also been an expanding market for poultry, eggs, and vegetables.

FARMS AND FARM OPERATIONS

Farms range in size from a few acres to a thousand acres or more. Most of them are between 50 and 139 acres in extent. The largest units engaged in intensive production are the truck farms on the river terraces and the Coastal Plain. On the best agricultural lands the average size is approximately 60 acres, and the holdings in general appear to increase in size as production decreases. Information indicates that the small acreages of the best lands return more cash per farm than larger acreages of less productive land.

According to the United States census, in 1940, of the total of the 4,299 farms, 3,828 (or 89.0 percent) were operated by owners, 395 (or 9.2 percent) by tenants, and 76 (or 1.8 percent) by managers. Of the tenant farms, 270 were rented for cash and 125 were worked on a share basis.

Cash rental varies from $5 to $25 an acre, depending on the use of the land. Most of the cash rentals are in truck-farming districts, and the highest price reported was $25 an acre for growing tomatoes. Several systems are followed under the share plans. The most common one is for the tenant to supply the labor, the machinery, two-thirds of the seed and fertilizer, and all of the lime. The landlord supplies the land and the rest of the seed and fertilizer. One-third of the crop goes to the landlord, and the tenant retains two-thirds. In some instances the tenant pays either the road or the school taxes.

The expenditures for fertilizer in 1939, as reported by the census, amounted to a total of $533,932 for the 2,742 farms reporting this item, representing an average expense of $194.72 for each farm. The kinds of fertilizers used vary with the different types of farming. On the dairy farms manure is generally applied to the corn ground prior to planting. Superphosphate is commonly applied to corn and the small grains or is added to the manure in the stable. Complete fertilizers, such as 4–12–4 and 4–16–4,[4] with a high ratio of phosphoric acid, are commonly applied to corn and the small grains on the general farms. Relatively heavy applications of complete fertilizers are used on the truck crops. Ratios vary with the crops, the soils, and the operators. Nitrogenous fertilizers are used by orchardists.

The census reports the total expenditure for labor in 1939 as $1,746,739, with 1,818 farms reporting. This represents an average expense of $960.80 per farm. Because of the proximity of this county to the large cities, labor is a problem, in that wages on the average are higher and efficient labor is scarcer than in other agricultural sections. In the truck-farming part of the county, labor available for this type of work is ample, as farmers are able to obtain foreign-born people from the cities, who are considered the best type of labor for truck farms.

[4] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

On January 1, 1939, the number of motortrucks registered in Bucks County was 2,050; automobiles, 4,510; tractors, 1,760; and gas engines, 2,910.[5]

The value of agricultural products of Bucks County in 1939, by classes, as reported by the United States census, is shown in table 3.

TABLE 3.—*Value of agricultural products, by classes, in Bucks County, Pa., in 1939*

Crops	Value	Livestock and livestock products	Value
All cereals	$1,563,874	Dairy products sold	$2,183,413
Corn harvested for grain	907,662	Whole milk sold	2,170,667
Wheat threshed	411,205	Cream sold [1]	6,973
Other cereals	245,007	Butter sold	5,773
Other grains and seeds	27,023	Poultry [2] and eggs produced	3,060,053
Hay and forage	1,207,768	Livestock sold and slaughtered	686,499
All vegetables	2,717,423	Cattle and calves	358,883
Vegetables for sale (except potatoes and sweetpotatoes)	2,282,231	Sheep and lambs	3,940
Vegetables for home use (except potatoes and sweetpotatoes)	179,619	Swine	323,676
Potatoes and sweetpotatoes	255,573	Wool shorn	1,714
Fruits and nuts	188,021	Honey produced	1,254
Horticultural specialties sold	491,716	Total	5,932,933
All other crops	2,647		
Forest products sold	8,913		
Total	6,207,385		

[1] Includes both sweet and sour cream (butterfat).
[2] Includes value for geese, guinea fowl, pigeons, quail, pheasants, and other and unspecified poultry.

CROPS

The principal general farm crops grown in Bucks County are corn, oats, wheat, and hay, and the general rotation consists of corn, oats, wheat, and hay (1 to 2 years). Other important crops are silage corn, sweet corn, potatoes, and tomatoes. Rye may take the place of wheat; barley and buckwheat may take the place of oats.

Corn, the major grain crop of the county, is well adapted to the soils and climate, and its yields compare favorably with those on some of the best soils in the country. It has been grown since the early days of settlement. Wheat is next in importance. Most of it is grown in the same areas that produce corn. It is well suited to the soils and climate. It fits well in crop rotations, principally as a nurse crop for grass and clovers, and has long been an important crop in this area. Oats, although an important crop, are being replaced gradually by other spring crops. The yields are generally light, and some farmers believe the climate too warm for this crop. It is a convenient crop to sow after corn, as it fits well into the rotation. Rye is not so important now as in decades past. It is more productive than wheat on droughty and light-textured soils, and most of the rye grown is produced on rolling land or valley slopes. Buckwheat and barley are not very important crops. The acreage of buckwheat is shrinking, but there is a consistent increase in the acreage of barley.

Potatoes are one of the special cultivated crops that have been produced since the days of early settlement. They have always been an

[5] PENNSYLVANIA DEPARTMENT OF AGRICULTURE. PENNSYLVANIA CROP AND LIVESTOCK REPORT, 1938. Pa. Dept. Agr. Bul. 565, v. 22 (6), 35 pp. Harrisburg. See p. 31.

essential garden product, but in recent years their production has become highly specialized as a side line to dairy and general farming or as an important truck crop. The soils and climate in general are suitable for satisfactory growth, and yields as high as 629 bushels an acre have been reported. Potatoes sometimes take the place of corn in rotations.

Hay is the leading crop of the area in acreage, although the acreage has been greatly reduced since 1879. It has been grown since earliest times and is still an important part of the basic rotation. The demand for hay, especially timothy, has been greatly reduced since the advent of the automobile. More emphasis is now placed on legumes in hay mixtures. At present red clover, sweetclover, and alfalfa are frequently sown with timothy. The rotation-pasture sods are rarely used longer than 2 years. Most of the permanent pastures are on slopes or lowland, and in general they are not so good or dependable as the pastures in rotation. Some interest has been shown in recent years in improving many of these old pastures.

Gardens and orchards are usually an important part of each farm, and most of the few commercial orchards are in the more rolling country. The acreage in vegetables is rapidly expanding. With the exception of potatoes, sweet corn, and tomatoes (for canning), most of the vegetable growing is concentrated near the markets of Philadelphia, Pa., and Trenton, N. J. The principal vegetables are cabbage, beets, asparagus, carrots, tomatoes, celery, lettuce, spinach, parsnips, beans, and peas. The principal fruits are apples, peaches, pears, plums, cherries, grapes, strawberries, raspberries, and blackberries or dewberries.

LIVESTOCK AND POULTRY

The 1940 census reports 5,297 horses, 339 mules, and 27,093 cattle, over 3 months of age on April 1, 1940; 1,367 sheep over 6 months of age; 15,089 swine over 4 months of age; and 732,901 chickens over 4 months of age. Comparable figures for 1930 are 8,064 horses, 339 mules, 24,132 cattle, 1,314 sheep, 11,323 swine, and 704,691 chickens over 3 months of age. These figures show a considerable reduction in horses and swine but an increase in chickens.

Practically all the cattle are of the dairy type, of which the Holstein-Friesian breed predominates, although there are some Guernseys, Ayrshires, and Jerseys. Many of them are purebred. Hogs are kept mostly for supplying meat and lard for home use and some for retail on huckster routes in the city. Scattered farmers have small farm flocks of sheep, principally Shropshire and Dorset, but none are of commercial importance. Nearly all horses are shipped in from outside sources.

Poultry ranks second to the dairy industry as a source of income. Most poultry flocks are kept as a side line to dairying or other types of farming. A large proportion of the scratch grains are grown on the farm. Commercial flocks, with a minimum of about 1,000 birds, depend almost entirely on commercial feeds. The losses of poultry from disease are high, and most of the birds are raised in confinement or on clean range. The laying flocks are kept almost entirely confined and by the use of electric lights at night are forced to lay more than

the normal number of eggs, with the result that few hens are kept after the second year of laying. Many varieties of chickens are scattered throughout the county, but the White Leghorn is the most popular breed. Doylestown is one of the most important egg markets in the State. An egg auction is maintained there and operates regularly.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field and the recording of their characteristics, particularly in reference to the growth of various crops, grasses, and trees.

The soils and the underlying formations are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of layers or horizons, called collectively the soil profile. Each horizon of the soil, as well as the parent material beneath the soil, is studied in detail, and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil and its content of lime and salts are determined by simple tests.[6] The drainage, both internal and external, and other external features, such as relief or lay of the land, are taken into consideration, and the interrelation of the soil and vegetation is studied.

The soils are classified according to their characteristics, both internal and external, with special emphasis upon the features that influence the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics the soils are grouped into classification units, the principal three of which are (1) series, (2) type, and (3) phase. In some places two or more of these principal units may be in such intimate or mixed pattern that they cannot be clearly shown separately on a small-scale map but must be mapped as (4) a complex. Some areas of land—such as rough stony land, alluvial soils, undifferentiated, tidal marsh, and marsh—that have no true soil are called (5) miscellaneous land types.

The series is a group of soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile and having similar parent material. Thus, the series comprises soils having essentially the same color, structure, natural drainage conditions, and other important internal characteristics, and the same range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The series are given geographic names taken from localities near which they were first identified. Chester, Penn, Lansdale, and Montalto are names of important soil series in Bucks County.

Within a soil series are one or more types, defined according to the texture of the upper part of the soil, generally to about the depth of plowing. The name of the texture to this depth, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, or clay,

[6] The reaction of the soil is its degree of acidity or alkalinity expressed mathematically as the pH value. A pH value of 7 indicates precise neutrality; higher values, alkalinity; and lower values, acidity. Indicator solutions are used to determine the reaction of the soil. The presence of lime is detected by the use of a dilute solution of hydrochloric acid.

is added to the series name to give the complete name of the soil type. For example, Montalto silt loam and Montalto stony loam are types within the Montalto series. Except for the texture of the surface soil, these types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping, and because of its specific character it is usually the unit to which agronomic data are definitely related. In comparisons of the type and phases of that type, to avoid the repetition of their complete names, the type is sometimes referred to as the normal phase.

A phase of a soil type is a variation within the type, differing from the type in some minor feature, generally external, that may be of special practical significance. Differences in relief, stoniness, and the degree of accelerated erosion may be shown as phases. For example, within the normal range of relief for a soil type some areas may be adapted to the use of machinery and the growth of cultivated crops and others may not. Even though no important differences may be apparent in the soil itself or in its capability for the growth of native vegetation throughout the range in relief, there may be important differences in respect to the growth of cultivated crops. In such an instance the more sloping parts of the soil type may be segregated on the map as a sloping or hilly phase. Similarly, some soils having differences in stoniness may be mapped as phases even though these differences are not reflected in the character of the soil or in the growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, complexes, and miscellaneous land types, in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

SOILS AND CROPS

The soils of Bucks County are characteristic of the middle Atlantic region and particularly of a section of the Piedmont Lowlands and a very limited part of the Coastal Plain. About three-fourths of the total area is included in the Piedmont and the remainder is Coastal Plain and river terraces and bottoms. The county rises in elevation from tide level on the Delaware River to 960 feet above sea level at the northern county line. The land through the central portion is characterized by a gentle gradient across the river terraces, the Coastal Plain, and the lower part of the Piedmont. It then rises in a series of seaward-facing steps. These steps or ridges are narrower and sharper in the northeast and broader toward the southwest. The valleys are deep in the northeast and shallow in the southwest.

The underlying materials of the county consist of igneous, metamorphic, and sedimentary rocks in the Piedmont, and unconsolidated sands, silts, clays, and gravels in the Coastal Plain and river terraces. The soils have been developed from the products of disintegration of the underlying rocks or unconsolidated sands, silts, clays, and gravels, modified by the vegetation and the influence of climate over a long period of time.

For convenience the soils of Bucks County will be discussed under three main headings and several subheadings: (1) Soils of the Piedmont Plateau, (2) soils of the Coastal Plain, and (3) soils of the

489603—46——2

stream terraces and bottoms. The subgroups of each area are based largely on differences in the character of parent rocks. Important differences in slope and natural drainage are brought out in the descriptions of soil types and phases.

Soils of the Piedmont Plateau are used chiefly for dairying, general farming, and poultry farming. Those of the Coastal Plain are used for the same purposes and for market gardening, and those of the stream terraces and bottoms are used for market gardening to a greater extent than the others.

In the following pages the soils [7] of Bucks County are described in detail and their agricultural relations are discussed; their location and distribution are shown on the accompanying soil map, and their acreage and proportionate extent are given in table 4.

TABLE 4.—*Acreage and proportionate extent of the soils mapped in Bucks County, Pa.*

Soil type	Acres	Percent	Soil type	Acres	Percent
Bucks silt loam	38,592	9.9	Montalto stony silt loam	448	0.1
Bucks silt loam, colluvial phase	15,872	4.1	Montalto stony silt loam, steep phase	832	.2
Bucks shaly silt loam	10,688	2.7	Watchung silt loam	9,536	2.4
Bucks-Chester silt loams	11,712	3.0	Springtown cobbly silt loam	1,856	.5
Bucks shaly silt loam, sloping phase	8,320	2.1	Springtown silt loam	1,280	.3
Penn shaly silt loam	3,968	1.0	Annandale silt loam	704	.2
Penn flaggy silt loam	5,184	1.3	Annandale silt loam, colluvial phase	384	.1
Penn shaly silt loam, sloping phase	5,120	1.3	Annandale cobbly silt loam	1,024	.3
Penn flaggy silt loam, sloping phase	6,336	1.6	Washington silt loam	1,472	.4
Penn flaggy silt loam, steep phase	5,504	1.4	Springtown silt loam, sloping phase	384	.1
Lansdale silt loam	4,992	1.3	Springtown cobbly silt loam, sloping phase	1,152	.3
Lansdale silt loam, colluvial phase	3,776	1.0	Annandale cobbly silt loam, sloping phase	1,728	.4
Steinsburg silt loam	10,112	2.6	Annandale cobbly silt loam, steep phase	1,408	.4
Steinsburg shaly silt loam	3,392	.9	Washington silt loam, sloping phase	768	.2
Steinsburg shaly silt loam, sloping phase	5,696	1.4	Rough stony land (Penn soil material)	704	.2
Lehigh silty clay loam	6,528	1.7	Rough stony land (Chalfont and Lehigh soil materials)	1,024	.3
Chester silt loam	16,000	4.1	Rough stony land (Montalto soil material)	3,520	.9
Chester silt loam, shallow phase	6,592	1.7	Sassafras silt loam	12,544	3.2
Neshaminy silt loam	1,664	.4	Sassafras silt loam, sloping phase	1,472	.4
Manor silt loam, gently sloping phase	1,024	.3	Sassafras loam	1,728	.4
Edgemont channery loam	4,608	1.2	Sassafras loam, sloping phase	256	.1
Chester silt loam, sloping phase	4,288	1.1	Woodstown silt loam	4,800	1.2
Brandywine silt loam	448	.1	Fallsington silt loam	640	.2
Manor silt loam	1,280	.3	Elkton silt loam	4,544	1.2
Neshaminy silt loam, sloping phase	128	(1)	Chenango silt loam	192	(1)
Edgemont channery loam, sloping phase	1,536	.4	Chenango gravelly loam	832	.2
Buckingham cobbly silt loam	448	.1	Chenango gravelly sandy loam	128	(1)
Buckingham cobbly silt loam, sloping phase	1,088	.3	Chenango gravelly loamy sand	1,216	.3
Buckingham cobbly silt loam, steep phase	1,216	.3	Unadilla silt loam	6,400	1.6
Califon silt loam	9,728	2.5	Elsinboro loamy fine sand	6,208	1.6
Duffield silt loam	2,816	.7	Elsinboro loamy sand	320	.1
Duffield silt loam, shallow phase	448	.1	Braceville silt loam	2,240	.6
Duffield silt loam, sloping phase	704	.2	Tioga silt loam	3,136	.8
Chalfont silt loam	20,800	5.3	Tioga loamy fine sand	3,200	.8
Chalfont flaggy silt loam	4,672	1.2	Bermudian silt loam	3,904	1.0
Doylestown silt loam	5,376	1.4	Codorus silty clay loam	2,240	.6
Greer silt loam	5,248	1.3	Bowmansville silt loam	7,680	2.0
Chalfont silt loam, sloping phase	1,536	.4	Wehadkee silty clay loam	7,424	1.9
Chalfont flaggy silt loam, sloping phase	4,928	1.3	Melvin silty clay loam	1,344	.3
Captina silt loam	1,472	.4	Alluvial soils, undifferentiated	14,528	3.7
Montalto silt loam	12,224	3.1	Tidal marsh	1,088	.3
Montalto silt loam, sloping phase	1,792	.5	Marsh	1,792	.5
Montalto cobbly silt loam	1,472	.4			
Montalto stony loam	8,960	2.3	Total	390,400	100.0
Montalto stony loam, sloping phase	4,032	1.0			

[1] Less than one-tenth of 1 percent.

[7] When a soil type is subdivided into phases, that part of the type that bears no phase name is referred to as the normal phase of the type.

SOILS OF THE PIEDMONT PLATEAU

Many different soil types and phases occur on the undulating to rolling Piedmont Plateau in Bucks County. Differences in soils are due partly to the different kinds of rocks from which the soils have been formed, partly to differences in the natural drainage, which is dependent largely on the slope gradient and the degree of permeability of the parent rocks, and partly to the length of time during which soil-forming processes have been at work. The soils of the Piedmont are discussed in relation to these various factors.

SOILS DEVELOPED FROM INDIAN-RED SHALES AND SANDSTONES

The Bucks and Penn soils compose the subgroup of soils developed from Indian-red shales and sandstones. They are extensive in the central, north-central, and northeastern parts of the county but do not form a continuous area, as they are interspersed with other soils in irregular northeast and southwest belts.

The surface relief of the soils of this group varies from almost level to steep. In undisturbed situations where the soils are covered with trees and brush the surface is usually covered with a thin layer of dead leaves and other forest debris. This layer rests upon partly or completely decomposed forest litter, usually intimately mixed with the inorganic material of the surface soil, giving it a dark brownish-gray color. Most of this dark color disappears with long-continued cultivation. With the exception of wood lots, areas along watercourses, and the steeper valley slopes, most of the timber and brush has been removed from these soils. The Bucks and Penn soils range from strong to medium acid in reaction.

Bucks silt loam.—This is the most extensive soil in the county and has a total area of 60.3 square miles. It is extensive in the vicinities of Wrightstown, Blooming Glen, Telford, Perkasie, Quakertown, Richlandtown, Wormansville, and Pipersville and in numerous other places throughout the central and north-central part of the county.

The surface relief of Bucks silt loam ranges from almost level to slightly undulating, and the soil has good surface and internal drainage. It has been developed from the products of disintegration of the underlying shales modified by the vegetation and the influence of climate for a long period of time. The Bucks soils are deeper and are developed from more strongly weathered material than the Penn soils, but they have a greater moisture-holding capacity and are more productive with good management. With the exception of occasional wood lots, most of the timber and brush has been removed. Around nearly every farm home, however, are some fruit, shade, and ornamental trees and shrubbery. In addition there are a few trees along fence lines, and many trees have been planted for windbreaks.

The surface soil of cultivated areas of Bucks silt loam consists of a pale-brown, pinkish-brown, or light reddish-brown mellow silt loam to a depth ranging from 8 to 12 inches, where it grades into yellowish-brown, light pinkish-brown, or reddish-brown friable silty clay loam. In most places between 15 and 20 inches in depth this layer grades into a more compact silty clay of a light Indian-red color. At depths ranging from 24 to 40 inches the silty clay layer gives way to the underlying brown or Indian-red shale or fine-grained sandstone or fragmentary shale intermixed with brown silt loam.

Bucks silt loam is strongly acid. Determinations of pH values [8] made in the field ranged from 5.0 to 5.5. The soil has a fair supply of organic matter. In undisturbed spots there is a considerable concentration of roots, particularly in the surface layer.

A few small areas of Bucks loam have been included with the silt loam. These areas are west and northwest of New Hope and north of Bowman Hill and have a total area of less than 2 square miles. Except for the lighter texture this included soil is similar to Bucks silt loam.

A few spots of Bucks silt loam, sloping phase, are also shown on the soil map as Bucks silt loam. The total area of this included phase is less than 1 square mile, and most of it is located 2 miles west of Newtown. These spots occur on moderately strong slopes, and the soil profile is generally shallower. The areas are more subject to erosion and somewhat less productive than normal Bucks silt loam.

Bucks silt loam is used generally for the production of corn, wheat, oats, rye, barley, and hay, supplemented by garden vegetables and fruit. Potatoes are an important garden crop, and a few farmers specialize in their production for market. The relative percentages of the area occupied by the principal crops are approximately as follows: Corn, 28 percent; wheat, 18; oats, 12; and potatoes, 7. The remainder of the cultivated lands are in hay and pasture. This soil is generally recognized as very productive when well managed. The greater part of it is used for farming purposes, and under normal conditions crop yields are high. It is one of the moderately deep soils of the county and is not so readily affected by short periods of drought as the Penn soils. The reported acre yields of corn average about 50 bushels; of oats, 50; wheat, 35; rye, 20; barley, 40 bushels; legume hay, 1½ to 2 tons; and timothy and clover, 1½ to 2½ tons. The general range of average potato yields is from 175 to 200 bushels. Two growers who specialize in growing the Russet variety of potatoes have produced as much as 629 and 609 bushels to the acre, respectively. Likewise in good seasons and with special management, corn may yield 80 bushels or higher, oats 60, wheat 45, and barley 70.

Bucks silt loam is used generally for dairying and general farming, for which it is well suited. Dairy farming is the dominant interest. The proximity of the areas to large centers of population, however, has brought about some diversification. Poultry farming is an important side line; vegetables and fruits are in greater demand; and there is a prospect of a wider range in the character of the crops grown on this soil type. The common rotations on the dairy farm are corn, wheat, and clover, or corn, oats, wheat, and clover. Manure is generally applied to corn ground prior to planting. Liming is a common practice, and the lime is usually applied prior to the seeding of the hay crop, at the rate of 500 to 1,000 pounds of ground limestone or hydrated lime to the acre. Superphosphate is used for corn and the small grains to supplement the lime and manure at various rates ranging from 150 to 500 pounds an acre. Potatoes commonly receive 1,000 to 2,000 pounds of a complete fertilizer.

Bucks silt loam, colluvial phase.—This phase is one of the major soils of the county and has an aggregate area of 24.8 square miles. It is everywhere associated with the Bucks and Penn soils. It is exten-

[8] Tests were made with Morgan indicator dyes.

sive in rather small areas throughout the central and eastern part of the area and particularly in spots along Neshaminy Creek and its branches, Deer Run and other tributaries of Tohickon Creek, southern tributaries of the east branch of the Perkiomen Creek, and in many other places near the heads of streams or along the small streams that drain the Penn and Bucks soils. The areas occupy benchlike positions above stream alluvium and generally have a slight slope toward the watercourses, or they occur in slight depressions near the heads of streams. Surface drainage is good, but the lower part of the subsoil is imperfectly drained, owing in some measure to water that seeps out from the underlying or adjacent rocks. This soil has a good average supply of organic matter. In undisturbed situations roots are abundant in the surface soil and more scattered in the subsoil.

The parent material is of the same origin as that of the Penn and Bucks soils in general, but in addition it is composed in part of colluvial material washed from adjacent higher land. Most of the land of this phase is open and clear of timber and brush except for a few trees near home sites and along fence lines and drainageways.

The surface soil of this phase consists of a pale-brown or light reddish-brown mellow silt loam 8 to 12 inches thick. This passes gradually into a lighter colored layer, which varies from light pinkish brown to light reddish brown in color and from silty clay loam to silty clay in texture. At depths between 20 inches and 30 inches this layer usually passes into a more compact silty clay loam of pale-brown color mottled with gray, yellow, and reddish brown; and this extends to depths usually between 3 and 4 feet, where it rests upon fragmentary or bedded Indian-red or brownish-red shales and fine-grained sandstone.

The soil is strongly acid. The pH determinations in the field ranged from 5.0 to 5.5.

Where farmed, this soil is used for the production of corn, wheat, oats, hay or forage, and pasturage. The reported yields of corn range from 40 to 75 bushels and average about 50 bushels to the acre; those of wheat range from 20 to 40 bushels and average about 35; oats average about 50 bushels, and hay averages about 2 tons. Bucks silt loam, colluvial phase, is generally recognized as being very productive under favorable conditions. The best yields are said to be obtained in dry years, and crops on this land are among the last to be affected by protracted dry spells.

Bucks shaly silt loam.—This soil type occupies slightly undulating surfaces or slight knolls and low ridges and is usually associated with Bucks silt loam. The slope gradient in general is favorable for the use of all kinds of labor-saving machinery. The origin of the parent material is the same as for the other Bucks and Penn soils. The soil has good surface and subsoil drainage; in fact, it is somewhat droughty.

Bucks shaly silt loam occupies a total area of 16.7 square miles. It is widely distributed in the central and eastern parts of the county, particularly in the vicinities of Blooming Glen, Headquarters, Hagersville, Sellersville, Telford, New Hope, Bedminster, and Line Lexington.

The surface soil to a depth of 8 or 12 inches consists of weak-brown or yellowish-brown silt loam that contains many small angular shale fragments. It rests upon lighter colored but slightly more compact

material of the same texture, which at a depth of 15 to 24 inches passes into brownish-red or Indian-red shales or fragmentary shales intermixed with light-brown or yellowish-brown silt loam. Over the surface and throughout the soil section is a conspicuous quantity of small angular chips or fragments of brown or yellowish-brown shale. The color of these fragments is always lighter and more dingy than that of the underlying rock. This change is probably due to long-continued weathering of the surface layers. In local places throughout the areas of this type there is a pinkish-brown light silty clay loam subsoil, rarely over 3 inches thick.

Bucks shaly silt loam is strongly acid. Recorded pH determinations in the field were between 5.0 and 5.5. This soil generally does not have as much organic matter as Bucks silt loam except in fields used as permanent pastures and in undisturbed local spots. Roots are abundant in some locations in the surface soil and are more scattered in subsurface layers. The small chips of shale on the surface and throughout the soil section are too small to interfere with cultivation and are said by farmers to have little effect on farm tools.

Bucks shaly silt loam is generally used for the same crops as Bucks silt loam, with the exception that rye sometimes replaces wheat in the crop rotation. It is not considered so productive nor so dependable as the silt loam, as the crops frequently suffer during dry spells. The reported yields of corn average about 40 bushels, of wheat about 20 bushels, of oats about 40 bushels, and of hay about 1 ton to the acre.

Bucks shaly silt loam, sloping phase.—This phase is not essentially different from the normal phase of Bucks shaly silt loam in profile features. The principal differences are in its greater slope gradient and in its generally shallower depth. It occupies valley slopes, and where cultivated it is subject to erosion. In general, however, the relief is not too steep for the areas to be cropped, and slopes average generally less than 7 percent. This phase has the same general reaction and about the same amount of organic matter as the normal soil.

The sloping phase of Bucks shaly silt loam has a total area of 13 square miles. It is located near Woodhill, along the slopes of Jericho Creek, near Sellersville, Perkasie, Blooming Glen, and Bedminster, and in other places throughout the central part of the county.

A few small areas of Bucks shaly silt loam, steep phase, that are too small to show on the soil map have been included with this phase. These inclusions amount to about three-fourths of a square mile and occur in spots along the steep slopes of the east branch of Perkiomen Creek southeast of Naceville and also along the east branch of Pleasant Spring Creek southeast of Perkasie. These included areas are too steep for agricultural use, and they are subject to serious erosion if cultivated. In places the underlying shale has been exposed by erosion.

Only about one-half of Bucks shaly silt loam, sloping phase, is used for cultivated crops. Much of it is used for pasture or is turned out for reforestation. In a few places it has been planted to evergreens. When cultivated it is used for the same crops as Bucks shaly silt loam, but it is less productive and crops are more uncertain, especially in dry seasons. The yields of corn average about 30 bushels, of wheat about 15 bushels, of oats about 35 bushels, and of hay about three-quarters of a ton to the acre.

Bucks-Chester silt loams.—Areas given this designation on the map represent small bodies of Bucks and Chester silt loams so intimately mixed that separations of these types could not be made on a map of the scale used in this survey. The surface soils are mellow silt loams that are definitely pinkish brown on the one extreme and yellowish brown or pale brown on the other. At a depth of about 10 inches the surface soils grade into lighter colored subsoils of light silty clay texture, which extend to depths of 24 inches or more and rest on compact silt loams. Details of the profiles may be obtained from the sections dealing with Bucks silt loam and Chester silt loam.

Where there is a definite Bucks profile, the underlying Indian-red or brownish-red shales are conspicuous at depths ranging from about 2 to 3½ feet. In the Chester profiles the soil section is much deeper and the parent rocks are not commonly seen, but mica is conspicuous. This is especially the case in those sections where the Chester soils are derived from certain gneisses. A somewhat different condition occurs in the central part of the county where Bucks silt loam is intimately associated and mixed with the shallow phase of Chester silt loam in the vicinity of New Britain, Doylestown, east and southwest of Carversville, and northeast of Landisville. This complex has a total area of 18.3 square miles.

The soils of this complex are strongly acid. Recorded pH determinations in the field were between 5.0 and 5.6. The soils of this complex have a good average supply of organic matter. In undisturbed situations roots are abundant in the surface and more scattered in the subsoil.

Probably about three-fourths of the total area of the Bucks-Chester silt loams is open and clear of trees and brush. The trees noted consist of maple, various oaks, elm, beech, poplar, cherry, dogwood, and sassafras. Where the land is utilized for agricultural purposes, the principal crops grown are corn, wheat, oats, potatoes, mixed hay, or alfalfa, supplemented by garden vegetables and fruits. Corn occupies about 26 percent of the cropland, wheat 20, oats 10, and potatoes 6, and the remainder is in hay and pasture. The reported approximate average acre yields are as follows: Corn, 50 bushels; wheat, 35 bushels; oats, 50 bushels; potatoes, 200 bushels; hay, 2 tons; and alfalfa, 2 tons. All common kinds of fruits and vegetables do well on this soil.

Most farmers spray the fruit trees, potatoes, cabbage, and beans to control insects and plant diseases. Some commercial fertilizer and lime are used on wheat ground, but manure is the principal fertilizer. This land in general is used for dairying and general farming. In some instances poultry and poultry products are important side lines.

The soils are easy to work, and crops usually get an early start and mature early. The surface features are such that crops can be produced economically by using labor-saving machinery. The deep soils insure plenty of water for crops, and it is said to be very uncommon for crops to suffer during dry spells.

Penn shaly silt loam.—This soil occupies slight knolls and low ridges within or near the borders of Bucks silt loam. The parent materials have the same origin as those of Bucks silt loam. Surface and subsurface drainage are somewhat excessive. The total area is 6.2 square miles. The larger areas are in the vicinity of Ottsville,

Headquarters, Pleasant Valley, and Wrightstown. The surface soil consists of dull reddish-brown silt loam 8 to 10 inches deep and has a conspicuous quantity of small angular fragments or chips of Indian-red or brown shale. Underneath the surface soil is a layer of about the same texture, but it is slightly more compact and usually somewhat lighter in color. At depths ranging from 15 to 26 inches this layer rests either on fragmentary shales intermixed with brown or reddish-brown silt loam or on bedrock of the same character. In places there is a slight development of subsoil that is heavier than the surface soil but rarely exceeds a thickness of 2 inches. This soil is strongly acid (pH 5.0 to 5.5). There is generally not so much organic matter in this soil as in the Bucks silt loam except in pastures and along fence lines where grass and weeds have been growing a long time. In undisturbed situations roots are fairly abundant in the surface layer and more scattered in the subsurface layers. The small fragments or chips of shale on the surface do not interfere with cultivation and are said to have little abrasing effect on farm tools.

This soil is neither so productive nor so dependable for crops as Bucks silt loam, as crops are liable to suffer during prolonged dry spells. Yields of corn are reported to average about 40 bushels, wheat about 20 bushels, oats about 40 bushels, and hay about 1 ton to the acre. The soil is handled much the same as Bucks silt loam, but rye is frequently substituted for wheat in crop systems, as wheat yields are comparatively light on this type.

Penn shaly silt loam, sloping phase.—The profile of this phase is not essentially different from that of normal Penn shaly silt loam. The principal difference is that the sloping phase occupies inclined positions on valley slopes and is usually shallower. The position is not too steep for agricultural use, as the average grade is generally less than 7 percent.

This phase has a total area of 8 square miles. For the most part it is closely associated with other Penn soils. It occurs near Pleasant Valley, southwest of New Hope, north and northeast of Wrightstown, near Ottsville, north of Pipersville, near Erwinna, and west of Kintnersville.

Less than half of the land is used for cultivated crops; the rest is used for pasture or is turned out for reforestation. Some local areas have been planted in evergreens. It is not so productive as the normal phase. Where cultivated it is used for the same crops, but yields are light and uncertain. Yields of corn are reported to average about 30 bushels, wheat about 15 bushels, oats about 35 bushels, and hay from ½ to 1 ton to the acre. The pastures are light, but they serve to protect the slopes from erosion.

Penn flaggy silt loam.—This soil forms slight ridges and low knolls within or near the borders of the other Penn soils. It has good surface and subsurface drainage but is somewhat droughty. It is derived from parent material similar to that of the other Penn soils. The total area is 8.1 square miles, and the larger areas are north of Erwinna, west and southwest of Ferndale, southwest of Pleasant Valley, and east of Dolington.

The surface soil consists of a brownish-red, Indian-red, or pale-brown silt loam, 8 to 12 inches deep. This is underlain by a more compact layer of the same texture, which, usually between depths of

15 and 24 inches, rests upon Indian-red shale or fragmentary shale intermixed with brownish-red silt loam. In places there is a somewhat heavier subsoil than usual—a thin layer of light silty clay loam, rarely more than 2 inches thick. Over the surface and throughout the soil are many book-shaped or flaggy angular fragments of Indian-red or brownish-red shale from 1½ to 4 inches in diameter and from ½ to 1½ inches thick. These fragments do not interfere seriously with cultivation but are said to be injurious to farm tools. This soil for the most part is strongly acid. It has a good average supply of organic matter, especially in undisturbed situations. Roots are abundant.

Included with Penn flaggy silt loam are a few small areas, totaling about 1½ square miles, near Pleasant Valley, having a soil profile similar to that of Bucks silt loam, but covered with a conspicuous quantity of rounded pinkish-stained quartzite cobblestones ranging from 2 to 5 inches in diameter. This material is characteristic of Springtown gravelly silt loam and has been deposited on the Penn silt loam from higher positions. These spots are more productive than Penn flaggy silt loam and have about the same agricultural value as Bucks silt loam.

Penn flaggy silt loam is used for the same crops as Bucks silt loam but is less productive. Rye frequently replaces wheat on this soil, as wheat yields are comparatively small. The yields of corn are reported to average about 30 bushels, of wheat about 15 bushels, of oats about 35 bushels, and of hay about 1 ton to the acre.

Penn flaggy silt loam, sloping phase.—The only essential difference between this phase and normal Penn flaggy silt loam is that the sloping phase occurs on slopes with gradients up to 7 percent. The total area is 9.9 square miles. Small areas are 1¼ miles northwest of Erwinna, one-half mile west of Uhlerstown, south of Lumberville, and near Trauger School, Kintnersville, and Headquarters, and a mile north of Hartsville. The drainage is somewhat excessive, and crops sometimes suffer during protracted spells of dry weather. About half of this land is under cultivation; the rest is used for pasture or is turned out for reforestation. Where cultivated it is used for the same crops as the normal soil, but it is not so productive. Yields of corn average about 30 bushels, wheat about 15 bushels, oats about 35 bushels, and hay from ½ to 1 ton to the acre.

Penn flaggy silt loam, steep phase.—This steep phase occurs principally in the northeastern part of the county, particularly along the bluffs of the Delaware River and some of the larger tributary streams. Some of the larger areas are west of Uhlerstown, Resolution Island, and Grenoble and near Kintnersville, Lumberville, Perkasie, Ferndale, Naceville, and Headquarters. Little or none of this land is under cultivation, and most of it is covered with trees and brush, the trees consisting of various oaks, maple, hickory, ash, elm, sassafras, dogwood, and beech. The total area is 8.6 square miles.

The surface soil consists of dark-brown, pale-brown, or Indian-red silt loam 6 to 12 inches deep. This is usually underlain by a layer slightly more compact but of lighter color. This subsoil layer is variable in thickness but rarely more than 10 inches thick. It rests on dark-brown or Indian-red silt loam intermixed with fragmentary or bedded Indian-red shale. Over the surface and throughout the

soil profile is a conspicuous quantity of angular flaggy fragments of Indian-red or brown shale ranging from 2 to 4 inches in diameter and from ½ to 2 inches thick. The soil mantle varies considerably in total thickness. In many places erosion has partly or completely removed the soil, exposing the underlying rocks.

This phase is strongly acid (pH 5.0 to 5.5). Much of the surface is covered with forest debris from brush and trees. The surface soil in undisturbed situations has more organic matter than other members of the Penn series, and roots are abundant.

SOILS DEVELOPED FROM GRAY AND YELLOW SHALES AND SANDSTONES

Most of the soils of the subgroup developed from gray and yellow shales and sandstones are in the south-central part of the county, but Lehigh silty clay loam is associated with the Montalto soils in the north-central part. The surface relief varies from the gently undulating slopes of the deeper soils to the steep slopes of some of the shallow soils.

The Lansdale soils are medium deep, well drained, and gently to moderately sloping; the Steinsburg soils are shallow, well drained, and gently to strongly sloping; and the Lehigh soil is shallow, imperfectly drained, and gently to moderately sloping.

Lansdale silt loam.—This is one of the important soils of Bucks County. It is restricted in general to the south-central part. The total area is 7.8 square miles. The larger areas are in the vicinity of Jamison, 1½ miles east of Grenoble, in the vicinity of Dolington and Stoopville, south, northeast, and southeast of Rushland, east of Edison, and northeast of Newtown. The relief ranges from undulating to slightly rolling, and the soil has good surface and subsurface drainage. The underlying rocks are mostly gray, yellow, and brown acid shales, although some very fine-grained sandstones and argillites are included.

The surface soil consists of mellow brownish-gray silt loam 10 to 15 inches deep and passes gradually into light friable silty clay loam subsoil of yellowish-brown color. This subsoil extends to a depth of between 24 and 36 inches, where it becomes lighter in texture and generally consists of pale-brown silt loam intermixed with fragmentary and bedded shale. There is more or less streaking and splotching of gray, yellow, and brown near the base of the soil profile. This feature generally is not attributable to poor drainage but to differences in color of the underlying shale fragments, which vary from light gray to yellow, brown, or in some places almost black.

The general depth of Lansdale silt loam is about 40 inches. It is characterized by greater uniformity in this respect than the associated Steinsburg silt loam. The soil is strongly acid (pH 5.0 to 5.5). There is a fair supply of organic matter. In undisturbed places roots are abundant in the surface layer.

Most of the land is open and clear, though there are some small scattered patches of timber and brush or small wood lots. Most of the wood lots consist of a mixed growth of maple and red, white, and black oaks, with some dogwood and hickory. Probably more than 75 percent of the total area of this soil is used for farming, mostly dairying and general farming, and it is well adapted to this kind of agriculture. The principal crops are corn, wheat, oats, potatoes, and

hay, supplemented by garden vegetables and fruit. Corn occupies about 25 percent of the cropland, wheat 20, oats 10, and potatoes 5 percent and the rest is in hay, forage, and pasture. Under good management approximately the following acre yields are reported: Corn, 50 bushels; wheat, 35 bushels; oats, 50 bushels; potatoes, 175 bushels; and hay, 2 tons. Lansdale silt loam is generally recognized as one of the strong, dependable soils of the county; however, it is neither so deep nor generally so productive as Chester silt loam.

Management practices include liming before seeding the hay crop in the common rotations of corn, wheat, and clover, or corn, oats, wheat, and clover. Manure is commonly applied to the corn ground prior to planting. Corn and small grains are also fertilized with 150 to 250 pounds of 20-percent superphosphate. Where manure is not available, complete fertilizers, such as 4–12–4 or 4–16–4, are commonly used. Heavy applications ranging from 500 to 2,000 pounds of complete fertilizers of various ratios are used for truck crops. In general, farming practices are similar to those on the Bucks soils.

Lansdale silt loam, colluvial phase.—This is one of the minor soils of the county and occupies a total area of 5.9 square miles. It occurs in spots near Neshaminy Creek, north of Traymore, south of Rushland, a mile south and southeast of Dolington, north and southwest of Stoopville, and in other places throughout the central part of the county. It occupies benchlike positions above stream bottom lands, or it occurs in slight depressions near the heads of streams. Surface drainage is usually good, as the areas have a slight slope in general toward the watercourses; but the lower part of the subsoil is imperfectly drained, because of water that seeps out from the underlying or adjacent rocks. The parent material is of the same origin as that of the normal phase, but in addition it represents in part some outwash or colluvial material derived from higher levels.

The surface soil consists of pale-brown silt loam 8 to 12 inches deep, which passes gradually into yellowish-brown light silty clay loam. This subsoil extends to a depth of 15 to 24 inches and passes rather abruptly into slightly compact silty clay loam of the same general color except for a faint mottling of gray and brown. Between 30 and 48 inches the mottling is more conspicuous and the silty clay loam is intermixed with fragmentary and bedded shale.

The soil is strongly acid. It has a good average supply of organic matter. Roots are abundant in the surface layer, particularly in undisturbed situations.

Most of the land is clear of trees and brush except for a few small wood lots and the presence of shade and ornamental trees near home sites. The greater part is used for the production of corn, wheat, oats, hay, and pasture. Corn occupies about 28 percent of the cropland, wheat 15, oats 10, and hay or forage 30 percent. Yields average about as follows: Corn, 50 bushels; wheat, 35 bushels; oats, 50 bushels; and mixed hay, 2½ tons to the acre. This is generally recognized as a strong soil for the production of grass and small grains. The best yields are said to be obtained in dry years, and the crops on this soil are among the last to be affected by dry weather.

Steinsburg silt loam.—The essential difference between Steinsburg and Lansdale silt loams is the general shallowness of the entire soil

profile of the Steinsburg. The surface relief of this soil ranges from slightly to gently rolling. Surface and subsurface drainage are good. The parent rocks belong to the same general geological formation as those of Lansdale silt loam, and they are generally similar in their range of characteristics, but there appears to be a greater proportion of argillites than is common to the Lansdale soil.

Steinsburg silt loam has a total area of 15.8 square miles. Bodies occur in the vicinity of Chalfont, east of Tradesville, near Line Lexington and Mount Pleasant, 2½ miles south of Bedminster, 1 mile northwest of Quakertown, and in other places throughout the central part of the county.

The surface soil consists of light-brown or yellowish-brown silt loam 6 to 12 inches deep. This passes gradually into a transitional horizon of somewhat compact pale yellowish-brown heavy silt loam or light silty clay loam. This layer is variable in thickness, ranging from ½ to about 2 inches, and gives way abruptly to splotched and streaked yellow, gray, or brown rather compact silty clay loam. Usually between depths of 20 and 24 inches this material is underlain by a lighter textured layer of the same colors, intermixed with fragmentary and bedded shales and argillites.

Like the Bucks, Penn, and Lansdale soils, the Steinsburg soils are strongly acid. Most of the Steinsburg silt loam does not have as much organic matter as the Lansdale silt loam. In undisturbed positions there is some concentration of plant roots in the surface layer, but below they are more scattered.

Probably not more than half of Steinsburg silt loam is cleared. A good proportion is kept in pasture. The rest supports a mixed growth of trees and brush including various oaks, maple, hickory, sassafras, and dogwood. Where cultivated it is used for the same crops as Lansdale silt loam, but it is less productive and less certain to produce good yields. Reported yields range about as follows: Corn, 30 to 45 bushels; wheat, 15 to 25 bushels; oats, 30 to 40 bushels; potatoes, 75 to 150 bushels; and hay or forage, 1 to 2 tons to the acre. Because of the moderate slope, the land is subject to some erosion, and this is reflected in the occurrence of local spots where the heavy subsoil is exposed at the surface. Pasturing the land instead of cultivating it helps to protect it from erosion.

Steinsburg shaly silt loam.—This soil generally occupies slight knolls and ridges in gently rolling country. It has good to excessive surface and subsurface drainage. The origin of the parent material is the same as that of Lansdale silt loam. The total area is only 5.3 square miles. The larger areas are 1 mile north of Line Lexington, three-quarters of a mile northwest of Dark Hollow, and half a mile east and 1 mile north of Bridge Valley.

The surface soil consists of pale-brown, yellowish-brown, or yellowish-gray silt loam, 8 to 15 inches deep, which rests on a lighter colored horizon of slightly more compact material of the same texture. Between a depth of 15 and 24 inches this material passes into pale-yellow or pale-brown silt loam intermixed with fragmentary or bedded gray, yellowish-brown, or light-brown shales and occasional argillites. The color of the lower layer is not uniform, but in general it is streaked or splotched with gray, yellow, and brown.

Over the surface and throughout the soil profile is a conspicuous quantity of small angular chips or fragments of stained shale that are generally yellowish or yellowish brown in color. Most of these fragments are thin and rarely more than 1 inch across. The small chips of shale on the surface do not interfere seriously with cultivation and are said to have little effect on farm tools. The soil is strongly acid (pH 5.0 to 5.5). It does not have as much organic matter as Lansdale silt loam except in fields kept in permanent pastures.

Steinsburg shaly silt loam as shown on the map includes a similar soil in which there is a conspicuous quantity of angular flaggy fragments of shale and argillite ranging in size from 1½ to 4 inches in diameter and from ½ to 1½ inches thick. The color of these fragments is generally grayish yellow, but some of them range from almost gray to brown. The total area of this variation is about 1 square mile. It is located about half a mile southwest of Steinsburg, three-quarters of a mile northwest of Grenoble, and 1 and 2 miles southeast of Penns Park. The presence of flaggy pieces of shale on the surface is said not to interfere seriously with cultivation but to be injurious to farm tools.

Steinsburg shaly silt loam is used for the same crops as Lansdale silt loam, with the exception that rye sometimes replaces wheat in crop rotations. It is not considered as productive nor as dependable as Lansdale silt loam, as crops frequently suffer during prolonged dry spells. Reported yields of corn range from 20 to 35 bushels, wheat from 10 to 20 bushels, oats from 15 to 30 bushels, and hay from ½ to 1 ton to the acre.

Steinsburg shaly silt loam, sloping phase.—This phase is essentially the same as the normal Steinsburg shaly silt loam with the exceptions that the total thickness of the soil profile is generally less and that it occupies positions on valley slopes where the gradient averages almost 7 percent. Small areas of Steinsburg shaly silt loam, steep phase, and Steinsburg flaggy silt loam are also included with this phase, as it was not practicable to show them separately on the soil map. The former occurs 1¾ miles northeast of Grenoble and is covered with brush and the slope is too steep for cultivation. The latter occurs on the bluffs on the south side of Neshaminy Creek near Dark Hollow.

Steinsburg shaly silt loam, sloping phase, has a total area of 8.9 square miles. It is usually associated with other Steinsburg and Lansdale soils. The larger areas are 1¼ miles northwest of Line Lexington, 2 miles northeast of Grenoble, on slopes along Neshaminy Creek, in the vicinity of Rushland, 1½ miles southeast of Bridge Valley, three-quarters of a mile northwest of Bridge Valley, and 2 miles northeast of Dolington.

Generally this phase is not too steep for cultivation. It will average less than a 7-percent grade. The land is susceptible to erosion, however, and for this reason much of it is used as pasture. Only about one-half of it is used for cultivated crops, similar to those grown on Lansdale silt loam. The rest supports a growth of hardwoods or is used for pasture. The reported yields of corn range from 10 to 25 bushels, of wheat from 5 to 15 bushels, of oats from 10 to 25 bushels, and of hay or forage from ½ to 1 ton to the acre.

Lehigh silty clay loam.—This soil occupies flat to gently rolling country. Drainage in the surface soil is only fair, and in the subsur face layers it is imperfect. The mottling, streaking, and splotching in the subsoil cannot all be attributed to poor drainage, as much of it represents variations in the color of the fragments of parent rock. The underlying rocks consist of shales and argillites that have been baked to a slatelike structure and color by intrusions of molten lava. The total area is 10.2 square miles. Most of it occurs in the north-central part of the county, and it is usually associated with the Montalto soils.

Most of the land is clear of trees and brush with the exception of small wood lots and a few trees near home sites and along fence lines. Most of the trees are various oaks, hickory, maple, elm, cedar, locust, and spruce.

The surface soil of normal Lehigh silty clay loam consists of gray, bluish-gray, or dark-gray light silty clay loam to a depth of 6 to 10 inches, where it passes gradually into a mottled silty clay loam of yellow, brown, gray, and purplish-gray colors. Below 12 to 16 inches this material rests rather abruptly upon a compact, slightly indurated heavy silty clay that is slightly darker than the layer above and is mottled, streaked, and splotched with yellow, gray, brown, and purplish gray. Generally below 24 inches this layer passes into a compact silt loam intermixed with dark-gray partly weathered thinly laminated shale and slate rock.

Over the surface and throughout the soil profile is a scattering of very small shale chips of various colors. In most places these are not concentrated thickly enough to designate the type as shaly, but they are fairly characteristic of the surface. The more shaly areas are commonly steeper and often have been left in timber or brush. The entire soil profile rarely exceeds a depth of 3 feet.

The soil ranges from slightly acid to slightly alkaline. There is only a fair supply of organic matter. In undisturbed situations roots are abundant in the surface soil but more scattered in the subsoil.

Most of the land is used for the production of corn, wheat, oats, potatoes, and mixed hay and pasture plants. Corn occupies about 35 percent of the cropland, wheat 11, oats 6, potatoes 3, and hay 25 percent. The yields of corn average about 35 bushels, of wheat about 18 bushels, of oats about 35 bushels, of potatoes 150 bushels, and of hay about 1½ tons to the acre. The best yields are said to be obtained in dry years. Crops are usually planted later and mature later than on the Penn and Bucks soils. The soil is rather difficult to handle. If plowed when it is too wet it does not scour readily from the plow, and if plowed too dry it breaks into large clods. The pastures are productive and are said to persist for long periods.

About one-fourth of the soil shown on the map as Lehigh silty clay loam is more poorly drained than the rest. The surface soil of areas in this wetter condition to a depth of 6 to 10 inches consists of gray to dark-gray light silty clay loam with faint mottles of brown or dark brown. This passes gradually into yellow or brownish-yellow silty clay conspicuously mottled with brown, purplish gray, and gray. Generally below 20 inches this layer rests upon compact slightly indurated grayish-yellow heavy silty clay mottled with brown and dark gray. This horizon is generally lighter in color than the one above and persists to depths between 2½ and 3 feet, where it

is intermixed with bluish-gray, purplish-gray, and brown fragmentary shale or slate or bedrock of the same colors.

The total area of this variation is about 4 square miles. Most of it is in the north-central part of the county and occurs 1 mile west of Applebachsville, 1 mile northeast of California, 1 mile southeast of Richlandtown, three-eighths mile south of Trumbauersville, 1½ miles southeast of Spinnerstown, and near Haycock Creek 1 mile west of Bucksville. It occupies level to slightly undulating areas along bottom lands, or slight depressions near the heads of streams. In general it may be considered to be poorly drained. It is not always wet, however, but seems to be alternately wet and dry, depending in great measure on the character of the seasons. The origin of parent material is similar to that of other Lehigh soils, but in addition there is some outwash and colluvial material derived from the soils located at higher levels.

Most of the land is cleared of brush and trees, but little of it is used for cultivated crops. In the better drained spots a few patches of corn and hay were seen. In general this wet phase is used for pasture, and farmers state that it is a strong soil for this purpose.

As mapped, Lehigh silty clay loam includes a flaggy variation, which is essentially the same as the normal soil except that over the surface and throughout the surface layer there is a conspicuous quantity of variously colored gravel consisting principally of flaggy shale and slate with some fragments of trap or diabase rock. These fragments range in size from about 2 to 4 inches. They are quite variable in character, and many of them came from adjacent and usually higher lying lands, especially those occupied by the Montalto soils. One area, 1 mile east of Chestnut Ridge School, has a slope of about 7 percent. The total area of this variation is about 2¼ square miles. Bodies are located half a mile northeast and three-fourths of a mile southeast of Ferndale; northeast of Chestnut Ridge School and a quarter of a mile northeast of Union School; west and 1 mile northwest of Trumbauersville; 2 miles southwest of Kellers Church and ½ mile south of New Hope. The relief is undulating to slightly rolling. The surface drainage is fair, but the subsurface drainage is imperfect. About half of this land is clear of trees and brush. Where it is utilized the principal crops grown are corn, wheat, oats, and hay or forage. Crop yields are less than on the more representative areas of Lehigh silty clay loam.

SOILS DEVELOPED FROM GNEISSES, ARKOSES, QUARTZITES, CONGLOMERATES, AND SCHISTS

The gneisses and schists of Bucks County are very old crystalline rocks composed chiefly of feldspars, quartz, and micas, with minor proportions of many other minerals. In both gneisses and schists the minerals are distributed in thin bands, the chief difference being that the mineral grains in the gneisses are coarse and each band is dominantly of one kind of mineral. The finer crystal grains of the schist are more or less thoroughly mixed. Even to the geologist who is accustomed to think of time in terms of millions of years, the gneisses and schists of Bucks County are very old.

The arkoses are sedimentary (stratified) sandstone rocks, the grains of which are a mixture of the same minerals that make up the gneisses and schists. In Bucks County the arkose rocks were deposited as

outwash materials from the area of gneiss and schist during the Triassic geological period—a very long time ago indeed, but much more recent than the period when the gneisses and schists were formed.

The quartzites and conglomerates (pudding stone) are made up principally of quartz.

The Chester, Neshaminy, Califon, and Brandywine soils are developed most typically from gneiss, but they were also mapped where the parent rock is arkose, and also where layers of schist and gneiss alternate. Many large areas of the Chester and Califon soils in Bucks County are developed from arkose. Manor soils are developed from mica schist. Buckingham and Edgemont soils are developed from quartzite and quartzite conglomerate.

Chester silt loam.—This soil has been developed from the products of disintegration of the underlying rocks, chiefly gneisses and arkose, modified by vegetation and climate for a long period of time. The relief ranges from undulating to gently rolling. The soil has good natural surface and subsoil drainage, and it is so deep and has such good moisture-absorbing and moisture-holding capacities that it is one of the last soils of the county on which crops are affected by dry weather. Most of the land is cleared of trees and brush, but a number of small wood lots are scattered throughout its extent and a few shade and ornamental trees are concentrated near home sites and along fence lines. The trees and brush consist principally of various oaks, hickory, beech, maple, dogwood, cherry, and sassafras. The undergrowth consists of young shoots of these trees, and goldenrod, ferns, wild carrot, blueberry, and yarrow. Many towns and villages are located on this soil, with the result that probably only about five-eighths of it is used for farming. Normal Chester silt loam is restricted to the south-central part of the county. Representative areas are in the vicinity of Southampton, Richboro, Trevose, Langborne, and south and east of Newtown. A total of 25 square miles is mapped.

The surface soil of normal Chester silt loam consists of pale-brown to brown mellow silt loam 8 to 12 inches thick. This passes gradually into yellowish-brown friable light silty clay loam, which, between depths of 20 and 30 inches, becomes heavier in texture and slightly more compact without appreciable change in color. This layer usually has a thickness of about 10 inches and grades into heavy yellowish-brown silt loam. At depths of from 48 to 60 inches this material rests upon light-brown loam, gritty loam, or loamy sand, slightly to conspicuously micaceous and intermixed with fragmentary gneiss or other crystalline rocks or arkose, or rests directly upon these rocks. Occasionally there are a few small chips of gneiss or arkose and more blocky fragments of vein quartz scattered over the surface, not large enough or numerous enough to interfere with cultivation.

The general thickness of the normal Chester silt loam ranges from 4 to 6 feet above the underlying rocks. The soil ranges from very strongly to strongly acid. There is generally a good average supply of organic matter. In undisturbed situations roots are abundant in the surface layer and more scattered in the subsurface layers. Some tree roots pass through the soil and into the crevices of the rocks beneath.

Included with Chester silt loam is a light reddish-brown soil that is limited to less than a quarter of a square mile on the county line

west of Spinnerstown. The surface soil consists of light reddish-brown friable silt loam about 12 inches thick. The upper part of the subsoil is reddish-brown heavy silty clay loam, which extends to a depth of about 24 inches, where it rests upon grayish-red crystalline rocks that were probably baked to their present color when the adjacent diabase rocks were forced in as lava during the Triassic geological period.

Also included with the normal Chester silt loam are a few small areas of Chester sandy loam and Chester loam. The total area occupied by these two types is less than 2 square miles. The Chester sandy loam is located half a mile northeast and 1 mile southwest of Peters Corners and southwest of Mechanicsville. Chester loam occurs north of Centre Hill. These soils are used for the same crops and have about the same value as Chester silt loam.

Chester silt loam is used more completely and for a greater variety of general farm crops than the other soils of the county. The principal crops are corn, oats, wheat, rye, barley, potatoes, tomatoes, hay, forage, and pasturage, supplemented by garden vegetables and fruit. In crop rotations rye is sometimes substituted for wheat, and barley for corn. Corn occupies about 25 percent of the cropland, wheat 18, oats 12, potatoes 3, and tomatoes 2 percent, and the remainder is in hay or pasture. Crop yields average about as follows: Corn, 50 bushels; wheat, 35 bushels; oats, 50 bushels; rye, 25 bushels; barley, 40 bushels; potatoes, 200 bushels; tomatoes, 10 to 12 tons; leguminous hay, 2 tons; and timothy and clover hay, 1½ to 2 tons to the acre.

Chester silt loam is generally recognized as one of the strongest soils in the county. It is an easy soil to work; it warms early in the spring, and crops usually get an early start. It has favorable surface relief, so that crops can be grown economically by the use of labor-saving machinery. Most of this soil type is used for general and dairy farming, for which it is well suited. The marketing of vegetables and fruits from home gardens and the raising and marketing of poultry and poultry products constitute important side lines, as much of it is favorably located with respect to markets.

Chester silt loam, shallow phase.—The soil profile of this phase in general conforms to that of the normal phase in color, texture, and structure, but the individual soil horizons are generally thinner, and bedrock is rarely more than 36 inches below the surface. In some places the rock is within 20 inches of the surface. The parent material consists of yellowish-brown gritty loam intermixed with bedded quartzite, coarse arkosic sandstone, fine-grained arkosic conglomerate, and occasional fragments of crystalline rocks, mostly gneiss. There is some mica in the parent material, but it is not so conspicuous nor so common as in the normal Chester silt loam. Although there appears to be considerable grit in the parent material, it seems to be completely weathered in the surface layers. The soil character of the shallow phase is more uniform throughout its area than are the underlying rocks. The arkosic sandstones and conglomerates normally are light grayish yellow, but thin layers of them are red and grade into the red shales and sandstones that underlie the Bucks and Penn soils.

Chester silt loam, shallow phase, is restricted to the central part of the county and is closely associated with the Bucks-Chester silt

loams and the Edgemont and Bucks soils. It occurs in the vicinity of New Britain, northeast of Doylestown, southeast of Cottageville, and near Mechanics Valley, Mechanicsville, and Peters Corners. It has a total area of 10.3 square miles.

It is used for the same crops as the normal Chester silt loam, but the yields generally are not so heavy, and crops are said to suffer during protracted dry spells.

Included with the shallow phase on the soil map is a variation that resembles the Bucks soils in color, in that the soil is more pinkish or pinkish red than the Chester soils. In other respects, however, including its value and suitability for crops, it is the same as Chester silt loam, shallow phase. The areas occur southwest of Centre Hill, 1 mile south of Centre Hill, and 1 mile northeast of Doylestown. The aggregate area is about 1 square mile.

Another variation consists of two small areas that are essentially the same as Chester silt loam, shallow phase, except that they are even shallower and parent rock fragments are scattered over the surface and throughout the soil profile. Crops are uncertain because of excessive drainage.

Chester silt loam, sloping phase.—This phase is not essentially different from Chester silt loam except that it is shallower and occupies inclined positions on valley slopes. The slope gradient in general averages less than 7 percent, and the land is not too steep for cultivation. This phase is one of the minor soils of the county. Most of it occurs in the south-central part, closely associated with Chester silt loam. The total area is 6.7 square miles. It is most extensive on the valley slopes along Neshaminy Creek and the headwaters of Mill Creek.

Less than half of the total area of this phase is used for field crops. Most of it is used for pasture or is covered with brush. When cultivated it is used for the same crops as Chester silt loam. It is not so productive, however, and crops suffer during prolonged dry spells. According to climatic conditions and management practices, the reported yields of corn range from 20 to 50 bushels and average about 35 bushels an acre. Wheat yields probably average about 18 bushels and range from 12 to 30 bushels. Oats yield from 20 to 50 bushels and probably average about 35 bushels. Hay yields from 1 to 1½ tons to the acre.

Included with the sloping phase are a few areas with many small stone fragments. These occur near New Britain, Lahaska, and Center Bridge. The total area of these inclusions is less than 1½ square miles. They are used for the same crops and have about the same agricultural value as Chester silt loam, sloping phase.

Califon silt loam.—This soil occurs around stream heads and along the very gentle slopes between the Chester soils and the stream bottoms. There is a slight slope toward the watercourses. The surface has medium drainage, but the lower part of the subsoil is imperfectly drained, partly because of water that seeps out from the underlying or adjacent rocks. Much of the parent material of this soil is like that of the Chester soils, but in addition it includes some outwash or colluvial material derived from soils at higher levels.

The surface soil is brownish-gray silt loam 8 to 12 inches thick.

This grades into yellowish-brown light silty clay, which at a depth between 15 and 24 inches becomes heavier and slightly more compact. The general color of the deeper subsoil is the same, but it is mottled with gray and brown, and the mottling becomes more conspicuous with depth. This layer extends to a depth between 3 and 6 feet, where it grades into fragmentary weathered crystalline rocks.

The surface layer is strongly acid (pH 5.0–5.5). There is a good average supply of organic matter. Roots are abundant in the surface layer, particularly in undisturbed situations.

As typically developed, Califon silt loam is closely associated with the Chester soils and occupies a total area of 15.2 square miles. It occurs along Ironworks, Mill, and Pine Run Creeks, near the headwaters of Pennypack Creek, and in other places throughout the south-central part of the county.

Most of this land is open and clear of trees and brush except for a few wood lots and the shade and ornamental trees near home sites. The greater part of it is used for the production of corn, wheat, oats, hay, and pasturage. Corn occupies about 32 percent, wheat 15 percent, oats 8 percent, and hay and forage 30 percent of the cropland. Depending primarily upon climatic conditions, the reported yields of corn range from 45 to 80 bushels, of wheat from 20 to 35 bushels, of oats from 40 to 70 bushels, and of mixed hay from 1½ to 2½ tons to the acre. Average yields are probably about as follows: Corn, 50 bushels; wheat, 25 bushels; oats, 50 bushels; and hay, 2 tons. The best yields are said to be obtained in dry years. Crops on this soil are said to be among the last affected by prolonged dry weather.

In some places there is a conspicuous quantity of flaggy rock fragments scattered over the surface, especially adjacent to the more stony soils. One of these spots occurs half a mile south of Springtown. These areas of flaggy soil have a total area of about 1 square mile. They are used for the same crops and have about the same value as the normal soil, although the stones interfere somewhat with cultivation. There are also many small places throughout the Califon silt loam where the surface soil is less well drained.

Included with this soil are a few small areas in the southwestern part of the county, south and southeast of Neshaminy, with an aggregate area of about one-half of a square mile, where the soil is less acid in reaction. This would have been shown as a separate type, but the distribution was too limited. It is associated with the Neshaminy silt loam, and it is used for the same purposes and has about the same value as the typical Califon silt loam.

Neshaminy silt loam.—As typically developed, this soil occupies undulating to gently rolling country. It has good surface and subsoil drainage. The soil warms up early in spring, and crops mature early. This is the deepest soil of the Piedmont part of the county, and the underlying rocks are rarely exposed. Where observed they were strongly weathered and most of them appeared to be granite or gneiss, although there are local intrusions of trap rock (diabase). The total area is only 2.6 square miles. The largest areas are at Bonair, in the vicinity of Warminster, and south and southeast of Neshaminy.

The surface soil is mellow weak-brown silt loam 8 to 14 inches thick. It grades into friable yellowish-brown silty clay loam. This

layer usually extends to a depth between 40 and 50 inches, where it rests upon slightly micaceous heavy silt loam or gritty loam of about the same color. The soil profile is very similar to that of Chester silt loam but averages slightly thicker. The principal difference in these two soils is that the Neshaminy is only slightly acid or neutral (pH 6.1–7.3). This soil type has a good average supply of organic matter. In undisturbed situations roots are abundant in the surface soil and more scattered in the subsoil.

Nearly all of the land is cleared of trees. There are a few small wood lots and also a few trees near home sites and along fence lines. The trees consist of various oaks, maple, hickory, ash, locust, and occasional cedar and spruce. When cultivated the soil is used for growing corn, wheat, oats, potatoes, hay or forage, and alfalfa. These are supplemented in some places by small acreages of such commercial truck crops as sweet corn, tomatoes, spinach, carrots, beets, rutabagas, and celery, besides garden vegetables and fruits for home consumption. Yields of corn probably average about 55 bushels, although yields of 75 to 90 bushels are reported.

Wheat averages 30 to 40 bushels, oats about 50 bushels, potatoes about 200 bushels, timothy and clover hay about 2 tons, and alfalfa about 3 tons to the acre. The varieties of potatoes grown are Russet, Irish Cobbler, Green Mountain, and McCormick. They are usually fertilized with 1,000 to 2,000 pounds of a 4–8–8 fertilizer or its equivalent.

Neshaminy silt loam is recognized as one of the strongest soils in the county and appears to be especially well suited to the growth of leguminous forage. Green-manure crops of clover, soybeans, and alfalfa are used for soil improvement. The soil is easy to work, and the surface features are such that crops can be produced economically by using labor-saving machinery. It is used for dairying and general farming, but the latter is probably the dominant system. There seems to be a tendency to increase the production of truck crops, probably because of the favorable location of this soil in respect to the larger nearby markets. All kinds of vegetables and truck crops common to the region do well on this soil.

Included on the soil map with Neshaminy silt loam are a few small areas in which the soil profile is much shallower and the colors slightly darker and where there is a conspicuous quantity of angular and blocky fragments of granite and trap rock (diabase) on the surface and throughout the soil profile. These areas are 2 and 4 miles west of Langhorne and comprise a total area of only three-fourths of a square mile. They occupy the breaks and the valley slopes, and where cultivated they are subject to erosion. Although used for the same crops as the typical soil, this inclusion is less productive and crops are more uncertain, particularly during protracted dry spells.

Neshaminy silt loam, sloping phase.—This phase occurs on slopes of about 7 percent gradient in close association with normal Neshaminy silt loam. The surface soil, to a depth ranging from 6 to 12 inches, is mellow weak-brown silt loam. It grades into friable yellowish-brown silty clay loam, which extends to a depth ranging from 30 to 40 inches, where it rests on slightly micaceous brownish-yellow weathered

gneiss and trap rock of heavy silt loam or loam texture. The depth to hard rock is somewhat less than in normal Neshaminy silt loam. The reaction of the surface soil varies from slightly acid to neutral. A total area of 0.2 square mile is mapped.

This soil is used for the same crops as normal Neshaminy silt loam, but a larger proportion is used for hay crops, pasture, and wood lots. Yields are somewhat less than on the normal phase, because of greater erosion on clean-cultivated areas and because of moisture deficiency during long dry periods.

Manor silt loam.—This soil occurs on gently rolling land with slopes averaging approximately 7 percent gradient. It is closely associated with Manor silt loam, gently sloping phase.

The surface is pale-brown to light-brown mellow silt loam, 6 to 10 inches thick. The subsoil is yellowish-brown to light reddish-brown clay loam or silty clay loam, which extends to a depth ranging from 12 to 20 inches and grades into strongly weathered mica schist or mica gneiss of loamy sand or sandy loam texture. A large quantity of mica throughout the profile gives the soil a somewhat greasy feel when it is moist. In many places parent rock lies very close to the surface. There is some difference in the character of the underlying rocks, which include gray to brown mica schists, mica gneisses, and phyllites, with some included slatelike layers. The total area is 2 square miles. This soil is not everywhere associated with Manor silt loam, gently sloping phase, as the underlying rocks outcrop in places on slopes where the uplands are covered with Coastal Plain deposits.

Most of Manor silt loam is used for urban development or recreational purposes. Part of it is covered with trees and brush. Where utilized for agricultural purposes it is used for pastures and the common farm crops. Corn probably averages about 35 bushels, wheat about 18 bushels, oats about 35 bushels, and hay about 1 ton to the acre, though there is considerable variation from area to area and from year to year. Its sloping position makes this soil subject to erosion, and in spots erosion has been severe enough to expose the underlying rock. Field crops and alfalfa and other leguminous crops do well on these slopes under favorable weather conditions, but they suffer during prolonged dry spells.

Manor silt loam, gently sloping phase.—This phase differs from Manor silt loam in that it is undulating to gently rolling instead of gently rolling to rolling. The surface drainage and the subsoil drainage are good. The parent material is similar to that of Manor silt loam and was developed by the disintegration and weathering of mica gneiss and mica schist. This phase has a total area of 1.6 square miles. The largest areas are 1½ miles southeast of Trevose, half a mile west of Hulmeville, and a quarter of a mile west of Langhorne.

The surface soil is a brownish-gray to pale-brown mellow silt loam 8 to 12 inches thick. This grades into heavy silt loam or light silty clay loam of yellowish-brown color, which below a depth of 15 to 24 inches rests upon a light-brown compact, gritty, loamy sand intermixed with bedded grayish-yellow mica gneiss or mica schist. Mica is a conspicuous constituent of this soil, especially in the lower layers.

The depth of the soil is variable, depending on the proximity of the underlying rock, which in some places comes to the surface. The soil ranges from medium acid to neutral in reaction. There is less organic matter than in the Chester soils. In undisturbed situations roots are abundant in the surface layer.

Most of the land has been cleared, but there are a few wood lots and patches of trees and brush. The principal trees are various oaks, hickory, maple, white ash, elm, and walnut. Only a very small proportion of the land is used for agricultural purposes, because most of it is in urban development projects. Where it is farmed the principal crops are corn, wheat, oats, and hay, supplemented by garden vegetables and fruits. Yields vary considerably because of climatic differences from year to year and because of variation in management. Average acre yields are estimated to be about as follows: Corn, 40 bushels; wheat, 20 bushels; oats, 45 bushels; and hay, 1½ tons. Alfalfa does well, and yields range from 1 to 2½ tons to the acre. Various kinds of vegetables and fruits also do well. This soil, however, is not generally so productive as Chester silt loam. It does best in wet years, because crops frequently suffer during protracted periods of dry weather.

Included with this phase are two small areas, about a quarter of a mile west of Langhorne, with a total area of about three-eighths of a square mile, in which the soil differs from the normal soil in that the surface and subsoil layers are light reddish brown. These included areas are used for the same purposes and have about the same value as the more normal soil.

Brandywine silt loam.—This soil occurs on steep slopes, associated with and developed from the same kinds of rock as the Chester soils. The soil profile, however, is much shallower than that of Chester silt loam, sloping phase.

The surface soil, to a depth of 6 to 12 inches, is brownish-gray silt loam, with a darker gray upper layer, 1 to 3 inches thick, in wooded areas. The subsoil is light yellowish-brown gritty heavy silt loam or heavy loam, with occasional spots where the texture is clay loam. The parent material, beginning at a depth ranging from 20 to 30 inches, is weathered gneiss, schist, or arkose of sandy loam texture. Considerable mica is also present. The material grades rapidly into harder rock at a depth ranging from about 24 to 40 inches. In places the parent rock outcrops on the surface.

The larger areas occur on the southern slope of Neshaminy Creek north of Langhorne, and on the southern slope of the same creek south of Parkland. The total area is 0.7 square mile. The slopes are too steep for agricultural purposes. Most of the land is used for wood lots.

Edgemont channery[9] **loam.**—This is one of the minor soils of the county. The total area is 7.2 square miles. The largest areas are three-quarters of a mile south of Doylestown, 1⅐ miles east of Doylestown, near Solebury Post Office, half a mile northeast of Mechanics Valley, and in other places throughout the central part of the county. The surface relief is gently rolling to somewhat hummocky. Surface drainage and subsoil drainage are good.

[9] The word "channery" was originally used in northern England and Scotland as a synonym for gravelly. The Scotch settlers of West Virginia and southwestern Pennsylvania have long applied it to soils that contain many fragments of fairly hard angular stones about 1 to 4 inches in diameter.

The surface soil consists of brownish-gray or pale yellowish-brown loam or silt loam 6 to 12 inches thick. This passes rather abruptly into pale-yellow or yellow light silty clay loam or fine sandy clay loam. This material extends to a depth ranging from 20 to 40 inches, where it grades into yellowish-brown or reddish-yellow loamy sand or sand intermixed with angular and rounded fragments of quartzite conglomerate. The total thickness of the profile in most places is more than 2 feet. In some places, however, the underlying conglomerate comes close to or outcrops on the surface. The conglomerate is quite variable in the size of the included fragments, which range from fine gravel to coarse cobblestones. Over the surface and scattered through the soil profile is a conspicuous quantity of small and large angular and rounded quartzite fragments. Most of the stone fragments in cultivated fields are small and range from ½ to 2 inches in diameter. The larger sizes, including an occasional fragment of more than 6 inches in diameter, have been removed.

Unlimed Edgemont channery loam ranges from extremely to strongly acid. In general there is a fair supply of organic matter where the fields are cultivated, but there is very little in the surface mineral layer under the litter and forest debris of areas covered with trees and brush.

About three-fourths of the total area of this type is open and clear. The rest supports a mixed growth of various oaks, chestnut, beech, maple, dogwood, poplar, hickory, and some birch. Most of the land is used for dairying and general farming, but in some places poultry farming is an important side line. Where cultivated the land is used for the production of corn, wheat, oats, potatoes, hay, or forage, supplemented by garden vegetables and fruits. Corn occupies about 24 percent, wheat 18, oats 8, and potatoes 7 percent, and the balance of the cropland is in hay or forage and pasture. All kinds of vegetables do well on this soil. A number of small orchards produce excellent apples, the principal varieties being Rome Beauty, Stayman Winesap, and Delicious. The trees are usually cultivated yearly, and a cover crop of clover or millet is commonly planted. The reported yields of crops vary rather widely, but the following are estimated average acre yields under the common practices: Corn, 35 bushels; wheat, 18 bushels; oats, 35 bushels; potatoes, 75 bushels; and mixed hay, 1 ton. Some excellent crops of alfalfa were noted on this soil, particularly in fields that had been heavily limed.

Edgemont channery loam, as mapped in Bucks County, contains several variations and inclusions that differ from the normal soil in one or more respects, such as color, stoniness, or texture. One variation includes small areas that are essentially the same as the normal soil except that the entire profiles are pinkish red or light Indian red in color. These areas total less than 1 square mile and occur half a mile south of Doylestown, 1 mile northeast of Pebble Hill, and 1 mile southwest of Mechanics Valley. They are used for the same purposes and have about the same agricultural value as the normal soil.

Two small areas of Edgemont stony loam are also included. One area is sloping and the other is steep. The former is 1 mile and the latter 2 miles southwest of Center Bridge. Their total area does not exceed three-quarters of a square mile, and they are both covered with trees and brush.

As mapped, Edgemont channery loam also includes about 1¼ square miles of light brownish-gray coarse sandy loam from 6 to 12 inches thick that passes into a pale-yellow or yellow coarse sandy clay loam subsoil. Below a depth ranging from 20 to 30 inches this rests on a loose incoherent gritty sand intermixed with fine gravel or bedded fine gravelly conglomerate. Although the soil usually averages more than 2 feet deep, there are local spots where the underlying conglomerate is close to or outcrops on the surface. Over the surface and throughout the soil is a scattering of small rounded brown-stained quartz pebbles that are not so large or conspicuous as those on more representative areas. The soil ranges from extremely to strongly acid in reaction, like the normal Edgemont channery loam. There is only a fair supply of organic matter, which is more conspicuous in cultivated fields than in the surface layer in wooded areas.

A variation of this coarse sandy loam inclusion occurs in two small areas, amounting to about three-fourths of a square mile, located 1¾ miles and three-fourths of a mile southwest of Center Bridge, that are light Indian red in color.

Two small areas of Edgemont channery sandy loam are also included. One of these is 1 mile southwest of Center Bridge and the other half a mile southeast of Mechanics Valley. Together they occupy about three-fourths of a square mile.

Probably less than one-half the area of these variations and inclusions is cleared of timber and brush. Where cultivated they are used for the production of corn, wheat, oats, potatoes, and hay, supplemented by garden vegetables and fruits. Under good management all kinds of vegetables and fruits do well. A few small apple orchards are said to be profitable. Corn yields 20 to 35 bushels, wheat 10 to 15 bushels, rye 12 to 18 bushels, oats 20 to 30 bushels, potatoes 50 to 150 bushels, and hay or forage 1 to 2 tons to the acre, according to the climatic conditions, management practices, and local soil conditions. These areas are not considered to be so productive as the normal Edgemont channery loam, and crops are said to suffer during protracted dry spells. However, they are easy to work, and they warm up early in spring, so that crops mature earlier than on the other soils of the uplands.

Edgemont channery loam, sloping phase.—This phase is not essentially different from normal Edgemont channery loam except that the soil is shallower to the underlying conglomerate and it occupies sloping positions of about 7-percent gradient on valley slopes. The areas, which total 2.4 square miles, are generally associated with Edgemont channery loam. The larger areas are half a mile north of Langhorne, a quarter of a mile southwest of Mechanics Valley, and three-quarters of a mile northwest of Lahaska.

This phase, where cultivated, is used for the same crops as the normal phase. About half of it is covered with trees and brush, and much of the open land is used for pastures. It is estimated that average acre yields are about as follows: Corn, 30 bushels; wheat, 15 bushels; oats, 30 bushels; and hay, 1 ton. Drainage is rather excessive, and crops suffer during protracted dry spells. The use of so much of the land for pasture represents an effort to protect the soil from erosion.

Included with the sloping phase of Edgemont channery loam are a few areas, amounting to about 1 square mile, in which the surface soil is coarse sandy loam. This latter soil is associated with inclusions of Edgemont channery loam, which have been described. The larger areas are 2 miles east of Doylestown, 2 miles southwest of Center Bridge, and one-eighth of a mile east and half a mile southeast of Mechanics Valley. Probably less than one-third of the land is cleared of trees and brush. The rest of it supports a mixed growth of various oaks, chestnut, maple, dogwood, poplar, beech, and some birch. Where cultivated it is used for the production of corn, wheat, and hay. Yields are reported to range as follows: Corn, from 15 to 30 bushels; wheat, 5 to 15 bushels; oats, 15 to 30 bushels; and hay or forage, ½ to 1 ton to the acre.

Buckingham cobbly silt loam.—This soil is well developed on the crests of Chestnut and Buckwampum Hills and Buckingham Mountain. The surface relief is gently rolling, and the surface and subsurface drainage are good. The total area is only 0.7 square mile. The parent material was developed by the disintegration and weathering of the underlying quartzites.

The surface soil consists of a thin, almost black, matlike humus layer about 1 inch thick. A light-gray layer less than a quarter of an inch thick marks the transition between the humus and the mineral soil. Below this is pale yellowish-brown silt loam, 6 to 8 inches thick, which rests upon light-brown slightly compact silty clay loam. Between 20 and 30 inches this layer in turn rests upon light-brown silt loam intermixed with fragmentary grayish-white quartzite. On the surface and throughout the soil is a conspicuous quantity of grayish-white quartzite fragments ranging from 2 to 3 inches in diameter. This soil is extremely or very strongly acid.

Practically all of Buckingham cobbly silt loam is covered with woods and brush. The trees consist of various oaks, aspen, dogwood, hickory, sassafras, and poplar. Young chestnut shoots are common, but no trees have survived the oriental chestnut blight. Many old and large chestnut stumps were noticed during the progress of the survey. The principal undergrowth is huckleberry, laurel, and wild grape.

Buckingham cobbly silt loam, sloping phase.—This phase is quite limited in distribution, although its area of 1.7 square miles is larger than that of the normal phase. The larger areas are on the south side of Chestnut Hill, on the south and west sides of Buckwampum Hill, and on the south side of Buckingham Mountain. It occupies sloping areas of about 7-percent gradient, especially near the bases of hills and mountains. The parent materials are similar to those of the normal phase in that the major part of them are derived from quartzite bedrock, but they differ in that more or less colluvial material has been deposited on the surface from adjoining higher lands.

The surface soil consists of brownish-yellow or yellowish-brown silt loam 8 to 12 inches deep. This passes into compact yellow or pale-yellow heavy silty clay loam or light silty clay. Between 24 and 36 inches this layer generally rests upon brownish-yellow silt loam intermixed with fragmentary gray quartzite. Over the surface and

throughout the soil is a conspicuous quantity of grayish-white and brown-stained quartzite from 2 to 3 inches in diameter. This phase averages a greater depth than the normal phase, as it includes some materials that have crept down slope from the steep phase of Buckingham cobbly silt loam. It lacks almost entirely, however, the black matlike humus of the normal phase, even in those areas covered with trees and brush.

Probably not more than half of the area is used for farming; the rest is covered with trees and brush. Where cultivated the soil is used chiefly for the production of corn, wheat, oats, mixed hay, pasture grasses, and orchard fruits, supplemented by garden vegetables and fruits. Corn occupies about 26 percent, wheat 20, oats 9, hay 20, and orchards 3 percent of the cultivated land. The reported yields are rather variable, because of variations in climatic conditions, management practices, and local situations. It is estimated that corn averages about 20 bushels, wheat about 15 bushels, oats about 25 bushels, and hay ½ to 1 ton to the acre. A number of small apple orchards are located on this soil, and they are said to do exceptionally well. The principal varieties grown are Winesap, Rome Beauty, Stayman Winesap, and Delicious.

Buckingham cobbly silt loam, steep phase.—This is essentially the same soil as the normal Buckingham cobbly silt loam except that it occupies steep positions and is generally more shallow and stony. Outcropping rock is more common and conspicuous.

The steep phase is the most extensive member of the Buckingham series in Bucks County, although it has a total area of only 1.9 square miles. It occurs on the steep slopes of Buckwampum and Chestnut Hills and Little Buckingham and Buckingham Mountains. Practically all of it is covered with trees and brush. It is too steep for the economic production of crops, but it affords protection and some scanty grazing for livestock.

SOILS DEVELOPED FROM DOLOMITIC LIMESTONES AND SHALES

Many soils developed from limestone have proved to be very productive under good management, and farmers in Pennsylvania consider that "limestone soils are good soils." While this general statement is not strictly accurate, it is true of a large proportion of the soils developed from limestones in Pennsylvania. Most of the limestones of Bucks County are dolomitic; that is, they are composed largely of mixed carbonates of calcium and magnesium. Ordinary limestones are composed dominantly of carbonate of calcium.

In the process of weathering, the calcium and magnesium carbonates are dissolved by slightly acid water and are removed in the drainage waters, whereas the impurities remain behind to form soils. Some of the ordinary limestones and dolomitic limestones have more impurities than others, and a smaller amount of rock will produce a proportionately greater volume of soil.

Soils developed from limestones and dolomitic limestones in Bucks County belong to the Duffield, Chalfont, Doylestown, Greer, and Captina series. Duffield soils are well drained, Greer and Captina soils are somewhat imperfectly drained internally, Chalfont soils are imperfectly drained, and the Doylestown soil is very slowly drained.

Duffield silt loam.—The relief of this soil varies from gently undulating to gently rolling. Both surface drainage and subsoil drainage are good. The underlying rocks consist principally of dolomites, dolomitic limestones, and limestones. Duffield silt loam is one of the minor soils of the county. It is restricted largely to the Buckingham and Lahaska Valleys and has a total area of 4.4 square miles.

The surface soil is mellow light-brown silt loam from 8 to 12 inches thick. This grades into yellowish-brown friable silty clay loam subsoil, which, at a depth between 20 and 30 inches, rests rather abruptly upon dark yellowish-brown, brown, or light reddish-brown compact silty clay. This layer in turn extends to 40 or 50 inches and is underlain by heavy compact yellowish-brown, brown, or light reddish-brown silt loam intermixed with fragmentary dolomitic limestone. The depth of this soil type is quite variable. In general, it averages about 2½ or 3 feet to the parent rock, but in some places the bedrock comes close to or outcrops on the surface. In other places the soil is more than 4 feet deep.

Duffield silt loam ranges from slightly acid to slightly alkaline, according to how much lime has been applied. It has a good average supply of organic matter. In undisturbed situations roots are abundant in the surface layers and more scattering in the subsurface layers.

Most of the land is open and clear of trees and brush. There are a few scattered wood lots and a few trees near home sites and along fence lines. Most of the trees are elm, cedar, spruce, maple, locust, sycamore, willow, and cottonwood. Duffield silt loam is used for dairying and general farming, for which it is well suited. Where cultivated, it is used for the production of corn, wheat, oats, potatoes, mixed hay, and alfalfa. Yields of corn probably average about 50 bushels, although in some years they may range from 60 to 80 bushels. Wheat averages about 35 bushels, oats about 50 bushels, potatoes 200 to 300 bushels, mixed hay 2 tons, and alfalfa 2 to 3 tons to the acre. All kinds of vegetables and fruits common to the region do well on this soil. It is well suited for the production of alfalfa and other legumes.

Duffield silt loam, shallow phase.—The relief of this phase is gently rolling, and both surface drainage and subsoil drainage are good. Surface runoff is usually more rapid than on the normal phase, and in places the subsoil is exposed. This soil phase is derived from the same kind of parent material as the normal phase. The total area is only 0.7 square mile. Representative areas are in the vicinity of and 1 mile northwest of Aquetong. The range in reaction is about the same as for the normal phase—from slightly acid to slightly alkaline. There is also a good average supply of organic matter. In undisturbed locations roots are abundant in the surface layer and less so in the subsoil.

The surface soil consists of mellow light-brown silt loam, 8 to 12 inches deep. This grades into mellow yellowish-brown heavy silt loam or light silty clay loam, which, at a depth between 20 and 24 inches, usually rests on yellowish-brown compact silt loam intermixed with fragmentary dolomitic limestone.

Where cultivated the soil is used for the same crops as Duffield silt loam. It is not considered to be so productive, however, and this may be the reason that proportionately more of it is in pasture. Yields of corn are reported to range from 35 to 50 bushels and probably average

about 45 bushels to the acre. Yields of other crops are about as follows: Wheat, 25 bushels; oats, 45 bushels; potatoes, 100 to 200 bushels; and hay or forage, 1 to 2 tons.

Duffield silt loam, sloping phase.—This phase differs from normal Duffield silt loam in that the soil is not generally so deep and the slope gradient is about 7 percent. Where cultivated it is subject to erosion, and the thickness of the soil over the rocks is quite uneven. In some places it exceeds 2 feet, and in others it is very shallow and the rock is exposed here and there. The total area is 1.1 square miles. The larger areas are half a mile south of Centre Hill and northeast and east of Aquetong.

Less than half of this land is used for cropping purposes, and most of it either is in pasture or has been turned out for reforestation. In some places it has been planted to evergreens. Where cultivated the same kinds of crops are grown as on the normal phase. Reported yields of corn range from 20 to 40 bushels and average about 30 bushels to the acre. Wheat averages about 18 bushels, oats about 35 bushels, and hay or forage 1 to 1½ tons. Some effort has been made in places to protect the slopes from erosion, but a more general and adequate control is needed.

Chalfont silt loam.—This is one of the important soils of the county and occupies an aggregate area of 32.5 square miles. Areas occur in the vicinities of Naceville, Schlichter, Eureka, Warrington, Dublin, and Kellers Church and in other places throughout the northern and western parts of the county. The surface ranges from almost level to slightly undulating. The drainage is imperfect, particularly in the subsoil. The surface in general is fairly well drained but is characterized by occasional small imperfectly drained spots. This soil has been developed from the disintegrated products of the underlying rocks, consisting of interbedded dolomitic limestones, limestones, shales, and argillites, through the influences of vegetation and climate over a long period of time.

The surface soil is grayish-yellow or light brownish-yellow heavy silt loam 6 to 10 inches thick. This rests on pale-yellow or light grayish-yellow slightly compact silty clay loam with faint mottles of gray and brown. Generally between a depth of 15 and 20 inches this layer passes rather abruptly into a compact yellowish-gray silty clay loam that is mottled and sometimes streaked with gray and brown. This latter material extends to a depth between 24 and 30 inches, where it is intermixed with fragmentary dolomitic limestone or interbedded dolomites, shales, and argillites. Chalfont silt loam ranges in depth from 24 to 36 inches, and changes in depth occur within a few feet. The surface soil ranges from slightly acid to slightly alkaline, depending partly on how recently lime has been applied. There is only a fair supply of organic matter.

Included with Chalfont silt loam are a few small areas in the vicinity of Traderville and southwest toward Montgomery County where the surface soils are more gray and the streaked or splotched layer comes within 12 inches of the surface. In some respects this variation resembles Steinsburg silt loam, but the area is shown on the soil map as Chalfont silt loam, chiefly on account of its reaction, which is slightly acid to slightly alkaline.

About two-thirds of the area is cleared of trees. The rest of it supports a mixed growth consisting of various oaks, shellbark hickory, butternut, cucumbertree, cedar, ash, cherry, locust, and maple. The cropland is used for the production of corn, wheat, mixed hay, and pasturage. Corn occupies about 26 and wheat about 20 percent of the area, and the remainder is in pasture and mixed hay. In the days when hay was an important cash crop this soil was one of the most productive hay lands in the county.

Yields are estimated to average about as follows: Corn, 35 bushels; wheat, 18 bushels; mixed hay, 2 tons to the acre. The pastures on this soil are strong and persistent. One farmer reports growing clover for 15 years without reseeding. Little success is had with fall-sown grains, as they are said to winterkill. Difficulty is also experienced in growing potatoes and carrots, as some farmers report that they rot in the ground. Farmers report that in places lime has been beneficial, although the soil is naturally only slightly acid. The principal problem in the use of this soil is imperfect subsoil drainage.

Chalfont silt loam, sloping phase.—This phase is not essentially different from normal Chalfont silt loam except that it is shallower and occupies sloping positions on valley slopes. It is inextensive in distribution, occupying 2.4 square miles. It is closely associated with the other Chalfont soils and with Greer silt loam. Although there is little to hinder the runoff of surface water, the subsoil drainage is imperfect and there is considerable seepage. The parent materials are similar to those of the other Chalfont soils.

About one-half of this phase is clear of trees, and the rest is covered with brush, of which cedar is conspicuous in some places. Much of the area is in pasture. Where cultivated it is used for the same crops as the normal phase. Yields of corn probably average about 25 bushels and those of wheat about 12 bushels, and hay yields about 1 ton to the acre.

Chalfont flaggy silt loam.—Much of this soil occupies the tops of ridges, and the surface is gently rolling in places. As a result, the soil has better surface drainage than Chalfont silt loam. The parent materials are the same as those of the other Chalfont soils.

This soil differs from Chalfont silt loam in that the soil is not so deep and there is a conspicuous number of flaggy fragments of dolomitic limestone, shales, and argillites scattered over the surface and throughout the soil. These fragments range in size from 2 to 4 inches in diameter and from ½ to 1½ inches thick. The total depth of the soil ranges from about 18 to 24 inches. Below the soil there is fragmentary or bedded rock.

The soil ranges from slightly acid to slightly alkaline. The pH value of the surface soil is higher than 6.0. This soil has only a fair supply of organic matter except where it is kept in permanent pasture. Northeast of Perkasie the gravel on the surface is unusually abundant and the soil is very shallow and is better drained than most of the type. The total area is 7.3 square miles.

Included on the soil map with Chalfont flaggy silt loam are a few small areas of Chalfont silt loam, shaly phase. These areas, in the vicinity of New Galena, have a total area of about 1 square mile.

This inclusion differs from the normal phase in having a conspicuous quantity of small shale fragments scattered over the surface and throughout the soil. It is also slightly better drained. Although used for the same crops, it is not considered so productive as the flaggy silt loam.

More than half of this land is cleared of trees and brush. The cropland is used for corn, wheat, mixed hay, and pasture. Estimated average acre yields are as follows: Corn, 30 bushels; wheat, 15 bushels; and hay, 1 ton. The pastures are not so strong nor so persistent as those on Chalfont silt loam.

Chalfont flaggy silt loam, sloping phase.—This phase is not essentially different from normal Chalfont flaggy silt loam except that it occupies valley slopes. Because of the greater slope, surface runoff is more rapid and thorough. The subsoils, however, even on slope positions, are not well drained and are affected by considerable seepage. The lower subsoils are conspicuously mottled. The organic content and the plant root penetration are similar to those of the normal phase. This phase is associated with other Chalfont soils and occupies a total area of 7.7 square miles.

Only about one-half of this phase is open and clear of trees and brush, and most of this is used for pasture. Where cultivated it is used for the same crops as Chalfont flaggy silt loam but is less productive. It is subject to erosion, and crops suffer during prolonged dry spells. Yields are reported to have a considerable range from year to year. Estimated average yields for corn are 25 bushels, for wheat 12 bushels, and hay 1 ton to the acre.

This phase includes a small total area of steep land on valley slopes. The depth of the soil averages thinner and is more variable than that of the sloping phase. The areas are near Point Pleasant, Smith Corners, Perkasie, Hagerville, and Gallows Hill. Runoff is rapid and is so excessive in some places that the underlying rocks are exposed. There is a considerable amount of seepage, however, and the lower yellow subsoils are conspicuously mottled with gray and brown. The parent materials are similar to those of the other Chalfont soils. Most of these areas are covered with trees and brush consisting of basket, red, white, and chestnut oaks, cedar, ash, hickory, cherry, and some dogwood.

Doylestown silt loam.—This soil occupies very gentle lower slopes and slight depressions near streams. It is imperfectly drained and is developed in part from colluvial material washed in from higher lands and in part from bedrock. Most of it is cleared and is used principally for pasture. This soil has a total area of 8.4 square miles, mostly associated with Chalfont soils.

The surface soil is gray or yellowish-gray heavy silt loam with faint mottles of brown and is from 6 to 10 inches thick. This passes into a lighter colored layer of pale-yellow or pale grayish-yellow silty clay loam mottled with gray and brown, which extends to a depth generally between 24 and 36 inches, where it passes rather abruptly into compact slightly indurated silty clay loam. This horizon is darker than the one above—more of a brown with conspicuous mottles of gray, yellow, rusty brown, and dark gray. It is intermixed

with fragmentary or bedded dolomitic limestones or with interbedded dolomitic limestone, shales, and argillites.

Doylestown silt loam has a deeper profile than Chalfont silt loam; its depth varies from 3 to 4 feet. Like the Chalfont soils, it ranges from slightly acid to slightly alkaline. This soil has a fair supply of organic matter. In undisturbed situations roots are abundant in the surface layer but quite scattered in the subsoil layers.

Greer silt loam.—The surface relief of this soil is more rolling than is common for Chalfont silt loam, and the surface runoff is generally better, but the lower subsoil is imperfectly drained. The parent materials are the same as those of Chalfont silt loam. The areas total 8.2 square miles and occur in the central part of the county in association with the Chalfont soils.

The surface soil of Greer silt loam is mellow light-brown or brownish-yellow silt loam 8 to 12 inches thick. This grades through a thin layer (½ to 3 inches) of pale-yellow or grayish-yellow heavy silt loam or light silty clay loam to a slightly more compact layer of pale-yellow silty clay loam mottled with gray and brown. At a depth between 15 and 24 inches this latter layer passes rather abruptly into compact pale-yellow silty clay conspicuously mottled and in places streaked and splotched with gray and brown and intermixed with fragmentary or dolomitic limestone and less commonly with interbedded dolomitic limestone, shales, and argillites.

The surface soil ranges from slightly acid to neutral. This soil has more organic matter than Chalfont silt loam, and roots are more abundant in the surface layer of undisturbed spots.

A variation occurs near Line Lexington, where the soil has a depth of about 30 inches and exhibits some of the characteristics of Lansdale silt loam. The character of the underlying rock and the approximately neutral reaction of the surface soil and the subsoil are sufficient, however, to bring it within the range of the Greer series.

Areas of Greer silt loam are more open than those of Chalfont silt loam, and most of this soil is used for corn, wheat, hay, and pasture. Yields are reported to average about as follows: Corn, 40 bushels; wheat, 22 bushels; and hay (mixed clover and timothy), 2 tons to the acre. Crops are more consistent in yields than on Chalfont silt loam. The pastures are said to be strong and persistent and thus fit in well with the prevailing dairying and general farming interests.

Captina silt loam.—This soil occupies gentle slopes near Duffield soils adjacent to small streams. It has good surface drainage, but the lower part of the subsoil is imperfectly drained owing in some measure to water that seeps out from adjacent or underlying rocks. The lower part of the soil material is similar to that of Duffield soils, but the upper part has accumulated through local wash and colluvial action from soils located at higher levels.[10] The total area is only 2.3 square miles. Representative areas occur in the vicinities of Lahaska and Central Hill.

The surface soil consists of mellow pale-brown silt loam 8 to 12 inches thick. This grades into yellowish-brown light silty clay

[10] In this respect it differs from Captina silt loam mapped elsewhere in Pennsylvania. The type usually occurs on definite stream terraces where alluvial material is thicker than in Bucks County.

loam, which extends to a depth between 18 and 24 inches and rests on dark yellowish-brown compact silty clay loam with conspicuous mottles of gray, yellow, and brown. This material persists to a depth between 30 and 50 inches, where it rests upon fragmentary or bedded dolomitic limestone.

The surface soil is slightly acid and has a good supply of organic matter. Roots are abundant in the surface layer, particularly in undisturbed situations.

Most of the land is clear of trees and brush except for a few wood lots and shade and ornamental trees near home sites and along fence lines. The greater part of the total area is used for corn, wheat, oats, mixed hay, forage, and pasture. Corn occupies about 30 percent, wheat 20 percent, and oats 10 percent of the cropland, and the remainder is used for growing hay and pasture grasses. Crops are reported to make the best yields during dry seasons. Yields probably average about as follows: Corn, 50 bushels; wheat, 25 bushels; oats, 50 bushels; and hay, 2 tons to the acre. Alfalfa and other legumes do well. Yields of alfalfa are reported to range from 2 to 3 tons to the acre. Pastures are said to be strong and very persistent.

SOILS DEVELOPED FROM DIABASES AND GABBROS

During past geological periods, and particularly in the Triassic, the earth's crust in what is now the Piedmont Plateau of the eastern part of the United States was disturbed by earthquakes and volcanic activity. The rocks were fractured in many places, and white-hot lava flowed into the crevices and forced the hard rocks apart. When the lava cooled, it crystallized to form diabases and gabbros, both of which are very hard dark-colored crystalline rocks. During the long periods of erosion since Triassic time the hardened lavas (also known as trap rock) were uncovered, and, since they are very resistant to erosion, they remain today as hills and low mountains in many parts of the Piedmont.

The Montalto and Watchung soils are both developed from diabases and gabbros. The Montalto soils are naturally well drained, and the Watchung soil is poorly drained.

Montalto silt loam.—The relief ranges from slightly undulating to gently rolling. The parent material is derived from diabases and gabbros. This soil has good surface and subsoil drainage, although the movement of water through the soil is not rapid. It is one of the heaviest soils in the area and does not warm up so readily as the soils derived from shales, and it is reported to be about 2 weeks later than Bucks silt loam. Outcropping rock in local spots makes it much more difficult to handle than the Bucks or Chester soils. Most of the Montalto silt loam occurs in the north-central part of the county, but there are scattered spots in other parts of the county. The total area occupied by this soil is 19.1 square miles.

The surface soil is brown to dull-brown heavy silt loam from 6 to 10 inches thick. This passes rather gradually into light silty clay loam that is lighter in color and slightly more compact than the surface soil. At a depth between 15 and 20 inches this layer passes rather abruptly into compact brownish-red heavy sticky silty clay that has some faint stains of black along the edges of cleavage planes. This

staining is especially noticeable in dry weather, when this part of the subsoil breaks into small irregular checks. This layer extends to a depth between 24 and 36 inches, where it passes into lighter material consisting of brown heavy silt loam with faint mottles of yellow, red, and black intermixed with fragments of diabase or gabbro.

There is considerable variation in the depth of the soil. In many places the underlying rock comes near the surface or outcrops. Scattered outcrops of these rocks are common in cultivated fields. An exception is in the southern part of the county, southeast of Neshaminy Post Office, where rock outcrops are uncommon. In this place the entire soil is also lighter in color and the subsoils are not so sticky. The surface soil ranges from slightly acid to approximately neutral. There is a good average supply of organic matter. In undisturbed spots roots are abundant in the surface and scattered in the subsoil layers.

Probably less than one-half of the total area is used for open pasture and cultivated crops. The rest, or most of it, is covered with trees and brush consisting of various oaks, hickory, cedar, locust, ash, maple, black walnut, poplar, and a smaller amount of basswood. When cultivated the land is used principally for corn, wheat, oats, hay, and pasture, and to some extent for garden vegetables and fruits. Corn occupies about 18 percent, wheat about 14 percent, and oats about 12 percent of the cropland, and the remainder is largely in hay and pasture. Various yields are reported, depending on the management practices and climatic conditions. Estimated average yields for prevailing conditions of management are as follows: Corn, 45 bushels; wheat, 30 bushels; oats, 50 bushels; hay, 1¾ tons; and alfalfa, 2 tons to the acre. Pastures are said to be very good. Apples are the principal fruit, and they do well. The principal varieties are Rome Beauty, Stayman Winesap, and Delicious.

Where row crops are grown on the somewhat sloping areas without proper erosion-control practices, the soil is rapidly eroded and many small rills and gullies are formed. Strip cropping and contour planting and cultivation should be more common practices.

Montalto silt loam, sloping phase.—This phase is essentially the same as normal Montalto silt loam except that the soil is generally more shallow and it occupies more sloping positions on valley slopes. It is closely associated with the normal phase, but is inextensive, occupying only 2.8 square miles. Because it is situated on steeper slopes, it has a much more rapid runoff and is exposed to more serious wash or erosion than the normal phase.

Most of the land is used for pasture in connection with dairying or general farming, but where it is cultivated it is used for the same crops as normal Montalto silt loam. It is not considered so productive, and yields are said to be somewhat lighter. Estimated average yields are as follows: Corn, 35 bushels; wheat, 25 bushels; oats, 40 bushels; and hay, 1¼ tons to the acre.

Montalto cobbly silt loam.—This soil is essentially the same as Montalto silt loam except for the conspicuous angular fragments of diabase from 2 to 4 inches in diameter that are scattered over the surface and throughout the soil. This type is generally associated with the other Montalto soils and is confined in general to the north-

central part of the county. The total area is 2.3 square miles. The larger areas are near Bowman Hill, Jericho Mountain, Solebury Mountain, and west of Glendale.

Only about one-half of the land is used for farming purposes; the rest is covered with trees or brush. When cultivated it is used for corn, wheat, oats, hay, and pasture. Some acreage is used for the production of apples, which are said to do well. Much more land is used for corn than for oats or hay. The cobblestones interfere somewhat with cultivation, but they are said to be beneficial during dry spells, because they check the evaporation of water from the soil. Yields are estimated to average about as follows: Corn, 30 bushels; wheat, 20 bushels; oats, 35 bushels; and hay, ½ to 1 ton to the acre.

Because of their small total area, a few spots of the sloping and steep phases of Montalto cobbly silt loam have been included on the soil map with the cobbly silt loam. The areas of these phases are chiefly on and near Jericho Mountain. About half of the sloping phase is cultivated, and the rest of it and practically all of the steep phase are in second-growth hardwood forest.

As mapped, Montalto cobbly silt loam includes also a considerable area of soil with the following characteristics: The surface soil is weak-brown gritty loam or heavy silt loam 8 to 12 inches thick. This passes gradually into yellowish-brown or light-brown silty clay loam or heavy silty clay, which extends to a depth of about 36 inches, where it rests on yellowish-brown or brown gritty loam or silt loam intermixed with loose or solid trap rock (diabase and gabbro). Over the surface and scattered throughout the soil is a conspicuous quantity of fragmentary rock ranging in size from 2 to 6 inches in diameter, most of which is diabase. Most of the cobbles are on the surface, and many of them have been brought down from higher levels. The soil is medium acid. It has a fair supply of organic matter. In the undisturbed situations roots are not so abundant in the surface layers as in those of Chester silt loam. Drainage is good in both the surface soil and the subsoil. The rock fragments on the surface are more variable in size and some are much larger than is common on typical Montalto cobbly silt loam. They interfere with cultivation in places and are hard on farm tools. In some places many of these cobbles have been removed by hand.

The areas of this more acid variation of Montalto cobbly silt loam are principally south of Bowman Hill and on the east and west sides of Jericho Mountain. They occupy the tops of ridges and divides and also gently rolling country near the bases of some of the hills.

Montalto stony loam.—This soil occupies undulating to slightly rolling country, and it has good surface and subsoil drainage. Scattered over the surface are large loose stones or outcropping rocks. Most of these are angular, but in some places they are rounded. Many of them are so large they could be removed only with dynamite.

Most of this soil is in the north-central part of the county. It has a total area of 14 square miles. The larger areas are in the vicinities of Haycock Mountain, Rock Hill, and Smoketown, near Shelly and Bowman Hill, and near Lone Cottage, Union, and Chestnut Ridge Schools.

The surface soil consists of brown heavy stony loam from 6 to 12 inches deep. This passes gradually into light silty clay loam that is

generally lighter in color and more compact, to a depth between 10 and 15 inches, where it rests rather abruptly on brownish-red heavy sticky silty clay with faint black or dark olive-drab stains along the cleavage planes. Below 20 inches this material generally grades into yellowish-brown somewhat gritty loam mottled or stained with black or dark olive drab and intermixed with fragmentary or solid diabase.

Considerable variation occurs in the depth of the soil, which ranges from almost nothing near outcropping rock to 2 feet or more. The surface soil is slightly acid to neutral. Many pH determinations were made in the field, and they ranged from 6.0 to 6.8. This soil in general has a fairly high content of organic matter. Roots are abundant in the surface soil and more scattered in the subsoil.

Most of the land is covered with brush and trees. The principal forest growth consists of various oaks, cedar, hickory, black walnut, locust, poplar, elm, maple, ash, and cherry. Little or none of this soil is used for the field production of crops. Vegetable gardens, small orchards, and pastures near home sites appear to be the limit of use. The rocky surface precludes any intensive agricultural use.

Montalto stony loam, sloping phase.—This phase is essentially the same as Montalto stony loam except that the soil in general is shallower. It occupies sloping positions on valley slopes, and where cleared it is exposed to more rapid erosion. The rocks in general act to check soil erosion, but shallow gullies are not uncommon, and the underlying clay is exposed here and there.

In distribution this phase is closely associated with the other Montalto soils. It is one of the less extensive phases and occupies a total area of 6.3 square miles. It occurs in places throughout the north-central part of the county.

As with the normal phase, the surface is covered with various sized rocks and with trees and brush. It has little or no agricultural value at present except to afford protection and some grazing for livestock.

Montalto stony silt loam.—This soil occurs on gently rolling to rolling areas on the tops of hills and ridges on Solebury and Jericho Mountains and also on Bowman Hill. The total area is 0.7 square mile. Stoniness is a marked feature of the landscape. In addition to rock outcrops, large and small fragments of stone are scattered over the surface. Some of these can be moved only with the use of dynamite. The rocky condition in general, however, is not so extreme as in rough stony land, as there are scattered spots of almost stone-free land. The surface soil consists of dull-brown to light-brown gritty silt loam or loam, 10 to 12 inches deep. This passes gradually into yellowish-brown friable silty clay loam or light silty clay that extends to a depth of 2 feet or more in favorable situations and is underlain by brown or dark-brown gritty loam or silt loam intermixed with fragmentary or solid crystalline rocks. The depth of the soil is quite variable, as it depends upon the proximity of the underlying rocks and ranges from almost nothing where the rocks protrude through the surface to 3 feet or more. The underlying rocks are diabases and gabbros. The surface layer ranges from very strongly to medium acid in reaction.

Most of the areas of Montalto stony silt loam are covered with trees and brush and are too stony for cropping purposes. The forest growth consists of various oaks, cherry, beech, maple, ash, and some poplar.

Montalto stony silt loam, steep phase.—This phase is essentially the same as Montalto stony silt loam except that it occupies steep positions on hills, mountains, and valley slopes. It is more extensive than the normal phase, although generally it is closely associated with it. Representative areas occur on the slopes of Solebury and Jericho Mountains and Bowman Hill and in the vicinity of Centerbridge. The total area is 1.3 square miles. Most of it is covered with forest, and it has no direct agricultural value except to afford shelter and scanty grazing for livestock.

Watchung silt loam.—In distribution the areas of this soil are closely associated with the Montalto soils throughout the north-central part of the county. The total area is 14.9 square miles. The relief ranges from flat to slightly undulating, as the soil occupies either benchlike positions adjacent to bottom lands or slight depressions at the heads of streams. The parent material is similar to that of the Montalto soils, but in addition it represents in part outwash or colluvial material derived from soils located at higher levels.

The surface soil is pale-brown to yellowish-gray silt loam 6 to 10 inches deep. This passes gradually into a lighter colored layer of yellow, pale-yellow, or brownish-yellow silty clay loam conspicuously mottled with gray and brown. Usually below 20 inches this layer rests on grayish-yellow compact and slightly indurated heavy silty clay mottled with brown, yellowish brown, and rust brown. This persists to about 3 feet, where it is intermixed with fragmentary diabase or solid diabase rocks. In some places these rocks occasionally outcrop on the surface, and in other places the bedrock is as much as 4 feet below the surface.

The surface layer ranges from slightly acid to neutral. There is a good supply of organic matter, and roots are abundant in the surface layers, particularly in pastures and undisturbed situations.

Included in the mapping of this type are a few stony areas. They are rather similar to typical Watchung silt loam except that the depth of the soil is more uneven, the soil is more generally wet, and there is a conspicuous amount of large, loose, and outcropping diabase rocks scattered over the surface.

Most of Watchung silt loam is clear of trees and brush and is covered with sedges and grass. The soil in general is too wet for cultivated crops, but some of the better drained spots are used for occasional patches of corn and hay. Most of the land, however, is used for pastures, which are productive for long periods.

SOILS DEVELOPED FROM GLACIAL TILL

A long time—probably a few hundred thousand to a million years—ago, a great glacier is thought to have moved slowly southward over the surface of the land from a center in what is now Canada. The southernmost limit of ice invasion in this part of the country was in northern Bucks County. The ice picked up rocks along its course, ground them into boulders, pebbles, sand, and rock flour, and left them behind when it melted. The rock debris, or glacial till as it is called, varies considerably from place to place, according to the proportions of different kinds of rock in it and the degree of fineness to which they were reduced by ice action. Various

members of the Springtown, Annandale, and Washington soils are developed in Bucks County from what is probably glacial till. As a whole these soils are naturally well drained.

Springtown cobbly silt loam.—This soil occupies the tops of ridges, and in relief it ranges from very smooth or undulating to slightly rolling. It has good surface and fair subsoil drainage. Some areas occupy the highest altitude in the area—about 960 feet above sea level. The origin of the parent material is somewhat in doubt. It is a very deep soil, and no consolidated rock was found. It could, of course, be derived from a very coarse conglomerate. If so, it is certainly unlike any of the other conglomerates in the area, and some of them have an abundance of very large gravel and small boulders. The relief, however, gives the impression of glaciated country.

Springtown cobbly silt loam is one of the inextensive soils of the county. It is restricted in distribution to the northern part of the county and particularly to the area along the county line between Northampton and Bucks Counties and in the vicinity of Fairmont. The total area is 2.9 square miles.

The surface soil consists of weak-brown silt loam from 8 to 12 inches deep. The upper part of the subsoil is a pale reddish-brown silty clay loam, which extends to a depth of 20 to 30 inches and passes rather abruptly into a grayish-red somewhat indurated silty clay loam or clay loam mottled with occasional black stains. This presumably is weathered glacial till, although some of it may be an older conglomerate. When dry this material breaks up into irregular lumps and thick, rough plates. Below a depth of 40 inches it usually becomes more gritty and lighter in texture but is still slightly indurated. This layer is also characterized by faint mottles of black, gray, and yellow.

Over the surface and throughout the soil profile is a conspicuous quantity of subangular or partly rounded gravel from 2 to 4 inches in diameter and occasional boulders from 6 to 15 inches in diameter. Most of this cobble and gravel is gray and yellow quartzite stained pink on the surface. The slightly indurated material is so generally deep that underlying bedrocks are exposed only in deep road cuts and ravines. Common exposures in road cuts show the depth of the unconsolidated till-like material to be more than 6 to 8 feet in most places. Most of the soil of this type is very strongly acid. The pH values are generally higher in the surface soils than in the subsoils. This soil has a fair supply of organic matter. Roots are abundant in the surface layer in undisturbed situations and are more scattered in the subsurface layers.

Included with this type is a light-colored variation. It is essentially the same as the normal phase except that the surface and subsoil materials are lighter in color and occur at lower altitudes. A shallow red variation that is closely associated with the Buckingham soils is also included. It has the same kind of gravel over the surface and throughout the soil section as the more normal soil, but it is much shallower, the reddish colors come closer to the surface, and the till rests on shales.

About three-fourths of the total area of this soil is used for cropping purposes, and the rest is covered with brush or second- or third-growth hardwoods. Where cultivated it is used for corn, wheat, oats, pota-

toes, hay or forage, and pasture, and also for garden vegetables and fruit. Corn occupies about 35 percent, wheat 10 percent, and oats 5 percent of the tilled land, and the remainder is in hay and pasture. Vegetables and fruit are usually produced for home use, and there are a few small commercial orchards. Apples are the dominant fruit and are said to do exceptionally well on this soil. The reported yields are variable, but the following estimates are given: Corn, 35 bushels; wheat, 20 bushels; oats, 35 bushels; potatoes, 175 bushels; and hay or forage, 1½ tons to the acre. Most of the land is used for general farming, with fruit as an occasional side line. Among the common varieties of apples grown are the Rome Beauty, Stayman Winesap, and Delicious. The orchards are cultivated yearly, and a cover crop of clover or millet is frequently planted between the trees. Considerable cobble, especially of the larger sizes, has been removed from the cultivated fields. The presence of cobble and gravel on the surface interferes somewhat with cultivation and is said to be hard on farm tools.

Springtown cobbly silt loam, sloping phase.—This phase is essentially the same as normal Springtown cobbly silt loam except that it occupies more sloping positions on valley slopes. There is some variation in color, however, as the surface soil is more gray and the immediate subsoil more yellow than those of the normal phase. This phase is also deep, and the gullying of the slopes in places, because of more rapid runoff, does not reveal any consolidated strata. The total area is only 1.8 square miles. The larger areas are in the vicinity of Springfield School.

Included with the sloping phase are a few areas of Springtown cobbly silt loam, steep phase. They are the same as the areas of the sloping phase except that they occupy steep positions on the valley slopes and have a greater concentration of gravel, cobble, and boulders.

Less than one-half of this phase is used for crops or pasture. The rest is covered with brush and second- or third-growth hardwood timber. When cultivated, it is used for the same crops as are grown on Springtown cobbly silt loam, but there is proportionately more land in pasture and orchards. The yields of crops in general are not quite so heavy, and the soil is more difficult to work, as there is a greater concentration of cobbles on the surface. The steeper slopes are covered with timber and brush and are too steep for cropping purposes, but a few are used for pastures.

Springtown silt loam.—This is a gently rolling soil in the northwestern part of Bucks County. It is associated with Springtown cobbly silt loam and with the Montalto soils but is usually at lower levels. On the other hand, it lies generally higher than some of the adjacent areas of Califon and Bucks soils. The total area is 2 square miles.

The surface soil of Springtown silt loam is brownish-gray, grayish-yellow, or light pinkish-brown silt loam, 8 to 12 inches deep. This passes rather abruptly into a brownish-yellow or light pinkish-brown silty clay loam, which becomes more sticky, compact, and heavy with depth. At a depth between 20 and 40 inches it is underlain by a gritty silt loam of light-brown, yellow, and light-red colors. This

layer is intermixed with fragmentary quartzite and crystalline rocks of various kinds.

It is used for the production of the common crops (corn, wheat, oats, and hay) and for pasture. It is somewhat more productive than Springtown cobbly silt loam, but not so productive as Chester silt loam. The pH determinations in the field indicate that it is strongly to medium acid. Crops are said to stand up well during periods of prolonged dry weather.

Springtown silt loam, sloping phase.—This phase differs from normal Springtown silt loam in that it is not so deep a soil and the slopes average about 7 percent. In plowed fields erosion is a problem, and it is advisable to keep the soil planted to close-growing crops as much of the time as is practicable. A total area of 0.6 square mile is mapped.

The soil is used for general farming and dairying. The same crops are grown as on Springtown silt loam, but yields are less. A larger proportion of the land is used for pasture, orchards, and forestry than of the normal phase.

Annandale cobbly silt loam.—This soil occurs in the gently rolling to undulating parts of northern Bucks County, near the Lehigh and Northampton County lines. It is developed from what appears to be very old glacial till, the materials of which are fragments of gneiss, diabase, gabbro, sandstone, shale, and conglomerate. The diabase and gabbro content is higher than in Annandale silt loam. A total of 1.6 square miles is mapped.

The surface soil, 8 to 10 inches deep, is a weak-brown to dusky brown friable silt loam, containing enough subangular cobblestones, 2 to 4 inches in diameter, to interfere somewhat with cultivation, but not enough to prevent it. The upper part of the subsoil is a light-brown to pale yellowish-brown sticky cobbly silty clay loam extending to a depth of 18 to 22 inches. This grades into pale-yellow blocky cobbly clay loam, which at a depth of 28 to 34 inches grades in turn into yellowish-brown clay loam faintly mottled with gray. This layer contains many gneiss, quartzite, and sandstone fragments and extends to a depth of 50 to 60 inches. The parent material beneath this layer is a yellowish-brown to grayish-yellow compact heterogeneous mixture of stone fragments (chiefly gneiss and quartzite) and sand, silt, and clay. The surface soil is medium to strongly acid, and most leguminous crops are benefited by the use of lime.

Land uses are about the same as on Chester silt loam, but somewhat more emphasis is placed on dairying. Crop yields are fairly high under good management, but not so high as on Annandale silt loam. Average yields are about the same as on Montalto cobbly silt loam. Included with this soil are a few stony areas, which are indicated on the map by stone symbols. These areas are mostly too stony for plowing but make good pasture and forest land.

Annandale cobbly silt loam, sloping phase.—This phase is like the normal phase except for differences in slope and except that in many places it is not so deep. In cleared and cultivated areas part of the surface soil has been removed by erosion, and in a few places gullies have formed.

The soil is used for the same crops as the normal phase, but the proportions of pasture, orchard, and forest are higher and crop yields are somewhat lower. Crop yields are also somewhat less than those on Montalto cobbly silt loam. A total of 2.7 square miles is mapped.

Annandale cobbly silt loam, steep phase.—This phase is shallower, steeper, and has a larger proportion of cobblestones and boulders than Annandale cobbly silt loam, sloping phase. The land is too steep for cultivation and is best suited to forestry, although a few areas have been cleared and are used for pasture. The total area is 2.2 square miles.

Annandale silt loam.—This soil occurs in undulating to gently rolling areas in northern Bucks County. The soil is developed over a heterogeneous mixture of fragmentary gneiss, sandstone, and shale, with considerable sand and clay and a small proportion of gabbro and diabase. The material appears to be very old glacial till that has been strongly weathered. A total area of 1.1 square miles is mapped.

The surface soil, 8 to 10 inches deep, is a dusky-brown or weak-brown silt loam containing a few small stone fragments of various kinds. The subsoil to a depth of 20 to 28 inches is a pale yellowish-brown firm but friable clay loam or silty clay loam, which is quite sticky when wet. This layer grades into a pale-yellow somewhat gravelly blocky clay loam, which, at a depth of 28 to 34 inches, grades in turn into a light-brown or yellowish-brown clay loam mottled faintly with gray. This layer contains many fragments of quartzite and a little gneiss. Beneath this, at a depth ranging from 50 to 60 inches, is a somewhat compact heterogeneous mixture of stone fragments and finer particles, already described, which is thought to be very old glacial till.

The surface soil is strongly to medium acid, and the subsoil horizons range from very strongly to medium acid.

Annandale silt loam is a highly productive soil where well managed, and it is used chiefly for dairying and general farming. Yields are not so high as on Chester silt loam.

Annandale silt loam, colluvial phase.—This phase occurs in very gently sloping areas adjacent to and around the heads of small streams, most of which are intermittent in flow. Drainage is slightly impeded over most of the areas, but it is slow to very slow in the lowest and most nearly level parts.

The surface soil to a depth of 10 to 14 inches is a brownish-gray to pale brownish-gray friable and thinly platy silt loam. The subsoil to a depth of about 20 inches is a pale-yellow heavy and sticky silty clay loam, which grades into yellow, brown, and gray mottled silty clay loam in which the proportion of gray increases with depth. The lower layers are much like those of normal Annandale silt loam, except that the materials are mottled.

The soil of this phase ranges from medium to strongly acid throughout. It is used in practically the same way as Califon silt loam, and crop yields are about the same. The soil produces its highest yields during years when rainfall is less than normal. In wet years it warms up very late in spring and crops are frequently injured by excess of moisture.

Washington silt loam.—This soil, with a total area of only 2.3 square miles, occurs in the rolling area in the northernmost part of Bucks County, where it occupies the gentler slopes.

The surface soil, to a depth of 8 to 10 inches, is a weak-brown or dusky-brown friable silt loam containing a few subangular pebbles and cobblestones in a few places. The subsoil to a depth of about 40 inches is a brownish-yellow to light reddish-yellow friable clay loam or silty clay loam. Beneath this is a brownish-yellow gritty clay loam containing subangular boulders and cobblestones of gneiss, sandstone, granite, and limestone. This appears to be strongly weathered glacial till.

The surface soil and the subsoil vary from medium acid to slightly acid, and the deeper parts of the parent material are alkaline.

Three-fourths or more of the type is plowed and cultivated. Corn, oats, wheat, and mixed and leguminous hays are the principal crops, and on most farms dairying is the main source of cash income. On these gently sloping areas, yields are about the same as on Annandale silt loam.

Washington silt loam, sloping phase.—This phase, as mapped, includes both moderately sloping areas averaging about 7 percent gradient and a few steeper slopes where gradients are as high as 20 percent. The soil profile differs from that of normal Washington silt loam in that it is not quite so thick and in a few places bedrock protrudes through the glacial till and is exposed at the surface.

About one-third of the area is used for cultivated crops, and the remainder is used for pasture and forestry. The crops grown and the yields obtained on the less steep areas are about the same as on Chester silt loam, sloping phase.

MISCELLANEOUS LAND TYPES

Miscellaneous land types in the Piedmont part of Bucks County include three kinds of rough stony land and a considerable area of alluvial soils, undifferentiated. The latter are discussed in a later section along with the rest of the soils of the first bottoms.

Rough stony land consists of lands too rough, stony, or broken for agricultural use. Large, loose, or outcropping rocks cover much of the surface. In the small spaces between the rocks the soils are quite variable and range from gritty loams to heavy clay loams underlain by shallow or deep subsoils. This range of soil conditions is shown on the accompanying soil map in three miscellaneous land types on the basis of the soil material.

Most of the rough stony land supports a mixed growth of timber and brush consisting of various oaks, hickory, maple, elm, beech, dogwood, cedar, locust, poplar, and cherry. It cannot be cultivated economically, but it affords protection and scanty grazing for livestock.

Rough stony land (Penn soil material).—This land type occurs largely on the Delaware River cliffs in the northeastern part of the county. These areas consist of outcropping shale blocks on the river bluffs and some of the tributary streams. The slopes range from steep to almost precipitous. This land occupies a total of 1.1 square miles and occurs west of Upper Black Eddy and near Kintnersville, Uhlerstown, and Lumberville.

Rough stony land (Chalfont and Lehigh soil materials).—This second land type is not so well defined. It occurs in association with the Chalfont and Lehigh soils on the river bluffs east of Tinicum

and has a total area of 1.6 square miles. It consists largely of Chalfont soil materials.

Rough stony land (Montalto soil material).—This land type has the largest area of any of the three types of rough stony land in Bucks County. It is the roughest of the three kinds and is most conspicuous on Haycock Mountain and Ringing Rock. The total area is 5.5 square miles.

SOILS OF THE COASTAL PLAIN

The Atlantic Coastal Plain of the eastern and southern United States consists of a series of level to rolling plains underlain by stratified sand, silt, gravel, and clay. A relatively small section of the Coastal Plain lies in southeastern Bucks County, west of the Delaware River bottoms. It has been slightly dissected so that it now consists of an undulating to level plain, somewhat lower than the Piedmont, with strong slopes adjacent to the streams that cross it.

The Sassafras, Woodstown, and Fallsington soils are developed in acid sandy and silty sediments over fine and coarse quartz gravel. The Elkton soil is developed principally in silt and clay deposits. The Sassafras soils are well drained, the Woodstown soil is imperfectly drained, and where not artificially drained the Elkton and Fallsington soils are saturated during about two-thirds of each year.

Sassafras silt loam.—This is one of the important soils of the county. The total area, 19.6 square miles, is all in the south-central part. Some of the larger areas are in the vicinities of Bensalem, Bridgewater, and Maud Post Office. The areas are almost level to undulating. There is good surface and subsoil drainage, and yet the soil seems to be able to conserve soil moisture. It is one of the last soils to show the effects of dry weather, especially where it is farmed efficiently.

Sassafras silt loam occurs on what is known as the Atlantic Coastal Plain which consists of deposits formed in the ocean in past ages and later elevated above sea level. These deposits are not very thick in Bucks County, and the underlying rocks are exposed in many of the deeper stream valleys.

The surface soil consists of yellowish-brown to weak-brown silt loam 6 to 12 inches deep. This passes gradually into a lighter colored layer of yellow to yellowish-brown light silty clay loam. This layer usually extends to a depth between 20 and 30 inches, where it rests upon a compact heavy yellowish-brown to light reddish-brown silty or sandy clay mottled or marbled with gray, yellow, and red and intimately mixed with small rounded white, yellow, and brown-stained quartz gravel. This gravelly layer, or bed, is quite variable in thickness, generally ranging from 10 inches to several feet.

This soil type is generally deeper in its western and central extension and shallower eastward toward the Delaware River. It ranges from very strongly to strongly acid. The pH values that were determined in the field varied from 4.5 to 5.2, except where the soil had been limed. In general, Sassafras silt loam is deficient in organic matter and the soil is slightly compact. Where it has been well managed, however, the content of organic matter is fairly

high and the surface soil is relatively mellow. In undisturbed situations, roots are abundant in the surface soil but are more scattered in the subsoil.

Included on the soil map with Sassafras silt loam are a few small areas of Sassafras gravelly silt loam with an aggregate area of about 1 square mile and located in the vicinity of Roelofs. These areas occupy low ridge crests and the approaches to valley slopes. The surface and subsoil layers are a little more reddish brown than the normal Sassafras silt loam, and there is a conspicuous concentration of small rounded gravel over the surface and throughout the soil section. Sassafras gravelly silt loam is shallower than Sassafras silt loam and has been formed principally by the erosion of the surface layers of Sassafras silt loam, permitting the underlying gravel beds to be exposed.

About two-thirds of the Sassafras silt loam is clear of timber, and the rest supports a mixed growth of various oaks, poplar, hickory, gum, maple, and beech, with small shoots of sassafras, ironwood, dogwood, and witch-hazel. Where cultivated, this soil is used for the production of corn, wheat, oats, hay, forage, pasture, and some garden vegetables and fruits. In addition some land is used for commercial truck crops. Much of the land, particularly near the larger towns, is held for urban development and real estate projects, and probably less than half of the entire area is used for agricultural purposes. There is considerable variation in the productive capacity of this soil, depending on the management. Some of the farms are highly productive. The reported yields of corn, for example, range from 15 to 80 bushels. Estimated average yields are as follows: Corn, 40 bushels; wheat, 20 bushels; oats, 35 bushels; potatoes, 200 bushels; and mixed hay, 1 ton to the acre. Some good crops of alfalfa are grown, especially where the soils have been limed. The yields on the included areas of Sassafras gravelly silt loam are less, especially during periods of drought.

One of the highly specialized truck farms reported the following maximum acre yields: Michigan Russet potatoes, 620 bushels; spinach, 600 to 700 bushels; parsnips, 350 bushels; carrots, 500 to 700 bushels; and tomatoes, 8 to 10 tons. Some acreage is also planted to asparagus, and some good crops were observed.

Sassafras silt loam, sloping phase.—This phase resembles normal Sassafras silt loam except that in general the soil is shallower to the underlying gravel and it occupies sloping positions on valley slopes. It occupies 2.3 square miles. Included with this phase on account of their restricted distribution are a few small areas of Sassafras gravelly silt loam, sloping phase, which occupy in all about half a square mile in the vicinity of Roelofs.

More than one-half of this phase is covered with trees and brush, and much of the open country is used for pasture. Where cultivated the land of this phase is used for the same crops as the normal phase, but it is not so productive, and the slopes are generally subject to serious wash and erosion. Reported yields of corn range from 15 to 30 bushels, wheat 5 to 15 bushels, oats 10 to 25 bushels, and hay or forage, ½ to 1 ton to the acre.

Sassafras loam.—The surface ranges from almost flat to undulating. Surface drainage and subsoil drainage are good. The soil is derived from deposits similar to those below Sassafras silt loam.

Sassafras loam has a total area of 2.7 square miles. Representative areas occur in the vicinity of and southwest of Fallsington, near Edgewood, and in the vicinity of Roelofs.

The surface soil consists of yellowish-brown or pale-brown loam 8 to 12 inches deep. This passes gradually into a lighter colored layer of fine to very fine sandy clay, which at a depth between 20 and 30 inches rests rather abruptly on a marbled light reddish-brown or brownish-yellow and yellow sandy clay intimately mixed with gray, yellow, or brown-stained small quartz gravel. This layer ranges from 10 to 20 inches in thickness.

Sassafras loam varies from very strongly to strongly acid. It has a fair supply of organic matter. In undisturbed situations roots are abundant in the surface layer and more scattered in the subsoil layer.

Included with the Sassafras loam because of their small total area are areas of Sassafras sandy loam and Sassafras gravelly silt loam. These soils are restricted in distribution to what is known as Turkey Hill, and their total area is less than 1 square mile.

Most of the soil of this type is cleared. Where cultivated it is used for corn, wheat, oats, potatoes, hay, pasture, garden vegetables, and fruits. Estimated yields are as follows: Corn, 35 bushels; wheat, 18 bushels; oats, 35 bushels; potatoes, 175 bushels; and hay, 1 ton to the acre. Some land is used for growing tomatoes, spinach, beets, and asparagus, and these crops seem to do well. The pastures in general are not so good as those on the soils of the Piedmont Plateau. Where the soil has been consistently limed, alfalfa has been successfully grown. The included areas of the sandy loam and gravelly silt loam types are not so productive of general farm crops but are well suited to fruits and early truck crops.

Sassafras loam, sloping phase.—This phase occurs on slopes, usually of a gradient exceeding 7 percent, and where cultivated it is subject to erosion. Gravelly substrata are nearer the surface than in Sassafras loam. The phase as mapped includes several small areas with a surface soil of gravelly loam.

The larger areas are 1½ miles west of Woodbourne and 1 mile northwest of Penn Manor. About one-half is covered with brush and trees, and most of the cleared land is used for pastures. It is less productive than the normal phase, and crops suffer during prolonged dry spells.

Woodstown silt loam.—This soil occupies flat and very slightly depressed areas near streams or heads of streams. It is imperfectly drained, particularly in the subsoil layers. The parent material is similar to that of the Sassafras soils, except that the surface layer in some places consists in part of colluvial material derived from higher lying Sassafras soils. This soil type has a total area of 7.5 square miles and is confined to the southern part of the county.

The surface soil consists of brownish-gray silt loam 6 to 10 inches deep. This passes gradually into pale-yellow heavy silt loam or light silty clay loam with faint mottles of gray and brown. This material continues to a depth of 15 to 20 inches, where it rests on compact brownish-yellow silty clay loam more conspicuously mottled with gray and brown. Usually within the 3-foot section the subsoil rests on a gravelly layer consisting of silty or fine sandy clay loam mottled or marbled with gray, yellow, and brown, intimately mixed with small rounded white, yellow, and brown-stained quartz gravel.

Woodstown silt loam ranges from extremely acid to very strongly acid. The soil has a good supply of organic matter. Roots are usually abundant in the surface layer, particularly in undisturbed spots.

A few small areas of Woodstown loam are included on the map with Woodstown silt loam on account of their limited distribution. These occur in the vicinity of Fallsington and 1½ miles southeast of Oxford Valley. The chief difference between them and the areas of Woodstown silt loam is the texture of the surface soil, which is a loam. The total of these areas is about 1¾ square miles.

About three-fourths of the land is clear of trees and brush, but little of it is used for cultivated crops, as most of it is in pasture. Where the soil is cultivated, corn and hay are the principal crops. Some small patches of small grains and vegetables are grown on the better drained spots or where the land has been ditched. The reported yields of corn range from 25 to 60 bushels and those of mixed hay from ½ to 1½ tons to the acre. Estimated average yields are 35 bushels and 1 ton, respectively.

Fallsington silt loam.—This soil occurs on level divides, chiefly around stream heads. It is wet during the winter, spring, and early summer, but generally dries out during late summer and autumn and frequently becomes very droughty during this period. Under natural conditions it has a cover of moisture-loving and swamp-tolerant hardwoods, and cleared areas grow up to sedges and water-loving grasses.

The surface soil to a depth of 10 to 14 inches is a very light-gray silt loam with dark rusty-brown mottles and many small black concretions. Beneath this is a layer of light-gray heavy silt loam mottled with yellow and brown and also containing many small brown and black concretions. At a depth ranging from 20 to 30 inches this layer grades into a heavy gray and rusty-brown mottled silty clay loam that becomes more and more gritty with depth. At a depth of 30 to 40 inches is a layer of rusty-brown and gray mottled gravelly clay loam or sandy clay loam that becomes more gravelly and sandy with depth. The reaction is extremely to strongly acid in the upper three horizons, and strongly to medium acid below.

Most of Fallsington silt loam either remains in forest or is used for pasture and hay. A few areas have been drained and are used for growing hay and corn. Yields of hay vary from very low up to 1½ tons to the acre. Corn yields are usually very low.

As mapped, the type includes several small areas of Fallsington loam, which have about the same use value as the normal phase.

Elkton silt loam.—This soil is similar to Fallsington silt loam except that the lower part of the profile is a heavy silty clay loam to a depth of 4 to 5 feet, where it may or may not be underlain by layers of sand and gravel. It varies from extremely to strongly acid in reaction. Roots are usually abundant in the surface layer and more scattered in the subsoil.

Elkton silt loam occupies flat or depressed areas near watercourses or on divides around the heads of streams. It is wet during much of the year and in cleared areas is covered with sedges and water-loving grasses. It was formerly covered by a swamp-hardwood forest. There are, however, a few local patches where artificial drainage has been established, and here it is used for the same crops and has about

the same value as Woodstown silt loam. In general, however, this type has little agricultural value at present except for pasture. Included with this type are a few small areas of Elkton loam and Fallsington silt loam. The total area is 7.1 square miles.

SOILS OF THE STREAM TERRACES AND BOTTOMS

A series of natural terraces and overflow bottoms follows the course of the Delaware River and its tributaries. All but the lower terraces are too high to be flooded. The sediments of the terraces are mostly silty and sandy, whereas those of the bottoms range from very sandy to rather clayey.

SOILS OF THE TERRACES

Most of the gravelly, sandy, and silty stratified deposits of the terraces are thought to have been laid down at the time the great glacial sheet was melting away from the area to the north of Bucks County. Many kinds of rocks contributed to these sediments, but quartzite is the dominant one.

Chenango silt loam.—The surface is almost level or slightly undulating. Surface drainage and subsoil drainage are good. Most of the land was above the flood waters of 1936, but it was covered in 1903. Chenango silt loam has a total area of 0.3 square mile. It is restricted to two areas at Brownsburg.

The surface soil consists of mellow brown silt loam 8 to 12 inches deep. This passes gradually into a lighter colored layer of yellowish-brown or light reddish-brown silty clay loam, which extends to a depth between 24 and 40 inches, where it rests on a compact bed of small rounded gravel intermixed with brown or light reddish-brown sandy or silty clay. This clayey gravel bed in most places has a depth exceeding 2 feet and is underlain by loose gravel and sand.

Chenango silt loam ranges from medium to slightly acid in reaction. There is usually a good average supply of organic matter. In undisturbed situations roots are abundant in the surface layer and more scattering in the subsoil.

Most of this type is clear of trees and brush except for a few trees near home sites and along fence lines. It is used for the production of corn, wheat, oats, potatoes, and hay, and to some extent for commercial truck crops. Reported yields show considerable variation, but it is estimated that average yields are about as follows: Corn, 45 bushels; wheat, 25 bushels; oats, 40 bushels; potatoes, 175 bushels; and mixed hay, 1½ tons to the acre. Some land is also planted to rye and alfalfa. Rye sometimes takes the place of wheat, and alfalfa replaces hay in the rotations. The reported yields of rye are about the same as for wheat, and alfalfa is said to yield about 2 to 2½ tons to the acre. Truck crops are not so important on Chenango silt loam as on the Tioga soils, but among the truck crops observed were spinach, beets, tomatoes, sweet corn, and asparagus, all of which seem to do well.

Chenango gravelly loam.—The total area of Chenango gravelly loam is 1.3 square miles. Areas occur north of Yardley, Pa., three-quarters of a mile west of Titusville, N. J., 1¼ miles south of Moore,

N. J., 1 mile northwest of Lambertville, N. J., and in the vicinity of Narrowsville, Pa. The relief ranges from almost flat to gently rolling. Most of the land is above overflow. It has good surface and subsoil drainage. The parent materials are similar to those of the other soils of the terraces.

The surface soil consists of grayish-yellow to light brownish-gray loam or silt loam 6 to 12 inches deep, resting on a slightly compact layer of lighter color, consisting of loam, silt loam, or light silty clay loam. This layer extends to a depth between 20 and 30 inches, where it rests on a bed of gravel intermixed with loam, silt loam, and fine sand. Over the surface and throughout the soil is a conspicuous quantity of rounded gravel ranging from about ½ to 3 inches in diameter. The gravel on this type is usually larger than that associated with the Chenango and Unadilla silt loams.

Chenango gravelly loam ranges from very strongly to strongly acid. It has only a fair supply of organic matter except in the places where it is used for permanent pastures. In undisturbed situations roots are not so concentrated in the surface layer as they are in the Chenango silt loam, and they are more scattered in the subsoil. Although there is considerable gravel on the surface, it does not seem to interfere seriously with cultivation except that it is said to be hard on farm tools.

Two small areas of imperfectly drained gravelly loam close to drainageways are included with this type on the soil map. They have a total area of about one-quarter of a square mile and occur 1 mile southwest of Titusville, N. J., and half a mile south of Moore, N. J.

Most of the type is clear of trees and brush. It is considered more valuable as a source of gravel and sand than for agricultural purposes. Where farmed it is used for corn, wheat, oats, potatoes, hay, and pasture. Yields are reported to range as follows: Corn from 35 to 50 bushels; wheat, 15 to 25 bushels; oats, 30 to 45 bushels; potatoes, 100 to 150 bushels; and mixed hay, 1 to 1½ tons to the acre.

Chenango gravelly sandy loam.—This is a very inextensive soil, as only 0.2 of a square mile, or 128 acres, is shown on the soil map. The areas are situated along the Delaware River about 1 to 2 miles north of New Hope. The sandy loam texture of the surface layer distinguishes this soil from Chenango gravelly loam.

The surface soil is light brownish-gray gravelly sandy loam to a depth of 10 to 14 inches. This grades rapidly through a light brownish-yellow gravelly sandy loam to a yellowish-brown gravelly loam or gravelly clay loam. At a depth of 20 to 30 inches this rests on interbedded layers of gravel and sand with a small proportion of clayey materials. The reaction of the first two layers generally is strongly acid, but the subsoil layers vary from medium to slightly acid.

The crops that are grown are about the same as those on Chenango gravelly loam, but yields average somewhat less. The soil is well suited to truck crops, and a part of it is used for this purpose.

Chenango gravelly loamy sand.—This soil occupies a lower position than Chenango gravelly loam, and a considerable proportion of it was flooded in 1903. The relief is undulating to very gently rolling. The parent materials are similar to those of the other soils of

the terraces. The type has a total area of 1.9 square miles. The larger areas are between Tullytown and Morrisville.

The surface soil consists of pale yellowish-brown or grayish-yellow gravelly loamy sand 6 to 12 inches deep. This rests on a slightly compact layer, lighter in color than the surface, usually grayish-yellow or yellow gravelly loamy sand, which extends to a depth of 6 feet or more. The pebbles on the surface and throughout the soil profile range from ½ to 2 inches in diameter and consist of quartz, quartzite, sandstone, shale, argillite, trap, gneiss, and granite.

This type ranges from very strongly to strongly acid. The soil contains very little organic matter except in places where it is used as pasture. The gravel on the surface does not interfere with cultivation.

Although most of this type is clear of trees and brush, very little of it is used for agricultural purposes. It has more value for urban and real-estate projects and as a source of gravel and sand. Where cultivated it is used for the production of corn, wheat, and potatoes, and occasionally for truck crops. The reported yields of corn range from 25 to 40 bushels; wheat, 15 to 20 bushels; and potatoes, 75 to 100 bushels to the acre. Crops mature early, but yields are generally light, especially in years having prolonged dry weather.

Unadilla silt loam.—This soil, with a total area of only 10 square miles, is restricted to the river terraces in the southern part of the county, particularly in the vicinity of Bristol and Edgely, north of Croydon and near Dunks Ferry. The relief is almost level to undulating. Surface drainage and subsurface drainage are good. The parent materials are similar to those of the other soils of the terraces.

The surface soil consists of mellow dull-brown silt loam 8 to 12 inches deep. This passes gradually into a yellowish-brown light silty clay loam, which, at a depth of 20 to 30 inches, becomes a heavier and more compact light reddish-brown or brown light silty clay loam. At a depth of 40 inches this rests on a gravelly bed consisting of compact reddish-brown or brown light silty clay, fine sandy clay, or loamy fine sand intimately mixed with fine gravel.

The Unadilla silt loam ranges from extremely to strongly acid. There is a good average supply of organic matter. In undisturbed situations roots are abundant in the surface layer and more scattered in the subsoil. On account of their limited distribution, three small areas of Unadilla silt loam, gravelly phase, totaling about five-eighths of a square mile, are included with this type on the soil map. These spots are located 1 mile southwest of Penn Valley and in the vicinity and northeast of Edgely. These areas are essentially the same as those of Unadilla silt loam except that over the surface and throughout the soil there is a conspicuous quantity of small rounded mixed gravel. These spots are used for the same purposes and have about the same value as the normal phase.

Although most of the total area is open and clear of trees or brush, probably less than one-half is used for agricultural purposes. Much of it is included in urban development or in real estate projects and as a source of gravel and sand. Where cultivated, Unadilla silt loam is used for the production of corn, wheat, oats, potatoes, and hay or forage, and for some commercial truck crops. There is not so great a variety of truck crops grown on this soil as on Tioga silt loam, and there is also less alfalfa. The reported yields of corn range

from 40 to 80 bushels; wheat, 20 to 40 bushels; oats, 40 to 50 bushels; potatoes, 100 to 300 bushels; and hay, 1 to 1½ tons to the acre. Estimated average yields are as follows: Corn, 50 bushels; wheat, 25 bushels; oats, 45 bushels; and potatoes, 200 bushels. Beans, tomatoes, rhubarb, and carrots are the principal truck crops. Snap beans are the most important, and in some places two crops are grown on the same field and yields of 100 ⅝-bushel baskets to each crop are reported. In general, fields are limed each year, and applications of about 700 to 1,000 pounds to the acre of commercial fertilizer of 4–8–7, 4–8–8, 5–10–5, 5–10–10 or similar ratios are used for each crop. One grower on this soil who specializes in potatoes claims a yield of 300 to 400 bushels. He uses 1,400 to 1,500 pounds of 4–8–7 fertilizer. Green Mountain and Irish Cobbler are favorite varieties. Potatoes are planted with a 2-row planter in rows 36 inches apart. They are sprayed 14 to 18 times with 5–5–50 bordeaux mixture.

Elsinboro loamy fine sand.—This soil occupies terraces of the Delaware River and represents alluvium deposited on the flood plains when the river occupied a higher position than it does at present. It is not normally subject to overflows or inundation, but most of it was covered in the river flood of 1903. The relief is almost level or slightly undulating. Surface drainage and subsoil drainage are good. The total area of only 9.7 square miles occurs in several bodies east and northeast of Tullytown and Penn Valley, northwest of Morrisville and Taylorsville, half a mile northwest of Moore, N. J., and half a mile south of Brookville, N. J.

The surface soil consists of dull-brown or brown loamy fine sand 8 to 12 inches deep. This passes rather abruptly into a lighter colored layer of compact light reddish-brown heavy loamy fine sand. Usually between 24 and 36 inches this grades into a less compact grayish-yellow or gray fine sand. This layer varies in thickness from 20 inches to 4 feet and rests on a bed of mixed gravel of mixed color and character.

Elsinboro loamy fine sand is generally slightly acid in the surface layer and slightly acid to neutral in the subsoil. There is a fair supply of organic matter, especially in the surface layer. In a few places there is a scattering of small rounded gravel on the surface. In undisturbed situations roots are abundant in the surface layer and more scattered in the subsoil.

Practically all of this type is cleared of trees and brush except for a few willows, sycamores, and elms along the river banks in some places. Most of the land is used for recreational purposes, and much of it is dotted with summer homes and camp sites and parks. Only a very small proportion is used for cultivated crops. Most of this is south and southwest of Morrisville. The principal crops are corn, wheat, potatoes, hay, and truck crops. Yields are estimated to average about as follows: Corn, 35 bushels; wheat, 15 bushels; potatoes, 150 bushels; and mixed hay, 1 ton to the acre. Some good crops of alfalfa were seen on this type during the progress of the survey. Farmers say they have little trouble in getting good stands. All kinds of vegetables do well and mature slightly earlier than on the heavier soils. The soil is easy to work, and surface features are such that labor-saving machinery can be used.

489603—46——5

Because of limited distribution, a small area of Chenango loamy sand and one of Chenango gravelly sandy loam have been included in the mapping of this soil. The former is half a mile south of Taylorsville and is about one-sixteenth of a square mile in extent. The latter occurs 1 mile northwest of Lambertville and occupies about a quarter of a square mile.

Also included with Elsinboro loamy fine sand, on account of its limited distribution, is an area of a high-terrace phase that occurs in the vicinity of Riegelsville and occupies about half a square mile. This area occupies a position about 160 feet above sea level. This phase differs from the normal soil in that the gravel bed comes closer to the surface, and the light reddish-brown color of the normal subsoil is missing; it is similar in texture to the normal phase. Practically none of this area is used for agricultural purposes. An important gravel and sand project is located on it. At a depth of 10 to 15 feet the gravel is cemented with lime carbonate. Partly weathered limestone fragments are frequent. The soil is neutral according to pH determinations made of the surface and subsoil layers.

Elsinboro loamy sand.—This soil occurs in positions similar to those of Elsinboro loamy fine sand. The profile resembles that soil except that the sand fraction is coarser and the percentage of silt and clay is slightly less. The type has a total area of only 0.5 square mile. It is restricted to the terraces of the Delaware River, and representative areas are west and northwest of Byram, N. J., half a mile west of Titusville, N. J., north of Narrowsville, and southeast of Fallsington.

Most of this type is cleared, but little of it is used for agriculture, as the greater part is used for recreational purposes. Where cultivated it is used for the production of corn, wheat, potatoes, hay or forage, alfalfa, garden vegetables, and fruits. It is less productive than Elsinboro loamy fine sand, and crops are affected adversely by protracted dry spells. Estimated average yields are as follows: Corn, 30 bushels; wheat, 12 bushels; potatoes, 100 bushels; hay, ½ ton; and alfalfa, 1 to 1½ tons to the acre.

Braceville silt loam.—This soil type with its inclusions forms parts of present and old drainage channels that have developed during flood periods and have become partly filled by colluvial materials. These areas are the first usually covered by water during high floods. The soils show imperfect drainage only in the subsoils and are usually worked in common with adjacent fields. The surface soil consists of dull-brown or dark-brown silt loam 8 to 14 inches deep. This passes gradually into a yellowish-brown clay loam or light silty clay loam that is rarely more than 6 inches thick. This rests on mottled gray, yellow, and brown compact silty clay loam or fine sandy clay loam, which, at a depth between 30 and 50 inches, is underlain by mottled gravelly loam or gravelly fine sand.

Braceville silt loam ranges from very strongly to strongly acid. This soil has a total area of 3.5 square miles.

On account of their small total area, three other imperfectly drained soils have been included with this type on the soil map. The first is Braceville loam, with a total area of about three-eighths of a square mile. It occurs on the west side and near the mouth of Neshaminy

Creek and also in a small area near Eddington. The principal difference between this and the normal soil is the texture. It is used, however, for the same crops and has about the same agricultural value. The second inclusion is Braceville loamy fine sand. The principal difference here also is texture, and the soil is much lighter than the normal soil. The total area is only one-fourth of a square mile. It is located east and southeast of Tullytown and half a mile northwest of Edgely. The third inclusion is a soil known elsewhere as Lobdell silt loam, which in general conforms to Braceville silt loam except that it is shallower, ranges from medium acid to very slightly alkaline, and is more subject to overflow. In Bucks County it is inextensive and occupies only about five-eighths of a square mile.

It is reported that crops grown on these phases in dry weather are generally heavier than on the soils of the uplands, but that in wet weather the adjacent uplands are more productive. Farms consisting of both the uplands and the imperfectly drained terraces are therefore in a better position to maintain production over a series of years marked by dry and wet conditions than are farms with only the one situation.

The principal crops grown on these phases are corn, wheat, hay, and forage. Reported yields of corn in dry seasons range from 40 to 60 bushels, wheat 15 to 35 bushels, and hay (timothy and clover) or forage 1½ to 2 tons to the acre.

SOILS OF THE FIRST BOTTOMS

Many areas of soils of the stream bottoms along the Delaware River lie at a level so high that they are covered by water only during exceptionally high floods. The various Tioga soils fall in this category.

The moderately well-drained Bermudian soil and the imperfectly to poorly drained Bowmansville soil consist largely of dull reddish-gray sediments washed from the Penn, Bucks, and Lansdale soils. The imperfectly drained Codorus and the poorly drained Wehadkee soils consist largely of materials washed from the Chester, Manor, and Montalto soils; and the poorly drained Melvin soil consists largely of materials washed from the Duffield soils.

Alluvial soils, undifferentiated, as the name suggests, are composed of alluvial materials of variable texture and drainage conditions.

Tioga silt loam.—This is one of the minor soils of the county in area, as it occupies a total area of 4.9 square miles. Most of it is restricted to the Big Bend of the Delaware River. It occurs in the vicinity of Penn Manor, 2 miles southeast of Tullytown, on Biles Island, 1 mile southeast of Yardley, and ½ mile northeast of Durham Furnace. The surface is almost flat to slightly undulating. Surface drainage and subsoil drainage are good. The areas were almost entirely covered by the flood waters of 1936, for the first time since the flood of 1903. Except for differences in the time of deposition, the parent materials are similar to those of the other soils of the terraces. The surface soil consists of mellow brown to dull-brown silt loam 8 to 12 inches deep. This passes gradually into a yellowish-brown heavy silt loam or light silty clay loam, which, at a depth between 15 and 24 inches, becomes more compact and slightly

heavier in texture and ranges from brown to slightly reddish brown in color. This layer is generally very shallow, rarely more than 6 inches thick; and it rests on a gravel bed consisting of brown or slightly reddish-brown loam (and more rarely fine sand) intimately mixed with small rounded gravel.

Tioga silt loam is not generally so deep as the Chenango or Unadilla silt loams, and the underlying gravel bed usually comes within 30 inches of the surface. This soil ranges from medium acid to slightly acid. It has a good supply of organic matter, and this is one reason that the surface layer is comparatively dark. The surface is generally free of gravel, but in places there is a scattering of gravel over the surface, though not in sufficient quantity for the surface soil to be considered gravelly. Such a condition occurs 1¾ miles northeast of Tullytown. Plant roots have no difficulty in penetrating to the underlying gravel bed.

Practically all of this soil is open and cleared of trees and brush except for a few trees near home sites and along fence or drainage lines. It is used for the production of corn, wheat, oats, potatoes, hay, and commercial truck crops. Under good farming practices and in the years of favorable moisture, yields are relatively high, as evidenced by reported yields of 50 to 80 bushels for corn, 30 bushels for wheat, 50 to 60 bushels for oats, 200 to 300 bushels for potatoes, 1½ to 2 tons for hay, and 2 to 3 tons for alfalfa. Average yields are estimated to be considerably lower and are probably about as follows: Corn, 45 bushels; wheat, 25 bushels; oats, 40 bushels; potatoes, 200 bushels; and hay, 1½ tons. Probably half of the entire area is used for commercial truck crops consisting of spinach, beans, beets, lettuce, rhubarb, tomatoes, potatoes, carrots, cabbage, cauliflower, sweet corn, horseradish, and asparagus. All truck crops seem to do well on this soil. The topography and the physical nature of the soil both encourage the use of labor-saving machinery, and crops are grown more economically than on other soil areas with less favorable features.

Tioga loamy fine sand.—Most of this soil occurs on or near the Delaware River banks, and the surface is almost flat to gently rolling. All of the areas were covered by the flood waters of 1936. The soil has good surface and subsoil drainage, but the water-holding capacity is not so good as on the Tioga silt loam. The parent materials are the same as those of the other soils of the bottom lands or low-river terraces. Tioga loamy fine sand, with its inclusions, has a total area of 5 square miles. Typical areas occur in the vicinity of Yardley, southeast of Andalusia, 1 mile southwest of Penn Manor, half a mile north of Kintnersville, near Uhlerstown, and in the vicinity of Riegelsville. The surface soil consists of brown or dull-brown loamy fine sand or heavy loamy fine sand 8 to 12 inches deep. This passes gradually into a lighter colored layer of brown loamy fine sand or heavy loamy fine sand, which, between 20 and 30 inches, passes into gray or yellowish-brown fine sand. This, in turn, is rarely more than 6 inches thick and rests on a compact bed of gravel consisting of reddish-brown gravelly loam or brown gravelly fine sand.

This soil is medium to slightly acid. It has a good average supply of organic matter, and this accounts for the dark color of the surface layer. The surface is practically free of gravel. In undisturbed

situations, roots are abundant in the surface layer and more scattered in the subsoil.

Included with this soil type are a few soil types too limited in distribution to warrant separation on the accompanying map. These include Tioga fine sand, Tioga gravelly fine sand, Tioga loamy sand, and Tioga gravelly sandy loam. Tioga fine sand occupies in all about 1 square mile. It occurs in the vicinity of Point Pleasant, on Lynn Island, half a mile north of Kintnersville, half a mile north of Narrowsville, on Moon Island, and on the island near Morrisville. Most of it is used for recreational purposes and urban development. Tioga gravelly fine sand occupies about half a square mile. It is located 1 mile and 2 miles southwest of Bristol and has about the same value as Tioga loamy fine sand. Tioga loamy sand occurs half a mile southwest of Scudders Falls, N. J.

Tioga loamy fine sand is nearly all cleared of trees and brush except where it occurs on the islands and river banks and where there is a more or less scattered growth of sycamore, elm, gum, willow, and maple. Most of the total area is used for recreational activities and real estate projects, and very little is used for agricultural purposes. Where it is cultivated, the principal crops are corn, wheat, oats, potatoes, and mixed hay. Estimated average yields are as follows: Corn, 35 bushels; wheat, 18 bushels; oats, 35 bushels; potatoes, 150 bushels; and hay, 1 ton to the acre. Alfalfa is successfully grown in some places, and yields of 2½ tons are reported. The soil is easy to work; it warms up early in spring, and crops mature early, but they are said to be more easily affected by prolonged dry weather than those on Tioga silt loam.

Bermudian silt loam.—This soil occupies the first bottom lands along streams and is subject to frequent overflows. These bottom lands are usually narrow, being rarely more than a quarter of a mile wide. The relief ranges from level to slightly undulating. Drainage in the surface soil is fairly well established, but the lower subsoil is imperfectly drained. The parent alluvium has been washed for the most part from the Penn and Bucks soils and deposited on the flood plains of streams during overflows.

Bermudian silt loam is one of the minor soils of the county, having a total area of 6.1 square miles. It occurs in the central part of the county and is well developed in spots along Little Neshaminy Creek and the northeast branch of Perkiomen Creek and also near the headwaters of Mill Creek. The surface soil consists of brown to dull reddish-brown heavy silt loam 8 to 12 inches deep. This passes gradually into a lighter colored layer of light silty clay loam of reddish-brown, yellowish-brown, or pinkish-brown color. This extends to a depth between 20 and 30 inches, where it passes into a compact silty clay of pinkish brown faintly mottled with yellow and rusty brown. Generally at a depth between 30 and 40 inches this material is underlain by a heavy silt loam of reddish brown or pinkish brown mottled with gray and yellow and intermixed with fragmentary Indian-red or reddish-brown shales, or it rests on bedrock of the same color.

The surface and subsoil layers range from strongly to medium acid. The soil has a good average supply of organic matter. In pastures and undisturbed situations, roots are abundant in the surface layer and more scattered in the subsoil layers.

Most of the areas are open and clear of trees and brush. A few sycamore, willow, alder, and various oaks form a scattered growth. An occasional crop of corn or hay is produced on the best drained spots, but most of the land is used for pasture.

Bowmansville silt loam.—This soil occupies level or nearly level first bottom lands, most of which are relatively narrow and subject to frequent overflows. Drainage in the surface layer is imperfect and in the subsoil poor. Like Bermudian silt loam, it is developed from material washed from the Penn and Bucks soils and deposited on the flood plains of the streams during overflows. The areas, which total 12 square miles, occur in spots along Neshaminy Creek, the northeast branch of Perkiomen Creek, Tinicum Creek and its tributaries, and the headwaters of Tohickon, Beaver Run, and Morgan Creeks. The surface soil consists of brown or reddish-brown heavy silt loam with faint mottles of yellow and is 6 to 10 inches deep. This passes gradually into a lighter colored layer of yellowish-brown or pinkish-brown light silty clay or silty clay with conspicuous mottles of gray and yellow. This layer extends to a depth between 18 and 24 inches where it rests on a loam or gritty loam of brownish yellow mottled with gray and yellow, intermixed with Indian-red or brownish-red shale fragments, or it rests on bedded rock of the same color.

Bowmansville silt loam ranges from strongly to medium acid. It has a good average supply of organic matter. Roots are abundant in the surface soil and more scattered in the subsoil layers.

About one-half of the total area is open and clear of trees and brush. The rest of it supports a mixed growth of various oaks, hickory, elm, sycamore, ash, willow, and alder. Most of the land is too wet for cultivated crops, but it affords some natural pasture for livestock.

Codorus silty clay loam.—This soil occupies low, flat, first-bottom lands along streams and is subject to frequent overflow. The bottom lands are usually narrow and rarely more than a quarter of a mile in width. Drainage in the surface is fairly well established, but in the lower subsoil it is imperfect. The soil consists essentially of material washed from the Chester and Lansdale soils. Codorus silty clay loam is one of the minor soils of the county. It is closely associated with the Chester and Lansdale soils and occurs more generally in the south-central part of the county, particularly in spots along Neshaminy, Newtown, and Mill Creeks. The total area is 3.5 square miles.

The surface soil consists of brown or yellowish-brown light silty clay loam 6 to 10 inches deep. This passes gradually into a lighter colored layer of yellowish-brown or light-brown silty clay loam with faint mottles of gray. This layer in turn extends to a depth between 15 and 22 inches, where it rests on yellowish-brown or light-brown silty clay with conspicuous mottles of gray and intermixed with fragments of shale and gneiss. The transition between this layer and the underlying bedrock is generally characterized by a lighter textured mottled gritty loam with fragmentary rock.

Codorus silty clay loam is variable in thickness, ranging from 18 to 36 inches over the underlying rock. It is strongly to medium acid. There is a good supply of organic matter. In pastures and undisturbed situations the roots are abundant in the surface layer but more scattered in the subsoil layers.

Most of the land is clear of trees and brush, but there are some scattered growths of various oaks, elm, hickory, alder, willow, and sycamore. Occasional crops of corn and hay are produced on the better drained spots, but most of the land is used for pasture.

Wehadkee silty clay loam.—This soil occupies the low first-bottom lands along streams, most of which are very narrow, rarely more than one-eighth of a mile wide, and subject to frequent overflows. It consists largely of materials washed from the Chester and Manor soils and deposited during overflow. Drainage in the surface layer is imperfect and in the subsoil poor. It is most extensive on the bottoms of Poquessing and Neshaminy Creeks and along the headwaters of Mill and Ironworks Creeks and their tributaries. The total area is 11.6 square miles.

The surface soil consists of brownish-gray heavy silt loam with mottles of gray, yellow, and black, to a depth of 6 to 10 inches. This rests on a more compact layer of silty clay loam, loam, or gritty loam conspicuously mottled with yellow, gray, and some black. Generally, below 20 inches this layer is intermixed with fragmentary schist, gneiss, and shale or rests directly on bedrock of the same character. The surface and subsoil layers are slightly micaceous. This soil is generally shallow and rarely exceeds a total depth of 30 inches. It is strongly to medium acid. There is a good supply of organic matter. Roots are abundant in the surface layer but quite scattered in the subsurface and subsoil layers.

Most of the land is open and clear, notwithstanding that near most of the watercourses there is a scattered growth of trees consisting of various oaks, sycamore, willow, and alders. Most of the areas are too wet and uncertain for cultivated crops, but they afford some natural pasture for livestock.

Melvin silty clay loam.—This is one of the inextensive soils of the county. It occupies level first-bottom positions along streams and is restricted to Lahaska, Buckingham, and Durham Creeks. Most of these bottoms are narrow, rarely more than a quarter of a mile in width, and they are subject to frequent overflows. The soil is developed from material washed from the Duffield soils and deposited during overflow. Drainage is imperfect in the surface layer and poor in the subsoils.

The surface soil, 8 to 10 inches deep, consists of brownish-gray silty clay loam slightly mottled with gray and yellow. This passes rather abruptly into a heavy silty clay loam of pale yellow or yellowish gray conspicuously mottled with gray, brown, dark brown, and black. Below 20 inches this rests on a more compact layer of pale-yellow silty clay mottled with gray, brown, and black, which is either intermixed with dolomitic limestone and argillites or rests directly on bedrock of the same character. Melvin silty clay loam is one of the shallow soils and rarely exceeds a depth of 30 inches.

The soil is slightly acid to neutral. It has a good supply of organic matter, and roots are abundant in the surface layer.

There is only a scattering growth of maple, elm, willow, sycamore, cedar, and cottonwood. Most of the areas are too wet and uncertain for cultivated crops, but they afford some pasture for livestock. In a few places small patches are used for the growing of water cress.

Alluvial soils, undifferentiated.—These soils occupy the low-lying poorly drained bottom lands bordering some of the streams. As mapped in Bucks County, this classification or mapping unit includes five general kinds of soils.

One kind represents wash or alluvium from the soils of the Coastal Plain, and the textures range from sands and sandy loams to silt and silty clay loams. It occurs in the southern part of the county along the bottoms of Queen Anne, Mill, Common, and Brock Creeks and Rock Run. It is inextensive and occupies only about 1 square mile. These lands are subject to frequent overflows and have little value except to afford some grazing or pasture. A few small areas in the eastern part of the county that consist of small islands, bars, and lands subject to frequent overflows of the river and also some areas along small branches that drain directly into the Delaware River are included.

The second kind of undifferentiated alluvial soils occurs in the north-central part of the county and occupies about 5 square miles. It is extensive in places along Tohickon, Ridge Valley, Unami, and Hickon Creeks and their tributaries. It consists of alluvium largely from the Lehigh and Montalto soils. The surface soil is generally gray in color and ranges from silt loam to silty clay loam in texture. It is faintly mottled, whereas the subsoil is conspicuously mottled. This kind of soil is generally wet the greater part of the year. The bottoms are generally much wider than the bodies of soils in the other groups and like the others are subject to frequent overflow. These lands are too wet for crop production, but they afford scanty grazing for livestock.

The third kind consists of alluvium largely from the Chalfont soils. The surface soil is faintly mottled gray silt to silty clay loam, and the subsoil is conspicuously mottled gray and yellow silty clay. These soils are not so poorly drained as the second kind. They are intermittently wet and dry and subject to frequent overflows. They are less acid than the first kind, and some fair pasturage is grown on the better drained patches. Most of this kind of alluvial soil occurs in the central and central-western part of the county, and it occupies a total area of about 3½ square miles. It is most extensive on the bottom lands along the north branch of Neshaminy Creek, along the east part of Tohickon Creek, along the north tributaries of Tohickon Creek, and at the headwaters of Haycock Creek.

The fourth kind of undifferentiated alluvial soils occupies the smallest area of any of the five kinds. These bottom lands are limited to the extreme northern part of the county near the headwaters of Durham Creek, and they have a total area of about three-quarters of a square mile. The alluvium comes largely from the Springtown soils. This variation is darker in color than the preceding kind. There is a faint mottling in the surface soil and conspicuous mottling in the subsoil. Over the surface and scattered throughout the soil is a conspicuous quantity of pink-stained quartzite gravel. Because these bottom lands are subject to frequent overflows, they are alternately wet and dry, and their usefulness for agricultural purposes is very limited. They afford some natural grazing for livestock. Locally, the more favorable places make fair pastures or produce an occasional crop of corn.

The fifth kind of undifferentiated alluvial soils consists of gravelly and sandy materials washed from former levees, which were leveled during the flood of 1936. This material was spread over adjacent soils to form deposits of varying thickness, particularly over a few small areas of the Delaware River flood plain near Bristol and northeast of Eddington. In places it helped to fill up some of the tidal marshlands.

Tidal marsh.—The surface soil consists of a mat of organic matter containing an abundance of decomposed or partly decomposed fibers and roots. The layer is quite variable in thickness, ranging from almost nothing in some places to a thickness of 3 feet in others. Underlying this layer is a brownish- or bluish-gray loam or silty clay loam mottled with brown or rust brown. In places there is some variation in the surface textures, due to more recent deposition of sand and fine gravel washed largely from former levees.

The total area of tidal marsh in Bucks County is only 1.7 square miles. This land type is most extensive near the mouths of streams tributary to the Delaware River, particularly below Trenton, N. J. Most of it supports a growth of marsh grasses, sedges, and some calamus, and most of it is covered during high tide. It has no agricultural value at present. In some places in New Jersey much tidal marsh has been reclaimed by the use of levees and ditches.

Marsh.—The areas of marsh represent a condition somewhat similar to tidal marsh, but they are not affected by the rise and fall of tides. This land type is very limited in distribution and is restricted to the terraces of the Delaware River. It has no agricultural value, since it is wet or covered with water most of the year. It supports a growth of weeds, grasses, sedges, and cattails.

ESTIMATED YIELDS AND PHYSICAL LAND CLASSIFICATION

In table 5 the soils of Bucks County are listed alphabetically and estimated average acre yields of the principal crops are given for each soil. The estimates are based primarily on interviews with farmers and with members of the staff of the Pennsylvania Agricultural Experiment Station and the College of Agriculture. They are presented only as estimates of the average production over a period of years, according to broadly defined current practices of management. It is realized that they may not apply directly to specific tracts of land for any particular year, as the soils shown on the map vary somewhat, management practices differ slightly, and climatic conditions fluctuate from year to year. On the other hand, these estimates appear to be as accurate as can be obtained without further detailed and lengthy investigations, and they serve to bring out the relative productivity of the soils shown on the map. Although truck crops and pasture are important in Bucks County, no numerical estimates of yields are given for them because of limited information.

TABLE 5.—*Estimated acre yields of the common field crops on the soils of Bucks County, Pa., according to common current practices of management* [1]

Soil	Corn	Wheat	Oats	Mixed hay	Potatoes	Principal use
	Bu.	*Bu.*	*Bu.*	*Tons*	*Bu.*	
Alluvial soils, undifferentiated						Pasture.
Annandale cobbly silt loam	30	20	35	1.00		General farm crops, pasture.
Annandale cobbly silt loam, sloping phase.	25	18	30	.75		General farm crops, pasture, timber.
Annandale cobbly silt loam, steep phase.						Timber, pasture.
Annandale silt loam	45	30	45	2.00	175	General farm crops, pasture.
Annandale silt loam, colluvial phase	45	25	50	2.00		Do.
Bermudian silt loam [2]	30			1.75		Pasture.
Bowmansville silt loam						Pasture, timber.
Braceville silt loam	35	15	30	2.00		General farm crops.
Brandywine silt loam						Timber and brush.
Buckingham cobbly silt loam						Do.
Buckingham cobbly silt loam, sloping phase.	20	15	25	.75		Timber, general farm crops.
Buckinghan cobbly silt loam, steep phase.						Timber and brush.
Bucks shaly silt loam	40	20	40	1.00		General farm crops.
Bucks shaly silt loam, sloping phase	30	15	35	.75		General farm crops, pasture, timber.
Bucks silt loam	50	35	50	2.00	180	General farm crops.
Bucks silt loam, colluvial phase	50	35	50	2.00	180	Do.
Bucks-Chester silt loams	50	35	50	2.00	180	Do.
Califon silt loam	50	25	50	2.00		General farm crops, pasture.
Captina silt loam	50	25	50	2.00		Do.
Chalfont flaggy silt loam	30	15	30	1.00		General farm crops, pasture, timber.
Chalfont flaggy silt loam, sloping phase	25	12	30	1.00		Pasture, general farm crops, timber.
Chalfont silt loam	35	18	30	2.00		General farm crops, pasture, timber.
Chalfont silt loam, sloping phase	25	12	20	1.00		Pasture, general farm crops, timber.
Chenango gravelly loam	40	20	35	1.25	125	General farm crops, gravel pits.
Chenango gravelly loamy sand	30	15			75	Urban sites, gravel pits.
Chenango gravelly sandy loam	38	18	30	1.00		General farm crops, truck crops.
Chenango silt loam	45	25	40	1.50	175	Do.
Chester silt loam	50	35	50	2.00	200	General farm crops.
Chester silt loam, shallow phase	40	20	40	1.50		Do.
Chester silt loam, sloping phase	35	18	35	1.50		Pasture, general farm crops.
Codorus silty clay loam [2]	30			1.50		Pasture.
Doylestown silt loam						Do.
Duffield silt loam	50	35	50	2.00		General farm crops.
Duffield silt loam, shallow phase	45	25	45	1.50		General farm crops, pasture.
Duffield silt loam, sloping phase	30	18	35	1.00		Pasture, timber, general farm crops.
Edgemont channery loam	35	18	35	1.00	75	General farm crops.
Edgemont channery loam, sloping phase.	30	12	30	1.00	75	Pasture, timber, general farm crops.
Elkton silt loam [2]	35			1.00		Pasture.
Elsinboro loamy fine sand	35	15	35	1.00	150	Summer homes, recreational grounds.
Elsinboro loamy sand	30	12		.50	100	Do.
Fallsington silt loam	15			.50		Timber, pasture.
Greer silt loam	40	22	40	2.00		General farm crops, pasture.
Lansdale silt loam	50	35	50	2.00	175	General farm crops.
Lansdale silt loam, colluvial phase	50	35	50	2.50		Do.
Lehigh silty clay loam	35	18	35	1.50	150	Pasture, general farm crops, timber.
Manor silt loam	35	18	35	1.00		Urban sites, pasture, general farm crops.
Manor silt loam, gently sloping phase	40	20	45	1.50		Urban sites, general farm crops.
Marsh						Wasteland.
Melvin silty clay loam						Pasture.
Montalto cobbly silt loam	30	20	35	.75		Timber, pasture, general farm crops.
Montalto silt loam	45	30	50	1.75	175	Do.
Montalto silt loam, sloping phase	35	25	40	1.25		Pasture, general farm crops.
Montalto stony loam						Timber and brush.
Montalto stony loam, sloping phase						Do.
Montalto stony silt loam						Do.
Montalto stony silt loam, steep phase						Timber.

[1] These estimated yields refer to those commonly obtained under dairy and general farming practices where the usual rotations are corn, oats, wheat, and clover, or corn, wheat, and clover. The details of management vary somewhat from farm to farm and from year to year, so these estimates are only general. Lime, superphosphate, and manure are commonly applied at least once in the rotation. More manure is generally available on the dairy farms, and commercial fertilizers are generally of more importance on the general farms. About 500 to 1,000 pounds of hydrated lime or ground limestone is generally applied prior to the seeding of the clover. Manure is applied to the corn ground prior to planting, and from 150 to 400 pounds of superphosphate is applied either separately or with the manure to the corn and small grains. Where complete fertilizers are used on the grains, those having relatively high phosphoric acid ratios, such as 4–12–4, are common. Where potatoes are grown as a special cash crop, they are fertilized with 1,000 to 2,000 pounds of a complete fertilizer, such as 4–8–8.

[2] Yields apply to the better drained areas.

TABLE 5.—*Estimated acre yields of the common field crops of the soils of Bucks County, Pa., according to common current practices of management*—Continued

Soil	Corn	Wheat	Oats	Mixed hay	Potatoes	Principal use
	Bu.	*Bu.*	*Bu.*	*Tons*	*Bu.*	
Neshaminy silt loam	55	35	50	2.00	200	General farm crops, truck crops.
Neshaminy silt loam, sloping phase	45	25	40	1.50	-----	General farm crops, pasture.
Penn flaggy silt loam	30	15	35	1.00	-----	General farm crops.
Penn flaggy silt loam, sloping phase	30	15	35	.75	-----	General farm crops, pasture, timber.
Penn flaggy silt loam, steep phase	----	----	----	------	----	Timber and brush.
Penn shaly silt loam	40	20	40	.75	----	General farm crops.
Penn shaly silt loam, sloping phase	30	15	35	.50	-----	Pasture, general farm crops, timber.
Rough stony land (Chalfont and Lehigh soil materials).	----	----	----	------	-----	Timber.
Rough stony land (Montalto soil material).	----	----	----	------	-----	Do.
Rough stony land (Penn soil material)	----	----	----	------	-----	Do.
Sassafras loam	35	18	35	1.00	175	General farm crops, truck crops.
Sassafras loam, sloping phase	----	----	----	------	----	Timber, pasture.
Sassafras silt loam	40	20	35	1.50	200	General farm crops, truck crops, urban sites.
Sassafras silt loam, sloping phase	20	10	18	.50	-----	Timber, pasture, general farm crops.
Springtown cobbly silt loam	35	20	35	1.50	175	General farm crops, pasture, timber.
Springtown cobbly silt loam, sloping phase.	25	15	30	1.00	-----	Timber, pasture, general farm crops.
Springtown silt loam	45	30	45	2.00	175	General farm crops, pasture.
Springtown silt loam, sloping phase	30	18	35	1.50	-----	Do.
Steinsburg shaly silt loam	25	12	20	.75	-----	General farm crops, pasture, timber.
Steinsburg shaly silt loam, sloping phase.	15	8	15	.50	-----	Do.
Steinsburg silt loam	30	15	30	1.00	-----	Do.
Tidal marsh	----	----	----	------	----	Wasteland.
Tioga loamy fine sand	35	18	35	1.00	150	Recreational grounds, urban sites, general farm crops.
Tioga silt loam	45	25	40	1.50	200	Truck crops, general farm crops.
Unadilla silt loam	50	30	45	1.50	200	Urban sites, gravel pits, general farm crops, truck crops.
Washington silt loam	45	30	45	2.00	175	General farm crops.
Washington silt loam, sloping phase	35	18	35	1.50	-----	Pasture, general farm crops, timber.
Watchung silt loam	----	----	----	------	----	Pasture.
Wehadkee silty clay loam	----	----	----	------	-----	Do.
Woodstown silt loam	35	----	----	1.00	-----	Do.

In table 6 the soils are listed in six groups according to certain physical characteristics that influence to a high degree their suitability for farming purposes. This grouping serves as a physical land classification.

TABLE 6.—*Grouping of soils in Bucks County, Pa., according to their physical suitability for growing common field crops*

ARABLE SOILS

Soil	Physiographic division	Soil group
Annandale cobbly silt loam	Piedmont	Deep, well-drained soils (level to gently rolling). The physical features of these soils make them relatively highly desirable for farming purposes. Smooth topography and relative freedom from stone favor tillage operations. Their inherent fertility and response to good management practices make them highly productive.
Annandale silt loam	do	
Bucks-Chester silt loams	do	
Bucks shaly silt loam	do	
Bucks silt loam	do	
Chenango silt loam	River terraces	
Chester silt loam	Piedmont	
Duffield silt loam	do	
Elsinboro loamy fine sand	River terraces	
Lansdale silt loam	Piedmont	
Neshaminy silt loam	do	
Sassafras loam	Coastal Plain	
Sassafras silt loam	do	
Springtown cobbly silt loam	Piedmont	
Springtown silt loam	do	
Tioga loamy fine sand	Bottom lands	
Tioga silt loam	do	
Unadilla silt loam	River terraces	
Washington silt loam	Piedmont	

TABLE 6.—*Grouping of soils in Bucks County, Pa., according to their physical suitability for growing common field crops*—Continued

Soil	Physiographic division	Soil group
Annandale cobbly silt loam, sloping phase	Piedmont	Less deep, well-drained soils (gently sloping to rolling). Certain unfavorable characteristics make these soils less well suited to growing crops than the soils above, particularly the shallower depth of the soils, the rougher topography, the increased droughtiness, and the greater susceptibility to erosion. Of course these characteristics are developed in different degrees for each soil.
Buckingham cobbly silt loam	do	
Buckingham cobbly silt loam, sloping phase	do	
Bucks shaly silt loam, sloping phase	do	
Chenango gravelly loam	River terraces	
Chenango gravelly loamy sand	do	
Chenango gravelly sandy loam	do	
Chester silt loam, shallow phase	Piedmont	
Chester silt loam, sloping phase	do	
Duffield silt loam, shallow phase	do	
Duffield silt loam, sloping phase	do	
Edgemont channery loam	do	
Edgemont channery loam, sloping phase	do	
Elsinboro loamy sand	River terraces	
Manor silt loam	Piedmont	
Manor silt loam, gently sloping phase	do	
Montalto cobbly silt loam	do	
Montalto silt loam	do	
Montalto silt loam, sloping phase	do	
Neshaminy silt loam, sloping phase	do	
Penn flaggy silt loam	do	
Penn flaggy silt loam, sloping phase	do	
Penn shaly silt loam	do	
Penn shaly silt loam, sloping phase	do	
Sassafras loam, sloping phase	Coastal Plain	
Sassafras silt loam, sloping phase	do	
Springtown cobbly silt loam, sloping phase	Piedmont	
Springtown silt loam, sloping phase	do	
Steinsburg shaly silt loam	do	
Steinsburg shaly silt loam, sloping phase	do	
Steinsburg silt loam	do	
Washington silt loam, sloping phase	do	
Annandale silt loam, colluvial phase	Piedmont	Deep, imperfectly drained soils (level to gently sloping). Imperfect drainage is the principal factor limiting the suitability of these soils, particularly for the growing of certain crops.
Bermudian silt loam	Bottom lands	
Braceville silt loam	River terraces	
Bucks silt loam, colluvial phase	Piedmont	
Califon silt loam	do	
Captina silt loam	do	
Codorus silty clay loam	Bottom lands	
Doylestown silt loam	Piedmont	
Lansdale silt loam, colluvial phase	do	
Woodstown silt loam	Coastal Plain	
Chalfont flaggy silt loam	Piedmont	Shallow imperfectly drained soils (level to gently sloping). These soils are too shallow and imperfectly drained to be suited to the growing of most crops, except pasture grasses.
Chalfont flaggy silt loam, sloping phase	do	
Chalfont silt loam	do	
Chalfont silt loam, sloping phase	do	
Greer silt loam	do	
Lehigh silty clay loam	do	
Watchung silt loam	do	
NONARABLE SOILS		
Annandale cobbly silt loam, steep phase	Piedmont	Steep and stony land. Areas are too rough, stony, or steep for the growing of common field crops.
Brandywine silt loam	do	
Buckingham cobbly silt loam, steep phase	do	
Montalto stony loam	do	
Montalto stony loam, sloping phase	do	
Montalto stony silt loam	do	
Montalto stony silt loam, steep phase	do	
Penn flaggy silt loam, steep phase	do	
Rough stony land (Chalfont and Lehigh soil materials)		
Rough stony land (Montalto soil material)	do	
Rough stony land (Penn soil material)	do	
Alluvial soils, undifferentiated	Bottom lands	Poorly drained land. Areas too wet for cropland.
Bowmansville silt loam	do	
Elkton silt loam	Coastal Plain	
Fallsington silt loam	do	
Marsh	Bottom lands	
Melvin silty clay loam	do	
Tidal marsh	do	
Wehadkee silty clay loam	do	

LAND USES, SOIL MANAGEMENT, AND AGRICULTURAL PRACTICES

On the basis of present use, about 30 to 35 percent of the area of Bucks County is not used for crops or pasture. Instead its uses may be grouped as follows:

(1) Space occupied by cities, towns, villages, railways, highways, roads, power transmission and telephone lines, lakes, and watercourses.

(2) Space occupied by woods and brush and abandoned lands. Most of the land covered by woods and brush is concentrated in the north-central part of the county, but small patches are found in all districts, usually near watercourses. The total area included in this group, as estimated in the field, is about 100 square miles, or about 16 percent of the county.

(3) Land used for recreational purposes, consisting of parks, camps, summer homes, and cottages. Most of this group is restricted to the terraces and bluffs of the Delaware River, northwest of Yardley to Black Eddy, and to the banks of tributary streams, particularly Neshaminy and Tohickon Creeks.

It is fortunate that the particular kinds of soils most needed for the maintenance and further development of the present types of agriculture should have such an extensive distribution in Bucks County. It is also significant that the agriculture initiated by the early pioneers has persisted for a period of from 150 to more than 200 years. This fact indicates that the soils were and are well adapted to the basic crops around which have developed the present diversity of agricultural interests. When it is considered that in 1940 Bucks County had a total population of 107,715, of which 31,635 was urban and that such markets as Philadelphia, Trenton, Easton, and Allentown are near, it is evident that there is here a concentration of buying power that has contributed in great measure to the diversification of agriculture and the prosperity of the farmers.

The principal kinds of farming in Bucks County are dairy, general, truck, fruit, poultry, and part-time farming. There is also the limited production of flowers, seeds, and other greenhouse and nursery products. Linked with field crops is the raising of cattle, chickens, swine, and sheep. Dairy and general farming are closely associated in their distribution throughout the area, but the former is concentrated especially in the central-western part of the county, where it dominates. Farms are classed as dairy farms when about one-half of the income is derived from dairy products.

The common rotations of crops on dairy farms run for a period of 3 to 5 years. They consist generally of corn, oats, wheat, and a legume hay (for 1 or 2 years), or of corn, wheat, and clover. Potatoes and tomatoes as cash crops and alfalfa frequently supplement these rotations. Preparatory to planting the corn, a legume sod is usually plowed late in fall or early in spring, and before or after plowing the land usually receives 6 to 10 tons of manure. The principal fertilizer used on the dairy farms for corn in addition to manure is superphosphate. Amounts vary from 150 to 300 or 400 pounds to the acre, depending on the individual practices and soil conditions. A part of the superphosphate is commonly added to the manure in the stable.

The corn is either allowed to mature and is husked for grain or is cut green to be put in silos. Most of the corn is usually fed to livestock on the farm.

Oats following corn in the rotation are not generally fertilized. As indicated above, some farmers omit oats from the rotation, as they consider the climate too warm for this crop. Wheat follows oats and usually receives about half a ton of hydrated lime and from 200 to 400 pounds of complete fertilizer, such as 2–12–6, 3–12–6, 4–12–4, or 4–16–4. Grass seed is sown in the wheat, and the grass is allowed to remain 1 or 2 years. Clovers are seeded in the wheat early in spring. Alfalfa is seeded in the wheat in spring or alone in August. Sweetclover has come into rather common use because of the interest shown by farmers in renovating old pastures. Applications of lime and superphosphate are generally made to these lands, and if there is a good sod a complete fertilizer rather high in nitrogen is favored.

The growing of grain alone for cash is not considered a very profitable type of agriculture in Bucks County. The chief value of the grain crops in rotations is its use as a nurse crop for legumes or grasses and for the straw, which is used as bedding. Grain is either marketed or fed to livestock. If the price of wheat is high the dairymen usually sell it, but if the price is low they grind it and include it in their stock feed.

Hay at one time was a good cash crop in this county. Since the development and use of automobiles and motortrucks, however, the outside markets for hay have declined to almost nothing.

General farming denotes a type that does not have any one main source of income. The interests are generally diversified. Corn, oats, wheat, and hay are usually produced. In addition there may be some acreage in potatoes, canning crops, vegetables, and fruit. General farms also usually have some livestock interest or interests, such as dairy cows, poultry, hogs, sheep, or goats.

Poultry farming ranks high as a source of income in Bucks County. The average flock of about 500 birds is a side line to general or dairy farming, and a good percentage of the scratch grains are grown on the farms. There is a general concentration of poultry farms in the western, north-central, and eastern parts of the county. The commercial flocks have 1,000 or more birds and depend almost entirely on commercial feeds. The loss in poultry from disease is very high, and as a result most of the birds are raised in confinement or on clean range.

Bucks County ranks first in the State in value of truck crops. Most of these crops are grown in the extreme southern and southeastern parts of the county. The total acreage as given by the United States census for the year 1939 is 19,181 acres. The principal crops are sweet corn, tomatoes, asparagus, rhubarb, beets, carrots, spinach, celery, and rutabagas. No definite rotation is practiced, as the specific crops that are grown from year to year depend largely on the demands of the market. Sweet corn, however, is the most important crop, with a reported acreage of 3,137 in 1939. This crop is grown by truck growers and dairy farmers. The dairy farmers have a plan of harvesting their sweet corn if prices are high or using it to fill silos if the prices are low. Heavy applications of complete fertilizers are commonly used on truck crops. The amounts and

ratios vary with the particular crops and soil conditions. Results of research investigations and farmers' experience suggest changes from time to time, and it is suggested that inquiry be made of the State Agricultural Experiment Station at State College for further details of fertilizer practices, particularly those concerned with the fertilization of specific truck crops. A considerable increase is reported in the acreage of snap beans, carrots, beets, cabbage, and celery since 1930. Two or three crops of vegetables may be harvested from the same land during the growing seasons; and this practice of double cropping, as it is termed, represents in fact a larger acreage in crops than the total acreage used for vegetables would appear to indicate.

Most of the tomatoes are grown under contract from canners and are usually sold under United States grades. The other tomatoes that are sent to the local and more remote markets are a side-line product of other types of farming. The acreage in this crop has greatly increased since 1929. Some of the more common fertilizer practices include the use of 500 to 800 pounds of 4–12–4 or 3–12–6 ratios. Again new recommendations are being made on the basis of further research.

More asparagus is grown in Bucks County than in any other section of the State, though the acreage is said to have decreased somewhat since 1930. The asparagus beds are said to be profitable over a period of 8 to 12 years if fertilized with 800 to 1,000 pounds of 4–8–8, or equivalent amounts, each year, after the cutting season.

Potatoes are listed separately from the other crops and considered a special crop, although most frequently grown here as a side line to more definite systems of agriculture. Bucks County is just on the border of the region growing late potatoes. Green Mountain and Russet are generally the more favored varieties, and very few of the Irish Cobbler variety are grown. One farmer who grew Irish Cobbler and Green Mountain on Unadilla silt loam reported that the Cobbler stood a cold, dry season better than the Green Mountain, but that the latter was more successful in a warm, wet season. Practically all growers depend on certified disease-free seed, most of which comes from Michigan and Maine and a little from Prince Edward Island. Probably the larger part of the seed is 1 year removed from certified seed, since much of it is obtained from growers who used certified seed the preceding year. Sweetclover, soybeans, and manure are relied upon as sources of humus, and an application of 800 to 1,200 pounds or more of 4–8–8 fertilizer or its equivalent is used. A few growers with a relatively high content of nitrogen in their soils have used 750 to 1,500 pounds of a 4–12–12 fertilizer, or its equivalent. The plants are sprayed with bordeaux mixture.

There are a few commercial fruit orchards in Bucks County, most of which are located in the central and northern parts of the county. Most of the other orchards are small and range from 2 to 10 acres, although nearly every home site has an orchard of mixed fruits. Apples are the dominant fruit, and the principal varieties are Stayman Winesap, Delicious, Jonathan, and Rome Beauty. The heavy infestation of insects, such as codling moth, curculio, European red mite, scale, and Japanese beetle, besides infection with scab, and Brooks fruit spot, make spraying essential to the production of marketable

fruit. Most of the fruit is marketed whole to the consumer, but some lower grades are used for cider. The principal variety of peaches grown is Elberta. This fruit is subject to brown rot and leaf curl and requires as careful spraying as the apples. The only small fruit of importance is strawberries. The principal varieties are Howard 17 (Premier), Chesapeake, and Dorsett. Most of the growers use nitrate of soda or cyanamide, and turn under cover crops for green manure.

As determined by tests by W. F. Greenawalt, county agent, most soils in Bucks County show a lime requirement of 1 to 1½ tons of hydrated lime to the acre. Since most of the lime is shipped in, hydrated lime was found to be the most economical. It is bought from markets in northern New Jersey or from Paoli, in Chester County, Pa. In the early days considerable lime was burned in the Lahaska and New Hope district and also in Spring Valley and near New Lime Kiln Creek. Some ground limestone is now prepared in the county, and it would seem that lime requirements could be easily met by using the available supply of dolomitic limestone that occurs so generously here. The composition of some of this stone (Solebury stone) is as follows:

	Percent
Carbonate of calcium	52.50
Carbonate of magnesium	42.11
Silica	3.60
Alumina	.65
Oxide of Iron	1.10
Moisture	.04

Practically no effort is made in Bucks County to farm steep land. Most of it is covered with trees and brush. In the last 10 years a number of these places have been planted with evergreen seedlings, some of which will doubtless be used eventually for Christmas trees. Some of the largest orchards are located on ridges with rather steep slopes. Most of them are cultivated in conformity with contours, and seeded to clover or millet as a cover crop after cultivation.

In general, the soils on the more gentle slopes are thinner than those on level land, as they have suffered from erosion. Too little is done to protect these slopes, although some farmers try to stop gullies and washes, some have converted the slopes to more permanent pastures, and others practice contour cultivation.

The horse is still used widely by the farmers of Bucks County for farm power, but the use of tractors, gas engines, and mechanized units is increasing rapidly. There is a great range in the kinds of tools and equipment used, varying from the most simple hand tools to elaborate power machinery. Horses, however, are still used to pull the plows, harrows, drills, cultivators, binders, weeders, and other farm implements in nearly all parts of the county.

Some farmers use a combination of power, such as the 8-row horse-drawn power sprayer. In some instances a motortruck is used for spraying, with a tank mounted on the back and the nozzle or spray boom in front. Tractors are also used to draw farm tools, while in addition there are mechanical units such as corn harvesters. In the trucking section probably more power equipment is used than in any other part of the county. Two-row planters and 6- and 8-row bean planters are used. Most of the heavy hauling to and from markets is done with motortrucks.

Tillage operations in general conform to the best practices. In all cultivation the main object appears to be to keep down weeds and grass. Most of the cultivated crops are planted in rows conforming roughly to surface relief, but in some of the more level situations the check-row system is used exclusively.

Table 7 gives a list of the principal crops, their common diseases, and the treatment generally used.

TABLE 7.—*Principal crops, prevalent diseases, and treatments used in Bucks County, Pa.*

Crops	Diseases	Treatment
Wheat, oats, barley	Stinking smut, loose smut	Seed treatment.
Corn	Smut	Resistant varieties.
Sweet corn	Smut, wilt	Do.
Potatoes	Scab, mosaic, leaf curl, blight	Disease-free seed and spraying.
Celery	Blight	Spraying.
Vegetables in general	Seed-borne diseases	Seed treatment.

The Japanese beetle is common to all parts of the county and is the most destructive pest that is active at the present time. No outstandingly effective control measures have been found, but it is noted that the intensity of infestation is waning somewhat. The beetle eats the silk off the corn before pollination takes place. Dusting sweet corn with hydrated lime has aided materially in keeping this pest out of the cornfields. Delayed planting of field corn to a period between May 25 and June 5 will bring the corn into silk after the heavy feeding period of the beetles is over (between June 20 and August 10) and will also enable the corn to mature before the season is over. Cherries, peaches, plums, some apples, and various shade trees are attacked by these beetles, and unless sprayed or dusted with lime they are almost completely defoliated. Lawns and some flowers and shrubbery are severely attacked.

In recent years Bucks County farmers have become interested in farmers' cooperative organizations. In 1937 there were in the county seven cooperative buying organizations handling principally feeds, fertilizer, lime, and seeds. The asparagus growers have a marketing organization, the poultrymen have a cooperative egg auction market, and the sheepmen have an organized wool pool (not of commercial importance, although quite a number of small flocks of sheep are scattered throughout the county). Several cooperative creameries are still operating, although the market for fluid milk is so much better than the butter market that these are gradually going out of business.

MORPHOLOGY AND GENESIS OF SOILS

Bucks County, Pa., is situated in the region of the Gray-Brown Podzolic soils in the northern parts of the Piedmont Plateau and the Atlantic Coastal Plain. The parent materials of the soils in general bear a close relation to the geology of the area. The differences in soil colors in much of the county are largely a reflection of geological differences.

The general geological formations are referred to as belonging to the pre-Cambrian, Cambrian, Ordovician, Triassic, and Quaternary

periods.[11] The pre-Cambrian division in this county includes the Baltimore and Wissahickon gneisses with some igneous intrusions of gabbro and diabase. These rocks occur in the southern part of the county. The Cambrian division is represented here by quartzites, conglomerates, and dolomitic limestones. The Ordovician is represented here by limestones and phyllites. The Cambrian and Ordovician rocks occur in the Buckingham and Lahaska Valleys and extend in a northeast direction. It is assumed that similar formations exist in the Springtown Valley, since the stratigraphy and the soils are very similar.

The Triassic is the most important division, since it occupies probably more than three-fourths of the entire area. It is represented here by the Stockton, Lockatong, and Brunswick formations. It includes variously colored shales, dolomites, dolomitic limestones, arkoses, and argillites, which have been metamorphosed in places by intrusions of diabase and other igneous rocks. Superimposed on the pre-Cambrian rocks in the southern part of the county are unconsolidated Coastal Plain deposits of gravel, sand, silt, and clay. Contiguous to this area and bordering the Delaware River are some well-developed alluvial terraces. Both of these divisions are representatives of the Quaternary period. The Coastal Plain is referred to as the Pensauken formation and the river terraces as the Cape May formation, both of the Pleistocene epoch.

In addition to the formations mentioned, there is some material along the northwestern border of the area that is probably glacial.

Soils have been developed from the products of disintegration of the underlying rocks and modified by vegetation and the influence of climate for long periods of time. The rocks of any one geological formation may be somewhat complex and a number of different soils may be developed from them. Conversely, one soil may be developed from several geological formations if the rocks are similar. The folding and faulting of underlying rocks and the influence of contact metamorphism explain in a measure the lack of close relationship of the soils to the parent rocks in the various groups.

Another important geological condition affecting the development of soils occurs where there is a conspicuous geological unconformity, particularly where the Triassic was deposited on the eroded surfaces of pre-Cambrian lands. This has resulted in an intricate mixing of red and yellow rocks. Another condition, but of less importance, occurs where the unconsolidated Coastal Plain deposits are imposed on pre-Cambrian rocks, or residuum from these rocks, particularly where this Coastal Plain material is so shallow as to modify the lower layers of the Sassafras soils. Also in certain conditions Coastal Plain deposits have been removed by erosion to expose the underlying rocks or soil material derived from the underlying rocks. There are also conditions where the rocks, gravel, and soil material that originated at higher levels have drifted down to lands situated on lower lying slopes.

---

[11] BASCOM, F., CLARK, N. B., DARTON, W. H., and others. GEOLOGICAL ATLAS OF THE UNITED STATES, PHILADELPHIA FOLIO, NORRISTOWN, GERMANTOWN, CHESTER, AND PHILADELPHIA QUADRANGLES, PENNSYLVANIA—NEW JERSEY—DELAWARE. U. S. Geol. Survey Folio 162 [35] pp., illus. 1909.

BASCOM, F., DARTON, N. H., KÜMMEL, H. B., and others. GEOLOGICAL ATLAS OF THE UNITED STATES, TRENTON FOLIO, NEW JERSEY—PENNSYLVANIA. U. S. Geol. Survey Folio 167, [28] pp., illus. 1909.

Climate, vegetation, time, and relief, as well as the character of the material, are the principal factors in the development of soils from weathered rocks. Most of the soils in Bucks County were developed under a forest cover consisting principally of hardwoods. There are a few eminences where there is evidence of a more general growth of chestnut and pine. The chestnuts are now restricted to an occasional tree and more often to young shoots of these trees. The principal forest growth now consists of various oaks, maple, hickory, elm, cherry, poplar, walnut, ash, dogwood, beech, sycamore, willow, and cottonwood, with a more restricted growth of cedar, black locust, and spruce. The undergrowth varies in different localities and consists of young shoots of the mature trees and of sassafras, sumac, laurel, huckleberry, wild grape, blackberry, ironwood, witch-hazel, and poison ivy. In the undisturbed situations that are covered with trees and brush, the surface is generally covered with such forest debris as leaves, twigs, and branches of the trees. Under this cover is generally a thin, compact layer of fermented leaves, and this rests on the mineral surface soil.

The climate of the county is characterized by short summers and rather long winters, and temperatures range from −20° to 105° F. The county has an average precipitation of about 47 inches. The average yearly snowfall is given as 36 inches.

In addition to the zonal Gray-Brown Podzolic soils, some of the soils belong to intrazonal and azonal orders, and most of them are related to conditons of relief. There is a range in elevation in Bucks County from tide level to 960 feet above sea level. This has resulted in a considerable variation in local relief. In many places steep slopes have favored erosion, and in others the low relief has prevented erosion and has slowed or even prevented natural drainage, so that the soils are thin in some places and thick in others, and compared with the regional or zonal soil they may be weakly or strongly developed.

There are no true Podzols within the county, although the Buckingham soils have thin light-gray A_2 horizons much like those of the Podzols, and a very thin mat of leaves and humus. There is, however, no brown subsoil layer (orterde).

On other soils of the county the organic matter in undisturbed situations is usually more thoroughly decomposed, browner in color, dispersed, and more evenly distributed throughout the surface soil, under a layer of leaves, twigs, and forest debris. The dark color of these undisturbed soils is due to organic matter, and this usually disappears with cultivation.

All of the Gray-Brown Podzolic soils and Planosols have, or have had, the threefold arrangement that characterizes the mature regional soil. They have a relatively light-textured A horizon and a much heavier B horizon with uniform color, texture, and structure, resting on a C horizon that is usually lighter in texture. In all the well-developed soils there is considerable evidence of eluviation in the A horizon, and a part of the original fine material apparently has been carried to the B horizon by gravitational waters. This material has helped to form the heavier texture of the B or "illuvial" horizon. This is the layer from which plants obtain much of their water, especially during dry weather. The thickness of this layer varies from a few inches in young soils to a few feet in some of the older soils.

Leaching of the more soluble plant nutrients is not so severe nor so prolonged as in more southerly climates. Moderately deep and long winter freezing checks the activities of soil-forming processes. This may explain in part why there is so little variation in general in the textures of the surface soils in this section, even where there is considerable variation in the physical character of the underlying rocks and parent material. In addition to the soils having well-developed profiles, others occur that have a very limited development. The aggregate area of these soils throughout the county is large.

On some of the valley slopes rapid geological erosion has checked soil formation to the extent that only AC soils have had a chance to form, whereas on steeper slopes erosion has been active enough to expose the parent material or the underlying rock.

On the imperfectly drained and poorly drained uplands, regional or zonal profiles have not been developed because of the excess of water. Instead, Planosols or claypan soils occur. Both the well-drained and poorly drained soils of the alluvial flood plains show little profile development.

Following are a few descriptions of some of the soils of the county.

Sassafras silt loam, a typical Gray-Brown Podzolic soil a quarter of a mile northeast of Woodside, Pa.:

Surface covered with leaves and forest debris.
A_0. ¼–½ inch,[12] matted leaves.
A_1. 0–¼ inch, dusky-brown silt loam with abundant roots.
A_2. ¼–8 inches, mellow brownish-gray silt loam.
B_2. 8–24 inches, yellowish-brown light silty clay loam, slightly compact; uniform in texture and color except along scattered root channels.
B_3. 24–30 inches, yellowish-brown compact silty clay loam.
C_1. 30–34 inches, yellowish-brown gravel and sand.
C_2. 34 inches +, slightly indurated, mottled gray, yellow, and reddish-brown sandy clay, intermixed with small rounded white, yellow, and stained quartz and quartzite gravel.

The Sassafras silt loam is the most important soil type developed from the unconsolidated materials of the Coastal Plain. The Woodstown series differs from the Sassafras in that it is imperfectly drained and is characterized by conspicuous mottling in the subsoil and by the slight development of a claypan. The Elkton and Fallsington soils both have strongly developed claypans, are intermittently wet and dry, and belong to the Planosol group of Intrazonal soils.

The soils of the terraces belong to the Chenango, Unadilla, Braceville, and Elsinboro series. The Chenango in this section is browner than is generally common to this series. It probably contains some material washed from the Penn soils. It is the shallowest of the soils on the terraces, as the gravel bed comes closer to the surface than is common in the Unadilla soil. The Unadilla soil is also browner than in other areas. The gravel bed is deeper than in the Chenango soils and rarely comes within 3 feet of the surface. Soils of both of these series range from either extremely or very strongly to strongly acid. The Braceville soil is the imperfectly drained associate of the Chenango soils. The Elsinboro soils are well-drained soils of the terraces that consist of a wide variety of materials so thoroughly

[12] Measurements of the mineral soil begin from the top of the A_1 horizon.

mixed that no one seems to dominate. This mixture comes from gneisses, schists, limestones, shales, and Coastal Plain materials.

The high bottom lands of the Delaware River are not subject to frequent floods or overflows. Thirty-three years, from 1903 to 1936, elapsed between the last two. Thus it can be realized that the soils of the bottom lands are very closely related to those of the terraces. The line between the two was established on the basis of the high water of 1936, and the separating line represents but a very slight difference in elevation in places. The soils were classified as soils of the Tioga series. The profiles are not strongly developed.

The Codorus soil is an imperfectly drained soil of the bottom lands that consists of alluvium washed from the Chester, Manor, Lansdale and other soils of the Piedmont Plateau.

The Wehadkee soil is a light-colored, imperfectly to poorly drained soil of the bottom lands that consists of alluvium from the Chester and Manor soils.

The Melvin soil is a poorly drained soil of the bottom lands that consists of alluvium from the Duffield soils.

The Bermudian soil is a fairly well-drained soil of the bottom lands that consists primarily of alluvium from the Bucks and Penn soils.

Bowmansville silt loam is the poorly drained associate of the Bermudian silt loam and is derived from the same kind of alluvium.

Chester silt loam, a Gray-Brown Podzolic soil of the Piedmont, 1¼ miles southeast of Newtown, Pa., has the following profile:

Surface covered with leaves and forest debris.
A_1. 0–½ inch, dark-brown silt loam with fragments of leaves and abundant roots.
A_2. ½–10 inches, mellow brown silt loam.
B_1. 10–18 inches, yellowish-brown light silty clay.
B_2. 18–26 inches, yellowish-brown slightly compact silty clay.
B_3. 26–45 inches, yellowish-brown light silty clay.
C_1. 45–62 inches, yellowish-brown gritty loam with some mica.
C_2. 62 inches +, brown loamy sand with some mica.

The soils of the Neshaminy series are very similar to the Chester soils in the general character of their profiles, but they are less acid, ranging from slightly acid to neutral throughout the profile. The Manor series is not very important as regards distribution. The soils are more generally shallow and do not show as strong a development of the regional profile as the Chester soils.

The Brandywine soil is the steep or strongly sloping Lithosol associated with the Chester soils and underlain by gneisses and schists.

The Califon soil is the imperfectly drained associate of the Chester soils. It occupies depressions and colluvial slopes.

Bucks silt loam, a Gray-Brown Podzolic soil, 1 mile west of New Hope, Pa., has the following profile:

Surface covered with leaves and forest debris.
A_1. 0–1 inch, dark seal-brown mellow silt loam with abundant roots.
A_2. 1–8 inches, reddish-brown mellow silt loam.
B_1. 8–20 inches, brownish-red light silty clay.
B_2. 20–40 inches, Indian-red compact silty clay.
C_1. 40–47 inches, Indian-red silt loam, intermixed with fragments of red shale.
C_2. 47 inches +, Indian-red shale.

A considerable area of Bucks silt loam is less red and paler brown in the A horizon and more yellowish brown in the B horizon than the above profile.

The Penn soils differ from the Bucks in that they are shallower and exhibit a less definite regional profile. The Lansdale soils differ from the Penn soils in the color of the parent materials and in the soil horizons. The parent material consists of shales intermixed with silt loam. The shales range from gray to yellow and brown and in places are almost black. The Steinsburg soils are essentially shallow Lansdale soils with more sloping relief. The parent material of the Edgemont soils was derived from a coarse conglomerate and that of the Buckingham from a grayish quartzite.

Igneous intrusions throughout the areas of the Penn, Bucks, and Lansdale soils are responsible for the development of the Montalto and Lehigh soils, the former directly, and the latter indirectly, through metamorphism. Watchung silt loam is the imperfectly drained associate of the Montalto soils that occupies slight depressions and colluvial slopes.

Duffield silt loam three-fifths of a mile southeast of Lahaska has the following profile:

A_1. 0–2 inches, grass turf, with dark-brown silt loam.
A_2. 2–12 inches, mellow silt loam.
B_1. 12–25 inches, yellowish-brown light silty clay.
B_2. 25–40 inches, dark yellowish-brown compact heavy silty clay.
C_1. 40–60 inches +, dark yellowish-brown silt loam with a slight reddish cast, intermixed with fragmentary and embedded dolomitic limestone.

The Chalfont series differs from the Duffield in the general drainage condition. It is imperfectly drained, more gray in color, and more plastic in the subsoil. The parent material is also different in that the Chalfont soils contain less limestone and more argillites, although both series have a range from slightly acid to neutral. Doylestown silt loam is associated with the Chalfont soils, but it differs in having a deeper profile and in occupying colluvial slopes on slight depressions. It is imperfectly drained, as are the Chalfont soils. Greer silt loam is more rolling than the Chalfont soils, with the result that surface drainage is better. The parent materials are similar.

Captina silt loam is similar to Doylestown silt loam in position and differs in that it is associated with the Duffield soils and derived from dolomitic limestones, as are the Duffield soils.

Three soil series of relatively small extent in Bucks County are recognized as having developed on what is presumably glacial till of Jerseyan age. The soils are representative Gray-Brown Podzolic soils and are generally similar except for those differences—primarily color and mineralogical composition—induced by differences in the character of the parent glacial till. The Springtown soils are developed from till that is derived largely from Triassic shales together with some conglomerate, quartzite, and gneiss. The Annandale soils are developed from till that is derived essentially from gneiss together with some quartzite and a slight amount of limestone. The Washington soils are developed from till that is derived from limestone together with some sandstone, shale, and gneiss. In other words, the till is mixed but has a sufficient amount to be calcareous in the less weathered portions.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C
Price 60 cents

U. S. GOVERNMENT PRINTING OFFICE: 1946

Accessibility Statement

This document is not accessible by screen-reader software. The U.S. Department of Agriculture is committed to making its electronic and information technologies accessible to individuals with disabilities by meeting or exceeding the requirements of Section 508 of the Rehabilitation Act (29 U.S.C. 794d), as amended in 1998. Section 508 is a federal law that requires agencies to provide individuals with disabilities equal access to electronic information and data comparable to those who do not have disabilities, unless an undue burden would be imposed on the agency. The Section 508 standards are the technical requirements and criteria that are used to measure conformance within this law. More information on Section 508 and the technical standards can be found at www.section508.gov.

If you require assistance or wish to report an issue related to the accessibility of any content on this website, please email Section508@oc.usda.gov. If applicable, please include the web address or URL and the specific problems you have encountered. You may also contact a representative from the USDA Section 508 Coordination Team.

Nondiscrimination Statement

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the

Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at http://www.ascr.usda.gov/complaint_filing_cust.html and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by:

(1) mail: U.S. Department of Agriculture
Office of the Assistant Secretary for Civil Rights
1400 Independence Avenue, SW
Washington, D.C. 20250-9410;

(2) fax: (202) 690-7442; or

(3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.