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Soil Survey

Huntingdon County Pennsylvania

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This number is the last Soil Survey Report for the year 1934

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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) those 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) County Surveyed, in which physiography, geology, and drainage, vegetation, water supply, wildlife, insects and plant diseases, history and organization, population and towns, transportation and public utilities, climate, nonagricultural industries, and agricultural history and statistics are discussed; (2) Productivity Ratings, and Land Uses and Soil Management in which the soils are grouped according to their relative physical suitability for agricultural use and their present management requirements and productivity are discussed.

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 in the sections on Productivity Ratings and Land Uses and Soil Management.

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 section on County Surveyed, Soils and Crops, Productivity Ratings, and Land Uses and Soil Management of particular value in determining the relation between their special subjects and the soils of the area.

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

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SOIL SURVEY OF HUNTINGDON COUNTY, PENNSYLVANIA

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

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[1] The Soil Survey Division was transferred to the present Bureau of Plant Industry, Soils, and Agricultural Engineering, July 1, 1939.

SUMMARY

Huntingdon County, of which Huntingdon is the county seat, is an irregular area of 587,520 acres, or 918 square miles, in south-central Pennsylvania.

The county lies wholly within the folded mountain-valley region, which is primarily a series of parallel long, narrow intermountain valleys separated and enclosed by long, narrow, steep-sided mountain ranges that rise 1,000 to 1,500 feet above the valleys to a general elevation of 2,000 to 2,400 feet above sea level. Most passageways from one valley to another are through deep notches or gaps cut through the mountains by streams. The relief is strong throughout. Level land is exceedingly scarce and occurs only in the broader valleys and on a few ridge tops.

The county is well watered. Runoff is rapid and erosive. Practically all of the runoff of Huntingdon County drains into the Juniata River, which flows southeasterly across the county. The main branches of the Juniata River—the Frankstown Branch Juniata River; the Raystown Branch Juniata River; and Great Aughwick Creek—empty into the Juniata in the central part of Huntingdon County.

The streams of Huntingdon County are swift-flowing and have potential resources of water power that are only partly developed. The larger streams flow in narrow, deep valleys and have an average fall of about 7½ feet to the mile. Some of the smaller streams are

much swifter. The quality of the water in these streams varies. The smaller streams are clean and carry potable waters, but the larger streams, the Juniata for example, are seriously polluted by sewage and waste materials from upstream towns and factories.

A thickness of nearly 30,000 feet of geologic strata is exposed in the county. Most of the beds lie at very steep angles. Some of the rocks are hard; others are soft. The hard sandstones and quartzites have resisted erosion and now form the rugged and stony crests of the major mountain ranges, whereas the softer brown, red, and yellow shales are exposed on the mountain slopes and in the more rolling shale hills lying from 300 to 500 feet above the main valley floors and 500 to 1,000 feet below the mountain tops. Exposures of limestone are limited in extent and occur in the lower and more nearly level parts of the valleys. All these rocks except the limestones are acid in reaction and the soil materials produced from them are also acid.

The county has a continental humid-temperate climate. The prevailing winds are from the west, and the 40-inch annual precipitation is fairly uniformly distributed throughout the year. The average length of the frost-free season is about 5 months.

Approximately three-fourths of Huntingdon County is either hilly or mountainous and is best suited to forestry. The original vegetative cover of this whole area was magnificent forest, chiefly oak and chestnut, but also including white pine, hemlock, ash, hickory, tuliptree, walnut, maple, and other species. The undergrowth was mainly dogwood, azalea, mountain-laurel, blueberry, huckleberry, and, in deep humid valleys, rhododendron and alder.

Within the 180 years of settlement, white men have cut, mutilated, or destroyed practically all of the virgin forests, and chestnut blight has killed the chestnut trees. The remaining forests are primarily second-growth oaks, and a number of areas that are repeatedly burned over have been reduced to a tangle of scrub oak and pitch pine and an undergrowth of lowbush blueberry and huckleberry. All the second-growth oak forests are young, and it will be at least a half century before more of the trees will be large enough for the manufacture of good merchantable oak lumber.

The pulp and paper mills at Tyrone and Williamsburg provide a nearby market for pulpwood. The forest areas are used for recreation, nature study, game refuges, and State parks.

The county is served by the main line of the Pennsylvania Railroad, and it has a network of paved and hard-surfaced highways.

More than 98 percent of the area of Huntingdon County is occupied by comparatively shallow soils that are the product of rock weathering and soil formation. Geologic erosion on steep slopes prohibits the soil material from accumulating and developing into a deep mature soil. The humid climate has leached the soils of the uplands until they are medium to strongly acid throughout. The soils that have been developed from acid shale and sandstone materials are the most strongly acid. All the soils of the uplands in the county are deficient in nitrogen, organic matter, lime, and phosphorus. More than 99 percent of these soils occupy slopes that are steeper than 4 percent, and most of the soils of the mountains occupy slopes that are steeper than 30 percent. When cultivated, all the soils of the uplands are subject to sheet and gully erosion.

The detailed soil survey and land use study of Huntingdon County indicate that there are seven broad groups of soils, most of which contain several soil series, types, and phases. Each soil type or phase has at least one soil or land use characteristic that differentiates it from all other soils in the area. The groups are as follows: (1) Soils of the limestone valleys—the Hagerstown, Duffield, Frankstown, and Murrill soils, many of which are good agricultural soils; (2) soils of the shale hills, mostly shallow shaly soils—Berks, Gilpin, Rayne, Calvin, and Amberson series and the Calvin-Edom complexes—all generally much less productive than the soils of the limestone valleys; (3) soils of the colluvial foot slopes—the Laidig, Buchanan, and Ernest soils—the smoother nonstony areas of which are good agricultural soils and the steeper and stonier areas of which are used for forestry; (4) soils of the river terraces—the Elk, Cassville, Holston, and Monongahela soils—fairly productive soils; (5) soils of the alluvial flood plains—the Huntington, Lindside, Warners, Moshannon, Pope, Philo, Atkins, and Senecaville soils, all of which are productive soils where adequately drained; (6) soils of the mountains, including the Clymer, Lickdale, and Lehew soils and the Lehew-Dekalb complexes—excellent forest soils developed from red and brown weathered sandstone and shales; the Leetonia and Dekalb soils—average or below average soils for forest developed from yellow, gray, and brown sandstones and shales; and the Morrison soils of the barrens—sandy soils of the smooth high valleys and medium to poor soils for forestry; (7) rough broken and rough stony lands; and (8) a miscellaneous land type—riverwash.

Even though Huntingdon County has been under the domination of white men since 1780, more than 70 percent of its area is still occupied by forests. The 1940 census indicates that less than 30 percent of the land is used for agricultural crops and grasses and that slightly more than 20 percent is considered cultivated land.

The early rural enterprises of the area, between 1750 and 1800, were mainly general farming and lumbering. Most of the livestock products were consumed on the farms or were sold locally to workers in the lumber camps and at the iron furnaces. The export products were mainly flour, grain, and whisky. From 1850 to 1900 agriculture was mainly general farming and the feeding of livestock which when fattened were sold at eastern markets. Now the agricultural activities have shifted largely to general farming and dairying. The important field crops are those that can be used as feed or pasture for dairy cattle and poultry. The main cash farm income is obtained from the sale of fluid milk and poultry products. High-speed transportation, together with refrigeration, has made it possible for farmers to sell fluid milk in Philadelphia and New York City.

The commonly grown grain crops are corn, wheat, oats, barley, rye, and buckwheat. Mixed clover and timothy has been the standard hay crop and has been included for many years in the prevalent rotation of corn, oats, wheat, and hay. Recently the acreages of soybeans and of alfalfa have been increasing rapidly.

All the soils are deficient in organic matter, lime, and plant nutrients, and these materials must be applied to all soils if maximum crop yields are to be obtained. Erosion is one of the greatest menaces to the future existence and survival of a profitable agriculture on much of the cleared land of Huntingdon County.

COUNTY SURVEYED

Huntingdon County, an area of 918 square miles or 587,520 acres, is situated in south-central Pennsylvania (fig. 1). This is a section of long, narrow valleys, separated or shut in on all sides by long, narrow, steep, rugged mountain ranges that parallel one another for many miles in a northeast-southwest direction.

Nearly all of the county is drained by the Juniata River, which rises at the foot of the Allegheny Mountains escarpment to the west, flows in a general southeasterly direction through the mountains and across the valleys of the central part, and thence flows eastward to the Susquehanna River. The Juniata River has provided a natural east-west passageway from one valley to another by cutting deep gaps in the mountain ranges.

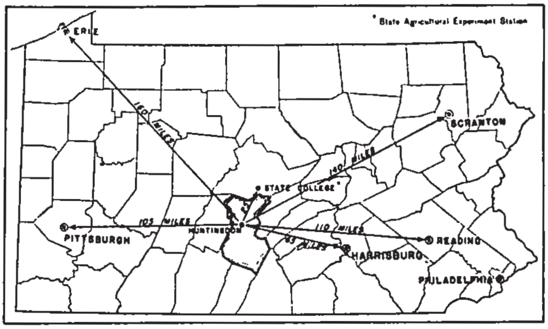

FIGURE 1.—Location of Huntingdon County in Pennsylvania.

The extreme north-south length of the county is about 48 miles; the east-west width ranges from about 13 miles at the narrowest point to more than 30 miles at the widest point, which is from the top of Tussey Mountain near Saxton to Tuscarora Mountain near Blairs Mills.

PHYSIOGRAPHY, GEOLOGY, AND DRAINAGE

The land area included in and surrounding Huntingdon County in general is a land of mountain ranges, hills, and narrow valleys. The mountain ranges are long, narrow, sharp ridges, the crests of which rise to an elevation of 2,000 to 2,400 feet above sea level. These mountain ridges parallel each other for many miles in a northeast-southwest direction and are broken only where streams have cut deep notches or gaps from one intermountain valley to another. The rolling uplands of the intermountain valleys lie 1,000 or more feet below the mountaintops. This mountain-valley area is in the most rugged part of the great folded mountain region, designated as the Valley and Ridge physical province of the Appalachian Highlands, and this province extends from New York to Georgia.[2] In Pennsylvania the Valley and Ridge physical province is bordered on the west by the Allegheny Mountains escarpment, west of which are the Appalachian Plateaus.

This area of valleys and mountain ridges, according to the geologists (*3, 4, 8, 24, 36*),[3] developed following shrinkage of the earth, which, in turn, wrinkled, folded, twisted, warped, and faulted the crust of the earth until the area now included in Huntingdon County contains one

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[2] FENNEMAN, NEVIN MELANCTHON. PHYSICAL DIVISIONS OF THE UNITED STATES. U. S. Geological Survey. (Map.) Washington, D. C. 1930.

[3] Italic numbers in parentheses refer to Literature Cited, p. 145.

of the most complex systems of geological structure in Pennsylvania. White and Lesley (*36*) state that a thickness of more than 30,000 feet of rock strata of different kinds is exposed in this area, in many places at very steep angles.

Throughout a very long period of weathering and erosion, great quantities of the softer and less resistant rocks have been removed, forming a series of valleys. The harder rocks, mostly quartzites and sandstones, remained in place to form the present mountain ridges. The valley floors are undergoing a new cycle of erosion, and they are being thoroughly dissected by deeply entrenched streams, most of which parallel the great valleys.

The streams are swift-flowing, and they are actively cutting their channels deeper into the underlying rock strata, most of which are sandstones and shales. This downward grading of stream channels encourages a vigorous land-erosion cycle that is thoroughly dissecting the area, and most of it now has very strong relief. In general, the slopes are steep from the tops of the ridges to the edges of the alluvial flood plains. The alluvial flood plains along the streams are generally very narrow, and where the valleys are wider there is generally a series of alluvial terraces, some of which are very old and occupy benchlike positions 100 feet or more above the present levels of the streams. The larger streams have cut great gaps through the mountain ranges (pl. 1, *A* and *B*) and in some places deep gorges across the valleys.

The drainage follows a trellis pattern; that is, the smaller streams, in general, flow in a northeast or southwest direction and parallel to the valleys and ridges, whereas the master streams, the Juniata River and the Frankstown Branch Juniata River, flow roughly at right angles to them.

Areas of level land are few in Huntingdon County and occur only in the broad valleys.

In general, the elevation of the main valley floors ranges from 600 to 1,400 feet above sea level, and that of the more prominent mountains ranges from 1,800 to 2,350 feet and averages about 2,000 feet.[4]

Elevations of some of the more important points are: Huntingdon, 642 feet; Mount Union, 602 feet; Mapleton, 597 feet; Petersburg, 681 feet; Alexandria, 714 feet; Broad Top City, 1,978 feet; summit of Jacks Mountain, 2,350 feet; Broad Top Mountain, 2,330 feet; Tussey Mountain, 2,300 feet; Blacklog Mountain, 2,065 feet; Shade Mountain, 2,000 feet; Stone Mountain, 2,200 feet; and Bald Eagle Mountain, 1,760 feet. The Juniata River enters the county at an elevation of 852 feet and leaves it at an elevation of 520 feet.

Huntingdon County lies wholly within the drainage basin of the Juniata River. Several large streams empty into that river in the central part. The largest of these is the Raystown Branch Juniata River, which rises in Bedford County.

The complexity of the mountains and valleys, the great anticlinal and synclinal folds, together with the great exposure of geological strata, makes Huntingdon County geologically and physiographically an unusually complex but interesting county. It has beautiful valleys hemmed in by picturesque, rugged mountains. The natural resources are sufficiently diversified to be of interest to sightseers, vacationists, naturalists, wildlife observers, and scientists.

[4] All elevations are taken from published U. S. Geological Survey topographic maps.

A study of the interrelations of soils and geological materials in this county shows definitely that the soils have inherited their most outstanding characteristics from the parent rocks. As previously stated, the upturned edges of a thickness of 30,000 feet or more of geological strata are exposed. The variation of hardness and resistance of these beds to weathering and erosion has been responsible for the mountains and valleys as they now occur in the area. The angles at which the different strata are exposed range from vertical to horizontal. General observations indicate the average dip of the strata to be between 35 and 50 degrees.

The alluvial deposits range in age from present-day deposits on flood plains to old deposits of river terraces, some of which date back before the glacial epoch—tens of thousands of years ago. The largest deposit of old river terrace material is about three-fourths of a mile east and north of Alexandria in the big horseshoe loop of the Frankstown Branch Juniata River, above its junction with the Little Juniata River. Some of this material now lies more than 150 feet above the level of the stream.

The great continental ice sheets did not extend far enough south to change any of the surface geology of the county (*25*). Therefore, soil materials of the uplands are all residual or colluvial in origin. The Allegheny "Coal Measures," a subdivision of the Pennsylvanian series of the Carboniferous system, are the youngest deposits of consolidated and stratified rock material in this county. They form the crest of Broad Top Mountain at the southern edge of the county. From three to five veins of excellent quality coal occur in this formation.

The Mauch Chunk shale and the Pocono formation (sandstone) represent the lower members of the Carboniferous system. Below the Carboniferous system lie the Devonian, Silurian, Ordovician, and the upper Cambrian systems. The total thickness of these systems is approximately 28,000 feet. The Cambrian system is the oldest, and it is represented in this county by the Mines dolomite and the Gatesburg formation, which is a complex of interstratified dolomites and sandstones. Exposures of these materials are in the central part of Nittany Valley (locally called Halfmoon Valley), mainly north of the Little Juniata River.

VEGETATION

Huntingdon County is in the northeastern part of the Southern Hardwoods forest region (*35*). Originally the natural land cover was primarily an oak and chestnut forest. There is no written record or residual indication in the soils of any natural prairie or grassland ever having existed in this county. According to histories (*1; 21, 22, vol. 1; 26, 34*), the Juniata Valley before settlement by the white man was entirely covered by dense forests. The tree growth was mainly oak and chestnut, with which occurred white pine, red pine, pitch pine, Virginia pine (scrub pine), tuliptree (yellow poplar), hemlock, and similar trees. A few beech, walnut, elm, cherry, red maple, and hickory trees were scattered through the forests of the lower valleys or along streams. The undergrowth was mainly mountain-laurel, azalea, rhododendron, bracken, blackberry, hazel, dogwood, huckleberry, blueberry, and dewberry.

Following the period of settlement, lumbering became an important industry. The discovery of iron ore at the edges of the valleys created a great demand for furnace charcoal. The sale of lumber, together with the demand for charcoal, brought about the harvest and destruction of one of the county's most valuable resources—the forests. Clean cutting, followed by brush fires, swept the land surface free of vegetative cover. New forest growth came on slowly, and fires frequently swept through the cut-over land. The harmful effects of such destructive methods of forest cutting will linger for many generations.

The present forests are primarily second-growth oak and pine (*32*). The chestnut was completely destroyed by the oriental chestnut blight between the years 1912 and 1930. This is a fungus disease that works within the bark of the tree. New sprouts continue to come up from the roots of old trees, but the blight generally kills them before they are large enough to produce fruit. The Virginia pine, chestnut oak, and pitch pine make up most of the tree growth on the shallow shaly soils, and Virginia pine is dominant on the abandoned lands. Red, scarlet, and chestnut oaks are now the trees of the mountain areas. A low scraggy worthless oak, called scrub oak, now dominates the more level mountaintops or valley ridges that have been burned over repeatedly. Large areas covered by scrub oak are on Broad Top Mountain and over what is called the barrens of Terrace Mountain west of Little Trough Creek and the barrens of Nittany Valley. The term "barrens" is in reality a misnomer, because, when first discovered by white men, this land was covered with a dense forest of large chestnut, oak, white pine, pitch pine, and tuliptree. Even now, after the area has been swept by numerous forest fires, old chestnut and oak stumps from 3 to 5 feet in diameter remain. The name "the barrens" has been applied to these two areas mainly because they have been made practically barren by clean cutting and repeated burning.

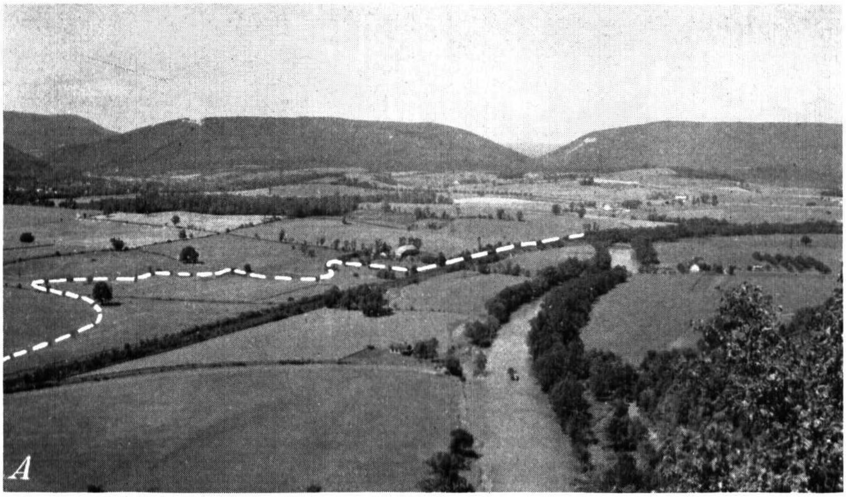
WATER SUPPLY

The water supply for Huntingdon County comes from four main sources: (1) Flowing streams, (2) springs, (3) deep wells, and (4) rain-water cisterns. Most of the water for towns comes from flowing streams that rise high up in narrow, forested mountain valleys. The water of the Juniata River is badly polluted by raw sewage that is emptied into the river by several towns and villages upstream. In addition the water in this river contains acids and other chemicals that are allowed to enter the Little Juniata River at Tyrone in Blair County. Huntingdon obtains its supply of water from Standing Stone Creek at the eastern edge of the town. Alexandria and Mount Union get their water supply from reservoirs in the mountains.

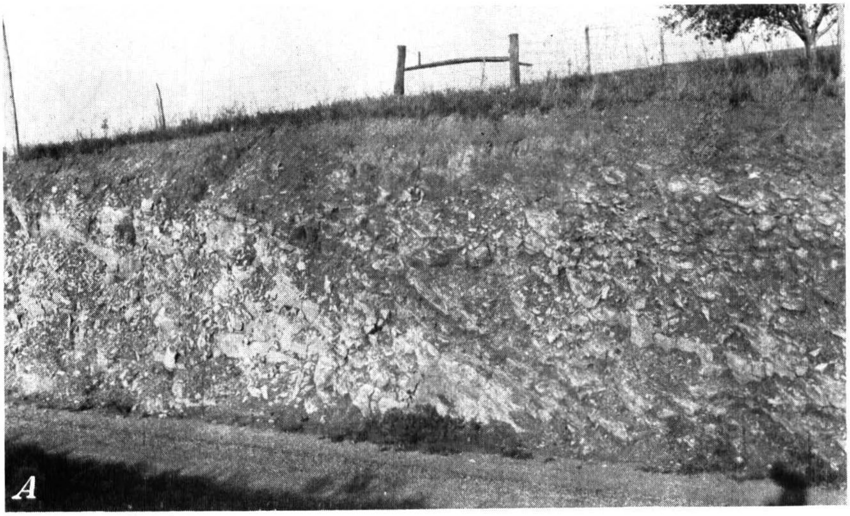
Supplies of water for farms in the valley are obtained largely from wells, springs, or mountain streams. Many residents of the uplands and high mountains depend on cisterns for storage of rain water.

WILDLIFE

The extensive areas of mountain forest land provide retreats and breeding grounds for wildlife. There are many deer, and deer hunting climaxes each hunting season. Hundreds of hunting cabins have been built in the mountain forests. The Pennsylvania State Game Commission has established a number of game reserves in the State forest areas. Pennsylvania State College has located a nature-study



A, Alluvial flood plain and old river terraces along Frankstown Branch, Juniata River between Alexandria and Petersburg. Heavy dashes mark the boundary between the Huntington soils on the flood plain in the foreground and Elk soils on the terraces in the middle ground. Note deep notches in Tussey Mountain, cut by Frankstown Branch, Juniata River on the left and Little Juniata River on the right. *B*, View upstream taken from near the same point.



A, Profile of Duffield silt loam, rolling phase, overlying broken shaly limestone at a depth of 2 to 3 feet. (Taken in Franklin County but typical of Huntingdon County.) *B*, Wheat on Murrill gravelly silt loam camp at the edge of Alan Seeger State Forest Monument. Students who major in nature study courses spend several weeks at this camp, where they may observe and study the habits and behavior of wild birds and animals.

Eastern ruffed grouse (locally called mountain grouse and mountain pheasant) and wild turkey are the more important game birds of the mountain areas, and Hungarian partridge, quail (bobwhite), and ring-necked or Chinese pheasant are numerous in the valleys.

The Game Commission maintains strict enforcement of the State game laws. The Commission has established rigid rules and regulations for the preservation and propagation of wildlife. Each year after the hunting season, many areas are restocked with rabbits, quail, pheasants, and occasionally wild turkeys.

Originally the streams were well stocked with fish, especially with the game fish—trout and bass. Large numbers of shad and salmon were in Great Aughwick Creek at one time. Industrial development together with soil erosion has polluted and muddied the streams until catfish, suckers, and carp are about the only fish surviving in most of the streams.

INSECTS AND PLANT DISEASES

Insects and plant diseases cause considerable damage to crops grown in Huntingdon County. Army worms and cutworms frequently attack corn and alfalfa in early spring. The corn earworm and the cornstalk borer attack the corn plant in late summer. The hessian fly frequently causes considerable damage to wheat. Late fall seeding may retard or eliminate the damage done by this insect. The local county agricultural agent or State extension specialist should be consulted for information concerning the control of insect pests.

Frequently rust and smut diseases attack small-grain crops. Potatoes may be attacked by Colorado potato beetles, aphids, flea beetles, and leafhoppers, which seem to be associated with tipburn of potatoes. Common scab damages the potato crop unless the soil is kept sufficiently acid to control the disease.

The more destructive insects attacking apples are the codling moth, the rose aphids, the budmoth, wood borers, and the San Jose scale. Apple scab is a serious apple disease. Peaches are attacked by the peach-tree borer, the oriental fruit moth, the plum curculio, and the shot-hole borer; San Jose scale and terrapin scale are the common scale insects that attack peaches; and peach leaf curl and brown rot are the more serious peach diseases. Recently the Japanese beetle has appeared in the county, and it may become a serious pest.

Vegetable crops are attacked by many different kinds of insects. For further information in regard to insects, pests, and plant diseases, the reader is referred to the local county agent, the Pennsylvania Department of Agriculture at Harrisburg, and the Department of Entomology and Plant Pathology, Pennsylvania State College.

Insects, such as houseflies and horseflies, are common. Mosquitoes are numerous during wet seasons, especially in wooded areas, both in the valleys and in the mountains.

HISTORY AND ORGANIZATION

The area now included in Huntingdon County originally belonged to the Conestoga (Susquehanna) and Shawnee Indians under the protection of the Iroquois Indians, known as the Six Nations (*21*, *22*, *vol. 1; 26*, *34*). This area first came under the claims of white men on March 4, 1681, when, for the sum of $80,000 (*27*), Charles II of England made a land grant to William Penn of 28,000,000 acres of land lying west from Delaware.

What is now Huntingdon County was purchased from the Indians October 22, 1758, and legally became the property of white men.

White men first entered the Juniata Valley some time after 1713. The Conestoga and Shawnee Indians occupied the valley about that date. James Le Tort is supposed to be the first white man to settle in the valley-ridge section. He settled in the Cumberland Valley near Bonny Brook some time between 1713 and 1719 (*18*, *vol. 1; 27*). Histories report that the earliest white men to enter the Juniata Valley were fur traders, and they came westward by way of the old Indian warpath from the Cumberland Valley (*26*). This was the earliest trail known to white men that went westward to the Ohio Valley, and it was the road taken by early Colonial troops in 1754 when they set forth to cope with the French and Indian disturbances in the Ohio Valley. At that time it was a one-man or one-horse trail through the mountains.

Although white men had been in what is now the county before 1748, there are no records or dates of their explorations, and the earliest record of a white man entering the area was in 1748, when Conrad Weiser, a young German, made a journey to Ohio. About 1750 approximately 30 families had settled on unpurchased Indian lands in the valleys, and a few settlements were made as far west as the foot of the Allegheny Mountains. Settlements on unpurchased Indian lands angered the Indians, and the Cumberland County magistrate ordered all white settlers off all lands west of Tuscarora Mountain and Blue Mountain, enforcing the order by burning all white settlements on Indian lands. Later, however, on June 6, 1754, the land westward to the Allegheny Mountains and north to the Susquehanna River, including the area that is now Huntingdon County, was purchased from the Six Nations at Albany, N. Y., by Thomas and Richard Penn.

In the same year George Crogan started the first permanent settlement at Augnwick (now Shirleysburg). At that time more than 200 Indians lived at Aughwick. The French of the Great Lakes region and the Ohio Valley induced the Indians to attack and destroy early settlements in the valleys of the Juniata River. Under such conditions permanent settlements in Huntingdon County were very few until after 1766. William Smith, an Episcopal clergyman, founded Huntingdon in 1767. By 1777 four or five houses and a fort had been built in Huntingdon—formerly called Standing Stone.

After having been in turn a part of Chester, Lancaster, Cumberland, and Bedford Counties, Huntingdon County was set apart from Bedford County by an act of the assembly on September 20, 1787. At that time Huntingdon County was about twice its present size. Huntingdon was then designated as the county seat. Later Huntingdon County was reduced to its present size by the formation of Mifflin County in 1789, Centre County in 1880, Cambria County in 1804, and Blair County in 1846. Very few changes have been made in the boundary lines since 1846.

Wars and the savage attitude of the Indians retarded settlement and development of the county between 1740 and 1780. After the close of the Revolutionary War and the end of antagonism of the Indians, agricultural development went forward at a rapid rate (*21*, *26*).

The first crops in the county were grown at Aughwick (Shirleysburg) by George Crogan in 1749. He planted 30 acres to corn, most of which was consumed by the Indians at the Aughwick camping grounds. By 1767 most of the good valley land had been claimed or settled.

Transportation was a difficult problem during the earlier years of settlement. Pack horses were the important means of transportation of goods between 1740 and 1796. The first wagon road west through the county was completed in 1808. The Harrisburg-Pittsburgh stagecoach was started in 1828. Arks and boats were used on the Juniata River as means of travel until 1800. The first barge, which traveled down the Juniata River in 1796, followed the swell of the river and carried flour, grain, and whisky. A canal up the Juniata River to Water Street was completed between 1829 and 1831. Boats were pulled by horse tug ropes at a speed of 3 to 4 miles an hour. The first boat arrived at Huntingdon in 1831. The first steam train arrived in Huntingdon June 6, 1850.

The first iron furnace was built at Orbisonia in 1780. Iron bars were forged in 6- to 8-foot lengths then bent in U-shape to fit mule or horse backs. Most of the iron was sent west to Pittsburgh. The price of iron in 1820 was $128 a ton. The early iron industry encouraged clearing of land, as the charcoal made from the felled trees paid for the clearing.

After 1780 a period of development and prosperity came into the valleys drained by the Juniata River. The lower valleys were devoted to grain growing, the upper ones to iron production. From the mountains came coal and timber. Thus, after the long struggle and the endurance of hardships, the close of the eighteenth century found the white men in possession of all the lands now included in Huntingdon County.

The production of iron ore and the cutting of forests was of prime importance until about 1890. Since that date the production of agricultural commodities has been of greatest importance. By 1910 lumbering was of minor importance and the production of iron ore had completely stopped. The old charcoal iron furnaces remain only as monuments to the early iron industry of Pennsylvania.

POPULATION AND TOWNS

Most of the early settlers were of Scotch and Irish descent. A few Germans were among the early settlers, but in general they came after the land had been settled. Most of the people now in the county are of Scotch, Irish, and German ancestry, except in the vicinity of Broad Top Mountain, where a number of Poles are employed in coal mining, and at Mount Union, where a few Italians are employed in the refractory-brick plants. The 1940 census reports a population of 41,836 for the county.

Huntingdon, the county seat, is the largest town. It is situated on the banks of the Juniata River and near the center of the county. According to the United States census, it had a population of 7,170 in 1940. Mount Union, with a population of 4,763, is the second largest town. It is also situated on the Juniata River, 11 miles below Huntingdon and at the east-central edge of the county. Other important towns and their populations are Mapleton, 803; Orbisonia, 729; Petersburg, 638; Broad Top City, 610; Rockhill, 548; and Alexandria, 442.

Tyrone, which is slightly larger than Huntingdon, is located on the Little Juniata River just over the western boundary in Blair County. A large paper mill at Tyrone is commercially important to Huntingdon County. Pennsylvania State College is located 5 miles north of the county line in Centre County.

TRANSPORTATION AND PUBLIC UTILITIES

Railway transportation is provided in part by the main line of the Pennsylvania Railroad, which in general follows the Juniata River through the county. A narrow-gage railroad, operated by the East Broad Top Railroad & Coal Co., connects Woodvale, Robertsdale, Saltillo, Three Springs, Rockhill, Orbisonia, and Shirleysburg with the Pennsylvania Railroad at Mount Union. A branch of this line extends from Orbisonia to Blacklog, Shade Gap, and Neelyton, terminating at the base of the Tuscarora Mountain. The line of the Huntingdon & Broad Top Mountain Railroad & Coal Co., standard gage, connects Dudley, Coalmont, Saxton, Entriken, Aitch, and Hesston with the Pennsylvania Railroad at Huntingdon.

Nearly all of the railroad stations or important points are now connected with a network of hard-surfaced all-weather roads. The William Penn Highway (United States Highway No. 22) enters the county at Mount Union and extends west through Mill Creek, Ardenheim, Huntingdon, and Alexandria to Petersburg, where it turns southward and extends to Hollidaysburg in Blair County, continuing westward over the Allegheny Mountains at Cresson in Cambria County. A State highway branches off to the north at Water Street, connecting with other main highways at Tyrone. United States Highway No. 522 branches off the William Penn Highway at Mount Union and extends southward through Shirleysburg, Orbisonia, and Shade Gap to McConnellsburg in Fulton County, where it joins the Lincoln Highway (United States Highway No. 30).

Nearly every main valley in the county has one or more hard-surfaced roads paralleling the valley. Very few of the better farms are more than 1 mile from a hard-surfaced road.

Water transportation was of importance between 1795 and 1850. After 1850 traffic on the river and canal gave way to traffic over the railroads and highways. Remains of the old canal channel, as it was built along the Juniata River, may still be seen, and even some of the abutments used as supports for the canal where it was carried over the river are still standing. In a period of 85 years the speed of freight transportation up and down the Juniata Valley has been increased from 5 to 50 miles an hour. Today trains of 100 carloads of coal move down the valley at a speed of 50 to 65 miles an hour. Fast passenger trains frequently travel through the valley at a speed of 70 miles or more an hour. Ten-ton commercial trucks now move along the highways at a speed of 30 to 50 miles an hour.

The development and use of water power reached its height during the early agricultural development of the county. Later, when the gasoline engine and electricity became important sources of power, several of the early mills run by water power discontinued operations. Nine such mills, however, were in a good state of preservation and in daily use in 1936.

The old Grazier Mill, situated on Warriorsmark branch of Spruce Creek in the northwestern part, has been converted into a hydroelectric power plant by the installation of a 220-volt electric generator. Two large hydroelectric power plants, the Warrior Ridge plant, on the Juniata River about 5 miles above Huntingdon and the Raystown power plant, about 4½ miles south of Huntingdon on the Raystown Branch Juniata River, have been in operation 20 years or more. They are not of the more modern type but do have large generating capacities. The potential hydroelectric power resources of Huntingdon County are far from being fully developed. A large amount of hydroelectric power could be generated on the Raystown Branch Juniata River, as the water level of that stream where it enters the Juniata River could be raised 140 feet or more without flooding much land above Saxton.

Many of the farmhouses now have telephones. Electric power lines have been extended into the better farming communities. This makes it possible for the better farm homes to have electric lights, radios, refrigerators, and other electric appliances. Soil productivity has in a large measure determined the boundaries of the more prosperous agricultural sections.

In general the schools are as good as the natural resources of the different districts are or will in the future be able to support. Recently the consolidation of school districts has brought about the abandonment of a number of rural schools. Improved roads have made the consolidation of schools possible, and motorbusses are used to transport the pupils to and from school.

All the larger towns have high schools that offer 4-year courses as prescribed by the Pennsylvania Department of Education. Juniata College, a coeducational institution, at Huntingdon, offers a 4-year college course in arts and sciences.

Nearly every community center in Huntingdon County has one or more large substantially built churches, and in most places the churches and cemeteries are well kept.

CLIMATE

The climate of Huntingdon County is continental, with warm summers and cold winters, but neither winter nor summer temperatures are extreme for the latitude. The prevailing winds, which are from the west, are usually drying, whereas the east winds are moist and humid and frequently are accompanied by heavy rains. In general, east winds are more frequent in the spring and summer than in the fall and winter. November and December seem to be the outstanding months for strong west winds. The valleys are afforded considerable protection from these strong winds by the mountain ranges.

Summers and winters are long, and the spring and fall seasons are rather short, as compared with the climate of the Midwestern and Southern States. The summers in Huntingdon County are generally warm and mild with considerable bright sunny weather from June to September. Summer temperatures commonly range from 60° to 90° F., and only rarely exceed 95°. Frequently hot days during the summer are interrupted by sudden and violent thunderstorms. August is the month of most frequent thunderstorms. Occasionally hail accompanies the thunderstorms. The total annual rainfall is approximately 40 inches. Kincer (*23*) gives summarized information relative to the rainfall and climate for the section.

Beginning with September, cloudy weather increases until January except for a period called Indian summer, which comes in October. This is probably the most beautiful of all seasons in the valleys and ridges of Pennsylvania. The forests that cover the mountainsides are aflame with brilliant reds, yellows, greens, and browns, and it is then that the harvest of corn and the planting of wheat mark the end of the growing season.

From early November until about the first of February the valleys and ridges are hemmed in with a dense layer of clouds through which the sun may shine for only a few hours or minutes during the day. This cloudy weather is frequently accompanied by fogs.

This mountainous region remains cold until late in the spring, as much snow and rain fall in the late winter and early spring. Floods, such as that of March 1936, are brought about by heavy rains on mountains that are covered with deep snow.

Snow generally covers the ground all winter, melting away in late March and early April. Some of the heaviest snowfalls come in March or early April. By the first of May spring has brought forth vegetative growth, and by the first of June summer temperatures have arrived. The rainfall is well distributed throughout the year.

Table 1, compiled from the records of the United States Weather Bureau station at Huntingdon, gives the normal monthly, seasonal, and annual temperature and precipitation.

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

[Elevation, 700 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total for the driest year (1930)	Total for the wettest year (1890)	Average snowfall
	°F.	*°F.*	*°F*	*Inches*	*Inches*	*Inches*	*Inches*
December	31.8	69	−15	2.92	2.91	3.35	6.8
January	28.9	72	−29	3.20	1.39	3.00	10.8
February	29.5	73	−23	2.69	3.08	5.18	10.3
Winter	30.1	73	−29	8.81	7.38	11.53	27.9
March	38.7	85	−7	3.46	2.26	3.61	7.1
April	49.3	95	6	3.49	3.28	4.91	1.8
May	60.3	98	22	3.75	2.29	6.36	.0
Spring	49.4	98	−7	10.70	7.83	14.88	8.9
June	68.5	100	29	4.12	3.65	4.18	.0
July	72.4	104	33	4.06	2.50	4.56	.0
August	70.7	105	36	3.88	.72	4.40	.0
Summer	70.5	105	29	12.06	6.87	13.14	.0
September	64.6	99	27	3.09	.71	3.55	.0
October	52.7	92	16	3.07	.40	5.04	.1
November	41.7	79	0	2.23	.80	1.38	1.0
Fall	53.0	99	0	8.39	1.91	9.97	1.1
Year	50.8	105	−29	39.96	23.99	49.52	37.9

The average frost-free season is about 5 months, beginning in May and ending in September or early October, although killing frost has occurred at Huntingdon as late as June 9 and as early as September 10. Temperatures throughout the county do not vary greatly, but the precipitation does. The direction of winds and the character of the relief affect the precipitation to a marked extent during July and August. Vegetation and crops in some parts of the county may be injured because of a scarcity of rainfall, whereas in other parts, where rainfall has been abundant, green pastures and tall corn show no need of additional soil moisture.

NONAGRICULTURAL INDUSTRIES

One of the most important nonagricultural industries is coal mining. Coal is mined on the top of Broad Top Mountain, and there is very little agricultural development, other than subsistence farms, on the top of this mountain.

Ovens for the making of refractory brick are located in Mount Union and Alexandria. The stone material used in the making of refractory brick comes from outcroppings of Tuscarora sandstone and Oneida conglomerate, commonly called "Ganister rock," which occur on Jacks Mountain near Mount Union and on Tussey Mountain and Short Mountain near Alexandria.

A very high grade of glass sand is made from the Oriskany sandstone, which is exposed near Mapleton. A large glass-sand plant, one of the most up-to-date in the country, is on the banks of the Juniata River midway between Mapleton and Mill Creek, where water from that river is used in the grinding of the sandstone and the processing of the sand. Glass sand from this plant was used in the manufacture of the world's largest (200-inch) telescope lens at Corning, N. Y. Abrasive powders for cleaning compounds are also made at this plant.

The principal present-day forest product is pulpwood, which is cut in 4-foot lengths and sold mostly to a pulp and paper mill at Tyrone (Blair County). Another pulp and paper mill at Williamsburg (Blair County) bids for some of Huntingdon County's pulpwood.

The county contains deposits of iron ore. Pennsylvania's great iron and steel industry began in this section, but later it moved west to Pittsburgh.

Clay of commercial value has been found on Warrior Ridge near Alexandria, in the Barrens of Nittany Valley, and near Shirleysburg and Orbisonia.

At present a radiator factory, a paper factory, and a large silk mill are located at Huntingdon. The total annual output of these factories runs well over a million dollars a year.

AGRICULTURAL HISTORY AND STATISTICS

The early settlement and agricultural development of the county was spread over a long period of years, as wars and rebellions were frequent and the Indians resented the coming of white men and the clearing of the land. Corn was one of the first and most important crops because it could be used for both human consumption and feed for livestock. A considerable quantity was converted into whisky, which was sold for export. Wheat was the next most important crop and the main cash crop. The first boat shipment of grain that left the county was mostly wheat. After flour mills run by water power were built, flour became the most important commodity of export. The bran and middlings were retained and used as feed for livestock.

The farmer's total cash income was not entirely from the sale of crops and livestock, as a part of it came from the sale of charcoal and sawlogs from the forests. The main items sold up to 1800 were flour, grain, and whisky. As the county developed and the areas of cultivated land became greater, the feeding of livestock became more important. The fattened animals were sent to eastern markets, where they were sold for slaughter.

The agriculture gradually developed into general farming, and the farmer grew those crops (mainly corn, wheat, hay, and potatoes) that were needed to supply food for his family and the local population and feed for livestock.

At first the lack of railroads, roads, and canals prevented a rapid expansion of agriculture. As soon as the canal up the Juniata River was completed, however, more land was cleared and agriculture developed more rapidly. Then the building of the Pennsylvania Railroad and the development of stagecoach roads stimulated agricultural development, and by 1860 it was going forward at a rapid pace. Corn, wheat, oats, rye, barley, buckwheat, hay, and potatoes were the leading crops. Beef cattle, hogs, sheep, and poultry were the important livestock commodities. Some dairy products, mainly butter and cheese, entered into the channels of trade.

During the Civil War the development of the county was held back for a time, but a brief period of prosperity and development followed the war. The panics of 1880 and the early 1890's affected the farmers adversely, and the development of new farming areas in the West placed the agriculture of Huntingdon County into keen competition with western agriculture. This situation has continued to the present time. The farmers of this county, however, have always had the advantage of lower cost of transportation to eastern markets. This difference in cost of transportation has made it possible for farmers on some of the better soils to compete fairly profitably with western farmers.

The growing and feeding of livestock gradually gave way to dairying. The development of refrigeration and a network of hard-surfaced roads made the production, transportation, and marketing of fluid milk possible. Dairying, especially the production of fluid milk, is now the leading agricultural enterprise.

Although originally the entire county was covered by dense forests, by 1870, according to records quoted by a county historian (*26*), 186,818 acres, or 31.8 percent of the area, had been cleared and classified as improved land, having an estimated value of $9,445,678.

The early settlers selected farms in the valleys, preferably near streams or springs, partly because the supply of water and transportation by water was important and partly because they recognized that the best soils were in the valleys.

The greater part of the land is hilly and mountainous and too steep and too stony for farming. Almost all of the mountain land has remained in forests. The early iron industry probably stimulated more clearing of land than was justified by the demand for land.

According to the Federal census for 1880, 66.1 percent of the area of the county was in farms, and 51.9 percent of the land in farms, or

34.3 percent of the total area of the county, was considered improved farm land. The area of improved land decreased steadily from 1880 to 1940, when 41.9 percent of the area of the county was in farms, and only 125,201 acres, or 21.9 percent of the area of the county, was improved. In many parts of the county as much as 10 or 15 percent of the cleared land has been abandoned and has grown up to poverty grass, brambles, and Virginia (scrub) pine. The main cause of deterioration and abandonment of land in Huntingdon County has been increased economic competition, cost of production, and indiscriminate land use. Soil erosion and continued depletion of soil fertility have brought about waste of valuable soil resources, and these can never be fully restored or replaced by man.

Table 2 gives data on land and farm areas as reported by the Federal census for the census years 1880 to 1940, inclusive.

TABLE 2.—*Number of farms and size of farm areas in Huntingdon County, Pa., in stated years*

Year	Total farms	Land in farms			Improved land in farms		
		Total	Per farm	Proportion of county area	Total	Per farm	Proportion of farm land
	Number	*Acres*	*Acres*	*Percent*	*Acres*	*Acres*	*Percent*
1880	2,579	388,327	150.6	66.1	201,699	78.2	51.9
1890	2,391	338,329	141.5	57.6	198,852	83.2	58.8
1900	2,425	363,171	149.8	61.8	199,020	82.1	54.8
1910	2,285	340,539	149.0	58.0	188,897	82.7	55.5
1920	2,111	325,840	154.4	55.5	172,682	81.8	53.0
1930	1,771	276,709	156.2	47.1	134,958	76.2	48.8
1940	1,625	240,041	147.7	41.9	125,201	77.0	52.2

The 1929–34 economic depression brought about a general depression of agriculture in Huntingdon County. The shut-down or curtailment of production in the factories and mills reduced the demand for agricultural products. Many of the unemployed moved out of the towns and onto the submarginal lands where they could obtain part of their subsistence direct from the soil. Since 1934 the employment of labor has shown much improvement, and farmers are in better financial condition. The economic depression, however, was responsible for a sacrifice of soil and land resources. Evidence of this may be seen in badly eroded and abandoned fields, sagging or falling farm fences, and farm buildings that have gone unpainted for a number of years. The United States Department of Agriculture is now aiding the farmers to improve and to conserve their soil resources.

The average size of farms in 1940 is 147.7 acres, of which about 77 acres is considered cropland and plowable pasture. Most of the remaining 70.7 acres is timberland, cut-over land, or abandoned old fields. There has been but little change in the average size of Huntingdon County farms in the last 60 years, and there is little evidence that suggests any great change in their size in the near future.

Land values in Huntingdon County vary greatly, depending on the character of soil, the slope or lay of the land, and the location with respect to markets and social centers. Land values range from almost nothing for land that is poorly suited to farming to as much as $150 an acre, not including the value of buildings and improvements for very productive farming lands. The higher bottom lands bring the highest prices, followed next by the lands of the limestone valleys, where the soils are mainly members of the Hagerstown, Duffield, and Frankstown series. The shale lands have the lowest agricultural value of any of the agricultural lands in the county. The more extensive soils from shale belong to the Calvin-Edom complex and to the Calvin, Berks, Amberson, and Gilpin series, the latter being the poorest of the group. It is the low value of the cleared shale lands that brings down the average value of all lands. In general the forested mountain lands have a greater value than much of the cleared shale land. The sandstone mountain lands have not been considered agricultural land, and they will not be so considered in this report but will be treated as forest lands.

Table 3 gives the value of all property per farm and the value of land per acre, as reported by the Federal census for the census years 1880 to 1940, inclusive.

TABLE 3.—*Value of all property per farm and value of land per acre in Huntingdon County, Pa., in stated years*

Year	Per farm					Per acre
	All property	Land	Buildings	Implements	Domestic animals	Land
		Percent	*Percent*	*Percent*	*Percent*	
1880	$3,940	[1] 87.7		3.4	8.9	[1] $23.01
1890	3,730	[1] 83.1		4.3	12.6	[1] 21.90
1900	3,201	48.2	31.9	5.8	14.1	10.30
1910	4,007	41.4	34.0	7.2	17.4	11.13
1920	6,715	38.6	31.0	11.5	18.0	16.81
1930	6,591	29.9	41.0	12.5	16.6	[1] 29.91
1940	5,135	30.0	40.1	13.2	16.7	[1] 24.36

[1] Land and buildings.

The present agriculture consists largely of general farming in which the common crops are hay, forage, and cereals, grown chiefly as feed for livestock. Poultry and dairy products, especially whole milk, are the most important products sold from the farms. Table 4 gives the value of farm products by classes as reported by the Federal census for the years 1909, 1919, 1929, and 1939.

TABLE 4.—*Value of agricultural products by classes as reported by the census for years 1909, 1919, 1929, and 1939 in Huntingdon County, Pa.*

Product	1909	1919	1929	1939
Cereals	$912,730	$2,609,502	$912,170	$756,421
Other grains and seeds	1,343	29,516	4,410	8,179
Hay and forage	433,293	1,127,922	549,170	409,817
All vegetables	174,953	620,448	[1] 268,430	[1] 184,397
Vegetables (excluding potatoes and sweetpotatoes) for home use only			94,080	78,563
Fruits and nuts	136,936	172,716	143,595	73,940
All other crops	192,954	333	[2] 3,655	[2] 6,465
Livestock products:				
Dairy products sold	230,466	539,949	880,552	628,961
Poultry and eggs produced	230,312	485,834	506,338	353,993
Wool and mohair shorn	11,838	[3] 19,484	[3] 10,442	[3] 3,895
Honey and wax produced	3,708	8,102	[4] 5,954	[4] 1,023
Forest products for home use and sale			124,651	[5] 38,807

[1] Includes all potatoes and sweetpotatoes but excludes other vegetables for home use.
[2] Includes horticultural specialties sold
[3] Wool only.
[4] Honey only.
[5] Forest products sold.

The more important cereal crops now grown in Huntingdon County are corn, wheat, rye, oats, barley, and buckwheat. The important hay crops are clover, clover and timothy mixed, alfalfa, alfalfa and timothy mixed, and alfalfa and clover mixed. Of the special crops, potatoes are probably most important. Recently a few farmers have specialized in the growing of vegetables for market, the more important being tomatoes, peas, beans, and sweet corn. These are sold at local stores and markets.

Table 5 gives the acreages of the principal crops as reported by the Federal census for the census years 1879 to 1939, inclusive.

TABLE 5.—*Acreage of principal crops in Huntingdon County, Pa., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1930
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
Corn	21, 517	20, 931	26, 008	24, 126	23, 011	16, 317	15, 459
Oats	11, 157	13, 939	13, 041	13, 904	15, 466	12, 085	10, 181
Wheat	33, 610	26, 608	30, 972	21, 520	26, 659	15, 566	14, 041
Rye	6, 955	4, 404	4, 170	3, 710	3, 359	2, 294	832
Barley	271	170	336	173	197	635	1, 402
Buckwheat	3, 282	2, 293	2, 711	3, 118	2, 390	1, 437	384
All hay	24, 581	30, 069	28, 566	28, 845	28, 546	25, 986	23, 293
Timothy				10, 515	9, 097		
Timothy and clover				15, 376	17, 763	[1] 24, 546	[1] 18, 361
Clover			4, 948	1, 723	823	[2] 111	[2] 374
Alfalfa				55	153	967	3, 152
Other tame grasses			23, 520	870	522	271	556
Wild grasses			51	261	46	6	65
Grains cut green			47	45	80	39	310
Legumes for hay					62	46	475
Silage crops					1, 098	2, 730	2, 098
Coarse forage			342	1, 283	14, 217	292	120
Potatoes	1, 918	1, 705	2, 160	2, 253	1, 971	1, 753	986
Market vegetables					252	245	156
Strawberries			35	41	28	32	15
Raspberries			45	29	18	54	22
	Trees	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*
Apples		129, 195	169, 333	115, 175	88, 687	75, 215	42, 367
Peaches and nectarines		13, 205	82, 275	34, 110	41, 410	22, 771	[3] 10, 221
Pears		2, 332	9, 792	10, 300	7, 253	5, 474	3, 416
Plums and prunes		1, 988	17, 045	10, 427	7, 671	3, 051	1, 114
Cherries		6, 139	16, 295	17, 313	14, 176	9, 374	4, 322
	Vines	*Vines*	*Vines*	*Vines*	*Vines*	*Vines*	*Vines*
Grapes			15, 789	7, 654	9, 763	9, 381	7, 234

[1] Timothy or clover, alone or mixed.
[2] Sweetclover only.
[3] Peaches only.

Corn has always been one of the most if not the most important grain crop grown in the county. It has occupied from 25 to 30 percent of all cropland since 1880. The average acre yield of corn according to the Federal census has ranged from about 25 to 39 bushels in different census years. The highest average yields were in 1919 and 1939. Wheat, the most important small-grain crop, was introduced into the Cumberland Valley about 1839 (*6*, pt. 2). This wheat had its origin in Italy and became known as Mediterranean wheat. By 1870 the annual production of wheat in Huntingdon County was approximately 389,000 bushels (*26*). Federal census reports for 1880 indicate a production average of about 11 bushels an acre, and no consistent trend is apparent in acre yields between 1880 and 1940, although the average yield was about 17 bushels an acre in 1939.

The less important small-grain crops are oats, rye, barley, and buckwheat. The total acreage of land in oats has remained about the same for 60 years. The acreage in rye has decreased considerably, whereas the acreage in barley has increased. Rye yields better than wheat on poor soils, and for this reason it has replaced wheat on shallow poor soils. Six-rowed winter barley has become an important crop that has recently displaced oats to a certain extent. Buckwheat seems to thrive on poor soils. It can be planted late because it matures quickly. The cost of growing buckwheat is rather low; therefore it is naturally adapted to short, cool growing seasons and poor soils. Yields of buckwheat range from 10 to 15 bushels an acre, depending on the season and the condition of the soil.

Timothy, clover, and a mixture of timothy and clover have been the most important hay crops from the time of first settlement, although now timothy alone has largely been displaced by the timothy-clover mixture. Recently the acreage of alfalfa alone and alfalfa and timothy mixtures has been increasing. Timothy is used to provide a soil cover for those areas in alfalfa fields where the stand of alfalfa for some reason is not good or where the alfalfa alone cannot hold the soil in place and prevent it from washing away or eroding.

Corn is and has been used not only for grain but also for fodder and silage for livestock. Corn fodder is commonly stored in the barns for winter, and silage is put into the silo in September.

The wild grasses, the commonest of which is poverty grass, are of little value as feed for livestock, and as a result the pasture grasses and legumes are mainly of tame or domestic origin. Kentucky bluegrass, white clover, redtop, and bentgrasses are the dominant plants in the permanent pastures. Kentucky bluegrass, together with white clover, has proved to be a very valuable pasture grass on the more fertile soils of the limestone valleys and on the alluvial first bottoms, high bottoms, and valley terraces. Canada bluegrass has replaced Kentucky bluegrass on the drier soils of the uplands, but it has not been very productive on the shallow acid soils from shale. The total acreage of good pasture land has not been determined, but it is not so large as it should be for the grazing needs of the county. The establishment of good pastures on the acid soils of the uplands of Huntingdon County is a problem for which no definite or economical solution has been found.

Special crops include potatoes, vegetables, and fruits. Apples are the only important fruit. The climate in general is not favorable for peaches. In addition to the crops listed in table 5, 234 acres of clover for seed and 274 acres of timothy were grown in 1929, and 627 acres of clover for seed and 85 acres of grass for seed in 1939.

Until about 1910 dairying was not of great importance. With the advancement of scientific methods for the pasteurization of milk and the development of refrigeration in connection with milk transportation, it became possible to transport milk long distances without danger of spoilage. The demand for whole milk in the larger cities has extended until now the farmers of Huntingdon County are shipping milk to Philadelphia and New York City. Dairying has become a specialized industry of major importance. Of a total production of 4,145,452 gallons in 1939, 3,000,387 gallons were sold as fluid milk.

Table 6 gives the number of domestic animals in 1920, 1930, and 1940, as reported by the Federal census.

TABLE 6.—*Number of livestock in Huntingdon County, Pa., in stated years*

Livestock	1880 [1]	1890 [1]	1900 [2]	1910 [3]	1920 [4]	1930 [5]	1940 [6]
Horses	6,962	7,568	7,011	6,149	6,014	3,487	2,743
Mules	420	589	656	745	894	882	830
Cattle	22,203	22,119	21,803	19,224	18,627	14,648	13,896
Sheep	16,373	18,847	23,526	14,505	5,885	4,892	2,737
Swine	15,448	15,819	16,088	13,543	15,698	6,514	7,856
Chickens	[7] 87,741	122,315	113,832	[7] 130,447	151,479	118,452	105,231
Bees (hives)	----------	----------	2,374	1,720	1,872	1,668	524

[1] Livestock of all ages, excluding spring lambs.
[2] Livestock of all ages on June 1.
[3] Livestock of all ages on April 15, excluding chickens under 3 months.
[4] Livestock of all ages on January 1.
[5] Livestock on April 1, excluding horses, mules, cattle, hogs, and chickens under 3 months and lambs under 6 months.
[6] Livestock on April 1, excluding horses, mules, and cattle under 3 months, pigs and chickens under 4 months; and sheep under 6 months.
[7] All poultry.

Most of the labor employed on the farm is supplied by the members of the farm family. The Federal census for 1940 shows 33.3 percent of the farms employing labor at an average cost of $263.74 a farm in 1939. A large proportion of the farm labor comes from nearby farms where there is a surplus, and much of the employment of labor on farms is not permanent throughout the year, but temporary during the harvesting of wheat, hay, and corn.

Many of the people who live on farms have additional employment in the various industries; for example, in the silk mills, brick plants, builders trades, wood cutting, coal mining, or road construction and repair.

Most of the soils of Huntingdon County are not well suited to corn. Good yields are obtained only on the deep alluvial flood-plain soils or on more level areas of deeper soils of the limestone valleys. The scarcity of corn-producing land results in a lower production of corn than is needed to balance the production of hay and forage crops. This overbalance of roughage naturally creates a demand for grain concentrates. Corn, oats, and barley are the important grains purchased by farmers. Some farmers buy the ready-mixed mill feeds, which are combinations of cracked corn, wheat bran or middlings, and possibly oats.

The early settlers recognized the need of fertilizers as an aid in the production of crops. Some of them bought land plaster (gypsum) in 1807 at a cost of $2 a bushel. An attempt was also made to use powdered coal as a substitute for land plaster, but this was without success.

Present-day agriculture cannot thrive unless the fertility of the soils is maintained or improved by applications of lime and fertilizers. Large quantities of lime are bought by farmers and spread on the cultivated fields. Some farmers produce their own lime by burning (*12*). According to the Federal census of 1940, approximately 11,127 tons of burned lime were bought by the farmers in the county at an average cost of $3.52 a ton.

The census for 1940 also shows that 1,119 farmers purchased $74,720 worth of commercial fertilizers, or an average of about $66.77

a farm reporting. Most of the fertilizer was ready mixed. Farmers generally apply fertilizer for the small-grain crops, mainly wheat. Phosphate fertilizers are now being applied for hay crops, mainly alfalfa.

For additional data relative to acreages and yields of important crops in Huntingdon County, the reader is referred to Pennsylvania Department of Agriculture General Bulletin 511 (*19*).

Owners operate 80.9 percent of the farms, managers 1 percent, and tenants 18.1 percent. Of the farms that are rented, about 90 percent are rented on the share-crop basis. The tenant usually furnishes the operating labor and equipment and one-half of the fertilizer, and he receives one-half of the crop produced.

According to the Federal census, the peak of rural population (including towns and villages of less than 2,500 population) in the county was reached in 1890. At that time the total rural population was 30,000. By 1940 the rural population had decreased to 29,903, or 71.5 percent of the total population.

The population is not uniformly distributed; nearly all of the rural population is concentrated in the valleys. In general the density of rural population is greater where the soil productivity is higher.

There is a great range in kind, amount, and quality of farm equipment on farms in Huntingdon County. On the better land in the limestone valleys where the soils are of the Hagerstown, Murrill, or Frankstown series, the farm buildings are substantial and well kept, the fences are good, and the farm machinery and equipment are more modern. Electric power lines have been extended into most of the better farming districts, and electric light and power is available for those who wish to connect with the electric power lines.

It is frequently said that "the prosperity of the Pennsylvania farmer may be judged by the size and condition of his barn." There is much truth in this statement, except when the barn is unusually old.

In contrast with the limestone valleys, and in many places less than half a mile away on the shallow soils of the shale lands, one can see a great difference in farm equipment. The farm buildings are in need of paint, and many of them are in a bad state of repair. This condition is not due entirely to the will of the people but to the difference in the capacity of the soils of that area to produce grain crops and grasses. Naturally, the people who farm the poorer soils cannot afford expensive farm equipment. The tillage implements are few and of the simplest design. Many of them appear to be patterned after the tillage implements used half a century ago.

SOIL SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many localities. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, gullies, ditches, pits, and other excavations, are studied. Each excavation exposes a series of distinct soil 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 [5] and its content of lime are determined by simple tests.[6] Drainage, both internal and external, and other external features, such as stoniness and the 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 those features that influence the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into classification units, the three principal 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 map but must be mapped as (4) a complex. Some areas of land, such as coastal beach or bare rocky mountainsides, that have no true soil, are called (5) miscellaneous land types.

The most important of these units is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile, and developed from one type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics, the same natural drainage conditions, and the same range in relief. The texture of the upper part of the soil, including that commonly plowed, may differ within a series. The soil series are given names of places or geographic features near which the soils were first found. Hagerstown and Dekalb are names of important soil series in Huntingdon County.

Within a soil series are one or more types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Hagerstown silt loam, Hagerstown silty clay loam, and Hagerstown stony clay loam are soil types within the Hagerstown 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 soil unit to which agronomic data are definitely related.

A phase of a soil type is a variation within the type, differing from the type in some minor soil characteristic that may have practical significance. Differences in relief, stoniness, and degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a soil type certain 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 plants.

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[5] 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 indicate alkalinity, and lower values indicate acidity.

[6] 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.

In such an instance the more sloping parts of the soil type may be segregated on the map as a sloping or a hilly phase. These differences, however, are not reflected in the character of the soil or in the growth of native plants.

The soil surveyors make 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.

Definitions of a number of other common terms used in describing soils and soil materials are as follows:

"Colluvial soil material" refers to soil material that has been transported, by gravity, creep, and local wash, from a higher to a lower level and deposited at the foot of slopes. It is generally heterogeneous and not distinctly stratified.

"Residual soil material" refers to soil material formed essentially in place, without addition of transported material, from decomposition and disintegration of the parent rock.

"Soil structure" is the arrangement of the individual soil particles in aggregates.

"Soil texture" is the relative proportion of soil particles of various sizes (sand, silt, and clay) present in a soil.

SOILS AND CROPS

The geographic position of Huntingdon County is such that it has a great many different kinds of rocks and weathered rock materials. The rock strata lie at steep angles and are exposed in narrow parallel belts that extend in a general northeast and southwest direction across the county. The weathering of these many kinds of rocks has produced a corresponding number of parent soil materials that are a complex mixture of many different kinds of soil and rock minerals. Natural variations in the mineral make-up, as well as in content of organic material, slope, and natural drainage of the soils, give rise to a large number of soil types and phases. All the soil materials of the uplands of the county are either residual or colluvial in origin. The mineral constituents of soils are derived from the minerals of the parent rocks; therefore the soils form narrow belts corresponding to the exposures of different geological strata.

The exposed rocks are broadly classed as sedimentary. Sandstones, quartzites, shales, limestones, and dolomites are the principal kinds. The sandstones and quartzites are very resistant to weathering and erosion, and they form the crests and steep slopes of many of the mountains. They are the parent rocks of sandy and stony very strongly acid soils. Most of the shales are less resistant to weathering and erosion than the sandstones and quartzites, and they have been reduced by erosion to areas of low mountains and steep rolling hills on which shallow layers of acid shaly soils have developed. The limestones and dolomites are rather easily dissolved and eroded by water, and it is for this reason that the limestone areas comprise the lower and smoother uplands.

Many of the better agricultural lands occur where the soils are developed from limestones and dolomites. Most of the lower grade agricultural lands consist of soils developed from shales, and the nonagricultural forested mountainous land includes chiefly soils developed from sandstone and quartzite rocks.

Soil drainage, growing vegetation, and decaying organic matter are factors that have affected the formation and development of soils. Poor drainage causes a stagnant soil condition. The soil takes on a disagreeable odor and a gray, yellow, bluish-gray, and rusty-brown splotched or mottled color design. Well-drained soils are generally of solid colors—brown, reddish brown, yellowish brown, or grayish brown.

Organic matter produced by growing vegetation usually darkens the soil with which it is mixed. In Huntingdon County the original vegetation, principally oak, pine, and chestnut, produced a rather large annual deposit of leaf litter and other organic material. When this kind of organic material decomposes, certain soluble organic acids are formed and are dissolved and carried down through the soil and into the ground water. The acids are effective in leaching away the basic elements, such as calcium and magnesium, from the surface soil and to a less extent from the subsoil. Because of leaching, all the soils of the uplands in this county, even those developed from limestone, are acid in reaction.

The kind and quantity of basic elements originally contained in parent soil materials in this area have determined to a large extent the rate of leaching and the depth to which the soils have been leached. The mineral materials that have accumulated through the decomposition of limestones and dolomites are mainly mixtures of aluminum silicates (clays), iron and aluminum oxides, and a small proportion of calcium, potassium, and magnesium silicates. This material is alkaline or only slightly acid in reaction until after the basic calcium and magnesium compounds have been removed by leaching; then it becomes acid. The mineral impurities (iron oxides and clays) in limestones are resistant to leaching, and it is for this reason that the soils of the limestone valleys have held their iron oxide compounds, which give them a strong-brown, reddish-brown, or yellowish-brown color.

In contrast with the soils of the limestone valleys, there are the soils of the sandstone and quartzite mountains, the mineral content of which is mainly quartz sand, aluminum silicates (clays), small quantities of iron oxides, and very little calcium and magnesium. The leaching process rapidly removes the small amounts of basic minerals originally present in the sandstones and quartzites. The surface soils of most of the sandstone mountain areas are sandy, thoroughly leached, very strongly acid in reaction, and grayish brown or gray.

The soils range from brown to reddish brown in the limestone valleys, from yellowish brown to grayish brown in the shale hills, and from grayish yellow or yellowish gray to light gray on the sandstone mountains and in "the barrens." In general, the surface soils are light-colored, and they all range from medium acid to very strongly acid in reaction except where they have been limed.

Organic matter in Huntingdon County decomposes almost as fast as it forms, so that most of the soils are fairly low in organic matter. Under forest cover the surface inch or two of soil is dark and fairly high in organic matter, but the subsurface soil contains much less.

Wherever the forest was removed and the soil put under cultivation the organic-matter content decreased rapidly, and the soils that have been cultivated for many years contain little organic matter.

It is difficult to maintain a supply of organic matter in the cultivated soils equal to the amount that the soil contained when under a forest cover. The maintenance of the organic-matter content of the soils in this county is difficult, but it is of great importance to the agriculture.

The productivity of all the soils, except possibly certain alluvial first-bottom soils, can be increased greatly by applying lime, manure and other organic matter, and commercial fertilizers.

Most of the soils are mellow, friable, and granular or nutlike in structure, so that water is absorbed rapidly and internal drainage is good. Exceptions to this statement will be noted in the descriptions of some of the soils, and it should be pointed out further that continued clean cultivation reduces the capacity of the soil to absorb water rapidly and increases the rate of runoff. The total area of poorly drained soils in this county is very small, and most of the wet soils are in low areas along drainage channels or around their heads. On a basis of soil characteristics, productivity, and general usefulness, the soils of Huntingdon County have been placed in eight groups, and they will be discussed in this section under the group headings as follows: (1) Soils of the limestone valleys, (2) soils of the shale hills, (3) soils of the colluvial foot slopes, (4) soils of the river terraces, (5) soils of the alluvial flood plains, (6) soils of the mountains, (7) rough broken and rough stony lands, and (8) miscellaneous land type.

The soils of the limestone valleys are deep. They occupy comparatively smooth valley lands, have good structure and drainage, and are naturally the least acid soils of the uplands. This combination of characteristics makes them the most productive soils of the uplands. Yields of corn are usually high.

The soils of the shale hills are comparatively shallow. The moisture-holding capacity is comparatively low—probably lower than that of any soils of other groups. The shortage of moisture, however, is partly due to the fact that the rate of water penetration in cultivated areas of these soils is slow, and this, in turn, promotes excessive runoff during and after torrential rains, which accompany violent thunderstorms in July and August. In dry weather yields of crops are reduced by lack of moisture; in wet weather the soils are quickly saturated at the immediate surface, and the resulting runoff induces severe sheet and gully erosion. These soils are not well suited to the production of corn, but good yields of small grains or other early maturing crops may be obtained on the more gently sloping areas through conservative soil-management practices.

The soils of the colluvial foot slopes are not so fertile as the soils of the limestone valleys, but they are generally as deep or deeper. The total area of these soils is small, but where well drained they have about the same general crop-producing capacity as the soils of the limestone valleys. The production of corn is important on them. Most of the soils of the colluvial foot slopes are either too steep or too stony for the production of clean-cultivated crops, and much of this land remains in forest.

The soils of the river terraces are developed from soil materials that have been transported by water and redeposited as stratified sediments by the streams when they flowed at a higher level than they do now. In most places drainage is good; in some places it is excessive.

Most of the soils of the alluvial flood plains are deep. Some are well drained, and some are not. Agricultural values vary greatly. In general, the alluvial soils are devoted to the production of corn, pasture grasses, and vegetables.

A few of the forested areas in the sandstone and shale mountains have been cleared and placed under cultivation, but the total area of cultivated land is comparatively small. Most of the cultivated areas are used for subsistence farming by persons who obtain most of their cash income from part-time employment in mines, factories, or public works. Two or three areas of sandy loam soils in the mountains have been cleared and used for the commercial production of apples.

The miscellaneous land type, riverwash, is bare, or occupied by weeds or small trees, and has little or no agricultural value.

In the following pages the different soils are described 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 7.

TABLE 7.—*Acreage and proportionate extent of the soils mapped in Huntingdon County, Pa.*

Type of soil	Acres	Percent
Hagerstown silt loam	3,520	0 6
Hagerstown silty clay loam	10,624	1 8
Hagerstown clay loam	11,968	2.1
Hagerstown stony clay loam	5,120	.9
Duffield silt loam	3,648	.6
Duffield silt loam, rolling phase	9,152	1.6
Duffield sandy loam, rolling phase	128	([1])
Duffield silty clay loam	1,728	.3
Frankstown cherty silt loam	4,864	8
Frankstown cobbly silt loam	1,344	.2
Frankstown cherty silty clay loam	3,200	.6
Murrill gravelly silt loam	4,672	.8
Murrill cobbly loam	3,008	.5
Murrill gravelly sandy loam, deep phase	640	.1
Murrill cobbly sandy loam, deep phase	960	.2
Berks silt loam	5,312	.9
Berks silt loam, rolling phase	8,448	1 4
Berks silt loam, heavy-subsoil phase	448	.1
Berks silt loam, shallow phase	128	([1])
Berks shale loam	6,592	1 1
Gilpin shaly silt loam	15,872	2.7
Gilpin gravelly silt loam	2,496	.4
Gilpin shale loam	60,224	10 3
Gilpin cobbly silt loam	3,072	.5
Rayne silt loam	1,216	.2
Rayne gravelly silt loam	384	1
Rayne cobbly silt loam	640	1
Calvin silt loam	6,528	1 1
Calvin gravelly silt loam	640	.1
Calvin gravelly silt loam, colluvial phase	512	.1
Calvin cobbly silt loam	576	1
Calvin shaly silt loam	12,672	2.2
Calvin loam	192	([1])
Calvin shale loam	9,472	1.6
Amberson shaly silt loam	8,000	1.4
Amberson shale loam	24,000	4 1
Amberson gravelly loam	384	0.1
Amberson cobbly sandy loam	3,008	.5
Calvin-Edom silt loams	8,448	1 4
Calvin-Edom gravelly silt loams	1,088	2
Calvin-Edom silty clay loams	10,176	1.7
Calvin-Edom shaly clay loams	704	.1
Laidig silt loam	576	.1
Laidig gravelly loam	192	([1])
Laidig gravelly loam, shallow phase	256	([1])
Laidig cobbly loam	4,352	.8
Laidig stony loam	5,760	1 0
Laidig stony sandy loam	26,496	4.5
Laidig loamy sand	64	([1])
Buchanan silt loam	768	.1
Buchanan silt loam, shallow phase	64	([1])
Buchanan cobbly loam	768	.1
Ernest silt loam	8,896	1 5
Ernest gravelly silt loam	1,088	.2
Ernest cobbly loam	1,664	.3
Ernest stony sandy loam	5,504	.9
Elk silt loam	2,688	5
Elk gravelly silt loam	128	([1])
Cassville silt loam	1,344	.2
Holston silt loam	2,880	.5
Holston silt loam, high-terrace phase	832	.2
Holston gravelly sandy loam	192	([1])
Monongahela silt loam	2,368	.4
Monongahela silty clay loam	448	.1
Huntington silt loam	4,864	.8
Huntington silt loam, high-bottom phase	704	.1
Huntington silt loam, colluvial phase	3,136	.5
Huntington fine sandy loam	768	.1
Huntington fine sandy loam, high-bottom phase	64	([1])
Lindside silt loam	1,664	.3
Lindside silty clay loam	1,024	.2

[1] Less than 0.1 percent.

TABLE 7.—*Acreage and proportionate extent of the soils mapped in Huntingdon County, Pa.*—Continued

Type of soil	Acres	Percent	Type of soil	Acres	Percent
Warners silt loam	192	[1]	Dekalb stony loamy sand	7,232	1.2
Moshannon silt loam	2,496	0.4	Clymer gravelly loam	384	.1
Moshannon silt loam, high-bottom phase	704	.1	Clymer cobbly loam	3,264	.6
Moshannon sandy loam	2,176	.4	Clymer sandy loam	128	[1]
Senecaville silty clay loam	1,216	.2	Lickdale stony silt loam	1,088	.2
Pope silt loam	3,008	.5	Lickdale stony sandy loam	3,520	.6
Pope silt loam, colluvial phase	896	.2	Morrison silt loam	1,088	.2
Pope silt loam, high-bottom phase	1,216	.2	Morrison sandy loam	5,504	.9
Pope sandy loam	704	.1	Morrison stony sandy loam	6,784	1.2
Philo silty clay loam	5,056	.9	Morrison loamy fine sand	896	.2
Philo silt loam	7,680	1.3	Morrison stony loamy sand	256	[1]
Philo silt loam, high-bottom phase	448	.1	Morrison-Frankstown complex	4,992	.9
Philo sandy loam	256	[1]	Rough broken land (Gilpin soil material)	2,688	.5
Atkins silty clay loam	768	.1	Rough broken land (Calvin soil material)	3,648	.6
Atkins clay	768	.1	Rough stony land (Dekalb soil material)	60,736	10.4
Atkins clay, high-bottom phase	64	[1]	Rough stony land (Leetonia soil material)	7,872	1.3
Lehew stony loam	8,448	1.4	Rough stony land (Lehew soil material)	13,888	2.4
Lehew shale loam	1,792	.3	Rough stony land (limestone material)	1,216	.2
Lehew-Dekalb stony loams	13,824	2.4	Riverwash	512	.1
Leetonia stony sandy loam	1,664	.3	Total	587,520	100.0
Letonia stony fine sand	640	.1			
Dekalb stony sandy loam	47,872	8.2			
Dekalb gravelly loam	1,792	.3			
Dekalb stony loam	256	[1]			
Dekalb cobbly sandy loam	7,680	1.3			
Dekalb shale loam	10,368	1.7			
Dekalb loamy sand	4,480	.8			

[1] Less than 0.1 percent.

SOILS OF THE LIMESTONE VALLEYS

The soils of the limestone valleys of Huntingdon County are similar to those of the limestone valleys elsewhere in the south-central part of Pennsylvania. The soils in this group have already been studied and classified in Blair, Lancaster, Franklin, and Centre Counties. The earliest settlers recognized the outstanding fertility and productive capacity of these soils. One of the very early American colonial settlements was on the soils of the limestone valleys of Lancaster County, and the success and prosperity of this settlement contributed greatly to the early development of the Nation. The agricultural importance of these soils was recognized in the establishment of one of the first experimental fields in the United States at what is now Pennsylvania State College in Centre County. Some of the most productive and most attractive farms in the United States are situated on these soils. In value of agricultural products Lancaster County is among the outstanding counties of the country.

Unfortunately, Huntingdon County does not have so large an area of these important productive agricultural soils as does Lancaster County. Their total area in Huntingdon County is 64,576 acres, which is only 11.1 percent of the total area. Areas of these soils are restricted to narrow belts, few of which are more than half a mile wide.

The land ranges from smooth and nearly level to very steep. Most of the more level areas of these soils are devoted to cultivated crops, and areas that are too steep or too stony for cultivation are used for white clover and bluegrass pasture.

The soils of this group have developed from residual soil materials accumulated in place as a result of solution, chemical decomposition, and decay of exposed limestones and dolomites. The insoluble impurities of the limestone remain when the lime (calcium carbonate) is dissolved and carried away in the drainage water. The soil-forming materials are mainly silts and clays, but in some places the soil mass contains considerable quantities of angular chert, siliceous fossils, and other coarse-grained inert materials. These materials were present in the parent limestones from which the soil materials were derived. These materials have accumulated over the limestones of the valleys to a depth ranging from a few inches to 20 feet or more. The average depth is between 3 and 7 feet. In most places lime has been removed to within less than half an inch of the underlying limestones or dolomites, and even though these soils have developed from limestone materials, they do not contain free lime.

The virgin surface soils were mostly brown mellow silt loam, and the subsoils were reddish-brown and yellowish-brown silty clay loam and silty clay. Nearly all of the original forest of huge white oak, red oak, white pine, and chestnut trees has been cleared, and now about three-fourths of the land is under cultivation. The rest is devoted largely to pasture and woodland.

The soils of the limestone valleys have not been so thoroughly leached as have most of the soils in the shale hills and forested mountain areas. Iron compounds impart to the soils of the limestone valleys a brown color in the surface soils and reddish-brown and yellowish-brown colors in the subsoils. The surface soils gradually become more yellow or gray as iron is leached from them, provided the organic-matter content is not high. In this county, therefore, color and structure can be used in part as indications of the agricultural productivity of the soils; that is, the dark-brown and reddish-brown mellow granular soils are least acid in reaction and generally are very productive under good management. Wherever the surface soil is leached and grayish brown or yellowish brown, the soil is more acid and generally not so productive as browner or more reddish-brown soils.

On the basis of soil color, structure, and origin of parent soil material, the soils of the limestone valleys are grouped in the Hagerstown, Duffield, Frankstown, and Murrill series. As mapped the Frankstown soils include areas of Elliber and Dunmore, the latter being derived from insoluble residues from dolomites in the northwestern part of the county. The Murrill soils are not developed entirely from limestone soil materials, but they are similar in productivity to the other members of the group.

Production of crops on the soils of this group is not restricted by drainage conditions, as these soils have good surface-soil and subsoil drainage. Much of the subsoil drainage water enters cavities in the underlying limestones. On the steeper slopes excessive runoff following heavy rains may cause considerable sheet and gully erosion on land that has been cleared and cultivated.

Originally, the surface soils consisted of brown loose fluffy silt loam. In many places erosion has completely removed the brown surface soils, thereby exposing the reddish-brown and yellowish-brown clayey subsoils. Reddish-brown or yellowish-brown spots in cultivated fields of brown soils are evidence of soil erosion, and in many places nearly or all of the original surface soil has been removed by sheet or gully erosion.

Members of the several series included in this soil group differ primarily in color, structure, and character of parent soil materials. The Hagerstown soils are rich-brown or reddish-brown soils developed from limestones rich in calcium. Inherently these are the most productive soils of the group. The Duffield soils are yellower than the Hagerstown, and the limestones giving rise to them contain a greater proportion of impurities in the form of silty-textured thinly laminated yellow shales than do the parent materials of the Hagerstown. The Frankstown soils are light brown or grayish brown, and they are developed from hard dolomitic limestones and dolomites containing much chert. The Murrill soils may be considered Hagerstown or Frankstown soils over which has been deposited a layer of gravelly or sandy soil material formed from sandstones and shales.

These soils are well suited to the production of clover, timothy, alfalfa, vegetables, corn, wheat, and pasture grasses, among which bluegrass is most important. Alfalfa and sweetclover grow much better on these soils after they have been limed. Farmers recognize the fact that the soils need additional lime, and many of the better farmers have their soils tested by the county agricultural agent for the purpose of finding out how much lime should be applied to the soil where alfalfa or sweetclover is to be grown.

Most of the soils of the limestone valleys are deficient in phosphorus, and farmers now know that better yields of wheat and alfalfa can be obtained by adding phosphate fertilizers to the soils. Even though these soils are deficient in lime, phosphorus, and organic matter, they can be kept in a state of high productivity by good soil management, including the return of barnyard wastes and manures to the soil and the application of lime and phosphate to the soils, in accordance with the needs of the crops that are grown.

Many of the better farms in the limestone valleys have been owned and operated by the same family for several generations, and the houses and barns are large and substantial. Brick or stone farmhouses are common. Farm operation on most of these farms is based on general farming and dairying, together with a cash income derived mainly from the sale of wheat, fluid milk, and poultry products. Storage of feed is essential, and it is for this reason that most of the farms have large barns in which all the feed needed for winter is stored. Most of the barns have upper and lower floors. The feed is stored on the upper floor, and the dairy cows and other livestock occupy the lower or basement floor. The most popular breeds of dairy cattle are Holstein-Friesian and Guernsey.

Farmers follow the standard Pennsylvania 4-year crop rotation of corn, wheat or oats, wheat, then clover and timothy hay. Where alfalfa is grown, a 6-year rotation is followed and the alfalfa takes the place of the second crop of wheat and of the clover and timothy for the 4-year period. Recently some of the farmers are following a 3-year rotation consisting of corn, wheat or winter barley, and clover and timothy hay. This rotation provides more feed crops and less wheat or other small grain.

Lime and fertilizers are used extensively on these soils. Before seeding to clover or alfalfa, lime is generally applied to the land at the rate of about 3 tons of ground limestone to the acre. Other amendments are either barnyard manure or commercial fertilizers containing nitrogen, phosphorus, and potassium. The ratios of these mixtures vary, but the more popular mixtures are the 0–12–5,[7] 2–12–4, and 16-percent superphosphate. If available, barnyard manure is usually applied to the cornland, and the commercial fertilizers are used on land devoted to wheat and alfalfa.

Yields of crops do not vary greatly between the soils of the different series in this group, but there are sufficient differences to warrant the following general statements concerning productivity. With the same texture of surface soil, the Hagerstown soils are most productive, followed in order by the Duffield, Murrill, and Frankstown soils. Because of variations within each series, especially in soil texture, stoniness, depth, and slope, and because of the influence of differences in soil management, yields of crops vary as much within each series as between the different series. A wide range also exists within each series as to the suitability of the land for cultivation. These differences in productivity and suitability for use are brought out in the detailed discussion of each soil type and phase and in the section on Productivity Ratings.

Where lime is used properly and legumes are grown and fed to livestock and manure is conserved and applied to the soil, phosphorus is often the only fertilizer needed. The soils are fairly well supplied with potash that is returned to the soil in properly conserved manure. Nitrogen is supplied by the legumes and manure. On farms where only small numbers of livestock are kept, both potash and nitrogen will be necessary, in addition to phosphorus, for optimum yields of cash crops.

HAGERSTOWN SERIES

The Hagerstown soils are considered the most desirable and most productive soils of the uplands. The slope ranges from almost level to very steep, and some areas have been badly eroded and are less valuable than those in which most of the original soil remains. The total area is 31,232 acres. Nearly all of the land has been cleared and is now devoted either to cultivated crops or to pasture grasses. These soils are well drained, even on level areas, because they overlie limestones that have been honeycombed by underground drainage channels. The rock strata lie at steep angles and weather very unevenly, so that the depth of soil material varies greatly.

In many places certain parts of the limestone resist weathering more than others, and now the resistant parts form outcrops of bedrock that are locally called "limestone reefs." Between the rock outcrops the depth of soil in most places exceeds 3 feet. Originally the Hagerstown soils were developed under a forest cover of hardwoods, dominantly white oak and red oak, together with some hickory,

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

maple, walnut, wild cherry, ash, chestnut, white pine, and other trees.

As soon as the Hagerstown soils were cleared and brought under cultivation, important changes began to occur in the surface soil. The deep-rooted trees no longer supplied the litter containing the basic elements that kept the surface soils from becoming strongly acid. The surface layer of organic material was broken up and decayed rapidly. Insects and earthworms became less numerous as the organic matter reserves of the soil decreased. Insect and worm holes that provided air and water channels through the soil were broken up and plugged by plowing. Absorption of rainfall became slower, and runoff became greater. In many places a part of the surface soil has been removed by erosion, and now the cultivated Hagerstown soils are different from what they were when they were under the protection of forests. Many somewhat red clay spots in cultivated fields show the effects of erosion. Where not eroded too severely and on too steep slopes, the Hagerstown soils are especially well adapted to cultivation and to the production of corn, wheat, oats, barley, alfalfa, clover, timothy, bluegrass, and other pasture grasses. The subsoils are fairly open, porous, and well drained in spite of the fact that they contain considerable silt and clay. They have a rather high moisture-holding capacity and hold plant nutrients well. If lime or fertilizer is applied, it is not leached out rapidly, but most of it is retained in the soil until used by growing plants. Some of the phosphorus becomes fixed in such an insoluble form, however, that it is only very slowly available to plants. Good yields can be obtained for many years without the use of fertilizers, but most farmers have found it profitable to increase the productivity by the use of soil amendments. This is a good policy because soils that are even as fertile as Hagerstown silt loam eventually become much less productive if plant requirements are not provided by the farmer. The Hagerstown soils must be limed occasionally if they are to be used for growing alfalfa and other crops that require an approximately neutral reaction.

Hagerstown silt loam.—As mapped in Huntingdon County, typical Hagerstown silt loam is a deep soil. The maximum thickness of surface soil and underlying soil material is about 12 feet, and the average thickness exceeds 4 feet. Thus, ample provision is made for water storage and for the spread of growing plant roots.

Most of this land is nearly level, and only a small proportion of the surface soil has been removed by erosion. The soil occurs in small irregular areas adjacent to other Hagerstown soils. Almost all of the land is under cultivation.

Following is a detailed description of a soil profile of virgin Hagerstown silt loam:

(1) A thin layer of decaying leaf litter, under which is very dark brown loose, spongy humus containing a small quantity of mineral soil material.

(2) 0 to 4 inches, dark-brown porous fine crumblike silt loam having a fairly high content of organic matter. The reaction is slightly acid to mildly alkaline.

(3) 4 to 14 inches, yellowish-brown or light-brown soft fluffy mellow silt loam that falls apart into soft crumblike aggregates when handled. This material is medium acid in reaction.

(4) 14 to 25 inches, strong-brown silty clay that breaks into fine sharp granular aggregates ⅛ to ¼ of an inch in diameter when dry and is plastic and sticky when wet. The reaction ranges from medium to slightly acid.

(5) 25 inches +, reddish-brown silty clay loam or silty clay that is slightly lighter colored than the material in the layer above and breaks into sharply angular granules ⅛ to ¼ inch in diameter. The granules are coated with a glossy mahogany-colored film of jellylike material. The reaction ranges from slightly acid to approximately neutral or mildly alkaline, but the neutral and alkaline reactions are confined to a layer an inch or two thick immediately above the hard limestone.

Under cultivation the surface layer of rich-brown silt loam is about 8 to 12 inches thick, and unless it has been limed it is medium or slightly acid in reaction. The subsoil is reddish-brown silty clay or silty clay loam, slightly less acid than the surface soil.

The smooth surface, great depth, ease of tillage, and high moisture-holding capacity of this soil make it exceptionally valuable for producing corn and alfalfa. In normal seasons fertilized areas produce 40 to 70 bushels of corn (shelled) an acre. If the soil has been limed heavily, alfalfa produces from 3 to 4 tons of hay an acre a year in three cuttings. All other general farm crops and vegetables return good yields.

The largest areas of Hagerstown silt loam are mapped in Nittany Valley and in Canoe Valley, in the west-central part of the county; smaller areas are in Big Valley in the east-central part and northeast of Petersburg.

Hagerstown silty clay loam.—Hagerstown silty clay loam is not so deep as Hagerstown silt loam. The total depth of soil material ranges from 18 inches to 4 feet and averages about 3 feet. The relief is more rolling than that of Hagerstown silt loam, and erosion has removed the surface soil in many places. Freshly plowed fields appear spotted because the reddish-brown subsoil is exposed here and there and contrasts markedly with the brown or yellowish-brown uneroded areas. The surface is irregular, and small knolls and "finback" ridges are numerous. Limestone outcrops are numerous on the higher areas.

The surface soil of cultivated areas of the silty clay loam is 8 to 10 inches thick and seems to be the product of the mixing by the plow of the original silt loam surface soil with the clay loam subsoil where the thickness of the original surface soil was reduced by erosion. On gently sloping areas the surface soil is silt loam, and on some of the steeper slopes and on ridge tops it is clay loam.

Nearly all of this soil is under cultivation, but it is not so well suited to corn as Hagerstown silt loam because the surface soil is shallower and heavier textured. Moisture is absorbed more slowly than in the silt loam, but the moisture-holding capacity of the surface soil, once the moisture enters it, is fully as high, if not higher. Yields are lower than on the silt loam. Ordinarily corn returns from 25 to 40 bushels an acre (shelled). The reaction of the surface soil ranges from medium to slightly acid, and the soil does not require quite so much lime when it is to be planted to clover or alfalfa as does the silt loam.

Several farmers reported that good stands of grasses could be obtained more frequently on this soil than on Hagerstown silt loam.

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This may be due either to the somewhat lower acidity of the surface layer of this soil or to its slightly higher moisture-holding capacity. Kentucky bluegrass makes an excellent growth on this soil. More small grain, hay, and pasture grasses and less corn are grown than on Hagerstown silt loam. Alfalfa yields from 1½ to 2½ tons to the acre per year, and wheat yields from 15 to 25 bushels when the soil is fertilized with commercial fertilizer—usually 20-percent superphosphate.

Hagerstown clay loam.—Most of this soil occupies steep slopes having a gradient of 12 to 30 percent. Runoff of rain water is rapid, and only a small proportion of the water is absorbed by the soil.

As mapped, Hagerstown clay loam includes areas of shallow Hagerstown soils where the slopes are too steep and where erosion is too rapid to allow the production of cultivated crops. The greater part of the soil has been used for growing grasses, and wherever it has been cultivated it is badly eroded. The original silt loam surface soil has been completely removed, and the present surface soil consists of reddish-brown or brownish-red granular clay loam, clay, or sandy clay loam. The areas of sandy clay loam are along the west slope of Warrior Ridge where sandy Dekalb soil materials have been washed down from the mountainside and spread thinly over Hagerstown clay loam. The total area of the sandy clay loam inclusion is not large, and almost all of it occurs on the western and northern slopes of Warrior Ridge where the limestones are exposed immediately below the Oriskany sandstone. The average depth of Hagerstown clay loam is less than 2 feet, and in many places limestone bedrock protrudes from the soil.

These reddish-brown soils contain a large quantity of clay, and they are very sticky and plastic when wet. Where they are exposed to alternate wetting and drying they become very granular, the soil breaking into sharply angular granules from ¼ to ½ inch in diameter. The soil material is nearly neutral in reaction, and little lime is needed for growing legumes. The moisture-holding capacity of the soil is limited by its slight depth, and the soil must be protected by a good grass sod or tree cover if it is not to become more eroded than it is at present. The soil is suitable for producing hay and pasture grasses. and alfalfa grows luxuriantly so long as the soil moisture holds out. When sown with either alfalfa or clover, timothy provides a better sod cover than either crop alone, and a larger proportion of the rainfall is absorbed by the soil under this kind of sod. Mixed bluegrass and white clover make valuable pasture on this soil, but the yield of pasturage is reduced during the drier parts of the summer, because of insufficient moisture-storage capacity of this soil.

Hagerstown stony clay loam.—Hagerstown stony clay loam is much like Hagerstown clay loam, except that it contains so many limestone rock outcrops that plowing is practically impossible. The depth of soil ranges from a few inches to 4 feet, and in some places it is too slight for a good growth of pasture grasses. The land ranges from nearly level to steep. Areas of this soil are generally small and irregular in shape, and almost all of them are devoted to pasture.

DUFFIELD SERIES

The Duffield soils in Huntingdon County form a narrow belt of smooth rounded hills from a point southwest of Entriken northeastward along the limestone valley, across the Frankstown Branch of the Juniata River and Little Juniata River near Alexandria and Petersburg, to Neffs Mills and to a point northeast of McAlevys Fort. Another area is south of Saltillo.

Nearly all of the Duffield soils are under cultivation because of the favorable relief and the mellow rock-free soil. Most of the areas are smoother than areas of the Hagerstown soils, and limestone reefs are not so numerous.

The Duffield soils are yellower and contain more silt than the Hagerstown soils. They have developed from limestone containing a large proportion of silty material, and in places the parent rock is better classified as yellowish-gray calcareous shale. The proportion of clay is higher in the Duffield soils of Huntingdon County than in those of Franklin County.

Almost the same crops are grown as on the Hagerstown soils, but the Duffield soils are better adapted to potatoes. Where the slope and depth of the Hagerstown and Duffield soils are the same, the Duffield soils are better for corn because the root systems can develop more rapidly in the silty Duffield material than in the heavier Hagerstown material.

The important crops grown on the Duffield soils are corn, wheat, clover, timothy, rye, barley, oats, alfalfa, sweetclover, Kentucky bluegrass, and mixed bluegrass, white clover, and timothy or redtop. Under equal management the yields of these crops are in proportion to the depth of the soil and the gentleness of the slope. On the deeper soils of more level areas, corn yields from 20 to 60 bushels an acre, depending on the supply of moisture and management. A few farmers have reported yields of as much as 80 bushels on selected areas of deep Duffield soils. Alfalfa yields from 2 to 4 tons a year, depending on the seasonal rainfall and the quantity of lime and phosphate fertilizer applied. Yields of other crops are more or less in line with corn and alfalfa. Farmers use either 16-percent superphosphate or 0–12–2 or 2–12–2 mixed fertilizers. About the same kinds and quantities of fertilizers are applied as on the Hagerstown soils. For potatoes and vegetables some farmers prefer the 4–8–8 fertilizer.

Duffield silt loam.—All the areas of deeper soil and the more nearly level areas of the Duffield soils are mapped as Duffield silt loam. Soil losses from water erosion are exceptionally small and have not materially affected the productivity of the soil. The individual areas of Duffield silt loam are small, and most of them are on ridge tops or in level benchlike positions and in the saddles between two or more ridges.

Under a forest cover Duffield silt loam has the following profile characteristics:

(1) Leaf litter and humus lying on the mineral soil, generally not more than 1 inch thick.

(2) 0 to 4 inches, dark-brown soft porous crumblike silt loam containing a fairly high proportion of decayed organic material.

(3) 4 to 8 inches, light yellowish-brown or dull brownish-yellow smooth silt loam without well-defined structure. The reaction is medium acid, and this layer is the most acid of the entire profile.
(4) 8 to 14 inches, material much like that above except that it contains slightly more clay and is somewhat firmer.
(5) 14 to 24 inches, brownish-yellow or pinkish-brown silty clay loam that breaks apart readily when moist and has an imperfectly developed nutlike structure, the individual aggregates ranging from about 1/4 to 1/2 inch in diameter.
(6) 24 to 48 inches, yellowish-brown silty clay loam containing numerous black and rusty-brown stains that give the exposed subsoil a speckled appearance. The lower part of the subsoil is compact silty clay loam that breaks into blocky aggregates from 1/4 to 3/4 inch in diameter. The material in the lower part of the subsoil is porous and can be easily pulverized between the fingers when moist. The material is medium to slightly acid in reaction.

In cultivated fields the brown silt loam surface soil ranges from 6 to 15 inches in thickness and is thinnest where the land is most sloping. The total depth of soil and parent soil material of Duffield silt loam ranges from 3 to 8 feet and averages about 5 feet to the bedrock of silty limestone or calcareous shale.

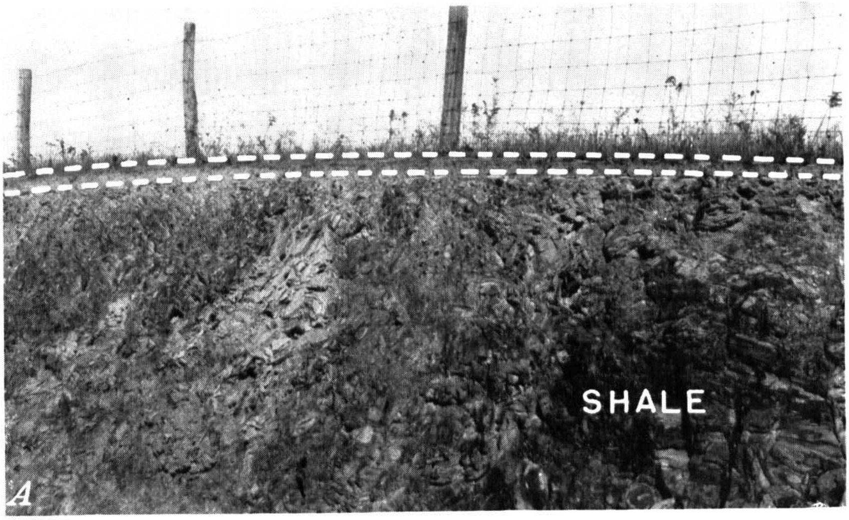
The silty texture, depth, comparatively gentle slope, and ease of cultivation of Duffield silt loam make it a very good soil for most cultivated crops. Nearly all of it is under cultivation and is used for producing corn, wheat, oats, barley, clover and timothy, alfalfa, and other crops. Much of the soil is deep and nearly level, and much is devoted largely to the production of corn. Following are usual crop yields: Corn, 40 to 60 bushels; wheat, 17 to 25 bushels; and alfalfa (where the soil has been limed), 2½ to 3½ tons an acre. Three cuttings of alfalfa are made each year.

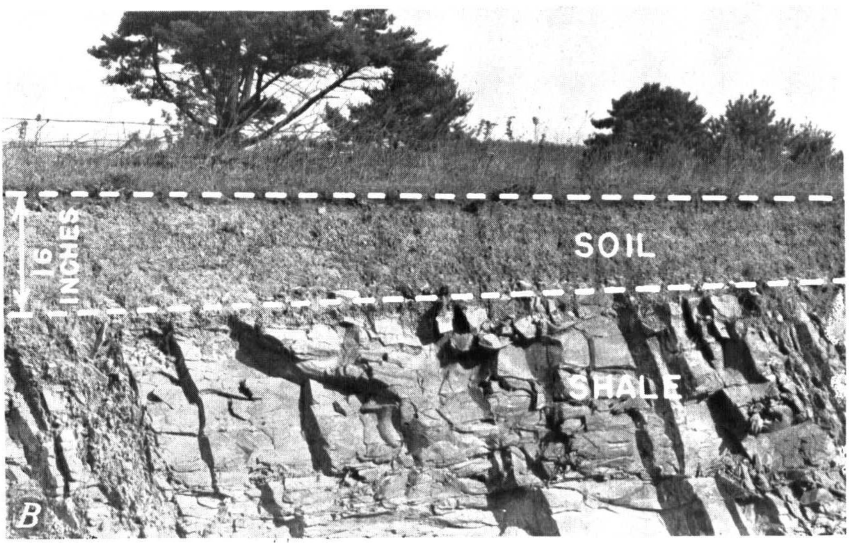
Like Hagerstown silt loam, Duffield silt loam has been leached until it is medium acid in reaction. Like the Hagerstown soils also, this soil is deficient in lime and phosphorus, and these amendments must be added before maximum yields can be obtained for most crops. Most farmers have obtained satisfactory results by adding 2 to 3 tons an acre of ground limestone or an equivalent quantity of burned lime. Many of the better farmers have found it profitable to apply phosphate fertilizer to all crops at a rate of 200 to 300 pounds of 16-percent superphosphate to the acre.

Small areas of sandy loam, totaling only slightly more than 50 acres, are included in Duffield silt loam as mapped They occur on slopes adjacent to and generally below areas of the Murrill and Dekalb soils, from which enough sand has been washed over Duffield silt loam to produce a sandy loam surface soil. In other respects this inclusion is very much like typical Duffield silt loam, and the two soils are similar in their agricultural usefulness. Yields of corn and potatoes are slightly higher on the sandy loam than on typical Duffield silt loam, but yields of other crops are approximately the same on the two soils.

Duffield silt loam, rolling phase.—This soil occurs in a narrow belt that parallels the limestone valley in association with typical Duffield silt loam. A small area is about 1 mile south of Saltillo, where yellow calcareous shales and limestones are exposed. Here, the surface soil and the subsoil contain large proportions of weathered shales (pl. 2, *A*).

A, Severely eroded and gullied area of Duffield silty clay loam. This area, under nonresident ownership and a 1-year-tenant management, is an example of extravagant waste of a valuable soil resource. *B*, Duffield silty clay loam well covered and protected from the ravages of erosion by alfalfa, a valuable legume and hay crop. This area is under the protective management of a resident landowner.





A, Profile of Berks shale loam This soil originally much deeper, has been thinned by erosion following cultivation Now less than 6 inches deep, it is typical of severely eroded Berks, Gilpin, and Amberson soils in many abandoned areas *B*, Profile of Gilpin shaly silt loam, which is about 16 inches deep in a cultivated area. The moisture-storage capacity of this soil is not sufficient in midsummer for crops like corn

Duffield silt loam, rolling phase, differs from normal Duffield silt loam mainly in having a thinner surface layer and a considerably steeper slope (from 8 to 15 percent in most places). The steeper slope induces rapid runoff of water and consequent erosion where the soils are used for cultivated crops. In many places so much of the silt loam surface soil has been removed that the silty clay loam subsoil is exposed by the plow. Many cultivated fields are badly scarred up and down the slope by a succession of rills or shallow gullies. In these places the lower part of the subsoil is exposed, and in some places erosion has reached all the way to the parent rock.

This soil is not well suited to cultivated crops because of the erosion hazard. Farmers recognize this, and the better farmers grow less corn and more small-grain and hay crops on this soil than on Duffield silt loam. Alfalfa, clover, and mixed timothy and clover are the principal hay crops. Some farmers sow mixtures of alfalfa and timothy because the timothy aids in forming a better sod and helps to reduce losses of soil from erosion while the alfalfa is getting well established. Alfalfa yields from 1¾ to 3 tons an acre each year, depending on depth of soil, rainfall, and the quantity of lime and phosphate fertilizer used. Wheat yields from 12 to 20 bushels an acre on fertilized soil. Yields of corn range from 20 to 35 bushels if there is plenty of soil moisture during July and August, but it is strongly recommended that as little corn as possible be grown on this soil, because cultivation stimulates and promotes soil erosion.

A number of the better farmers have kept the steeper areas of this soil in permanent pasture in which mixtures of white clover, timothy, ryegrass and Kentucky bluegrass are grown. These pasture lands produce very well except during the dry periods in July and August. Most pastures would be greatly improved by liberal applications of lime and phosphate fertilizer.

Duffield sandy loam, rolling phase.—Several small areas of Duffield sandy loam, rolling phase, are mapped along the northwest slope of Warrior Ridge where the sandy Dekalb soil material from higher levels has been carried down and deposited on the Duffield soils that occupy the slopes below the Dekalb soils, thereby giving rise to a sandy loam surface soil that rests on the silt and clay that accumulated over the underlying silty limestones. This soil differs from Duffield silt loam, rolling phase, only in texture of the surface soil. The agricultural use of this soil and yields of crops or pasture grasses are almost the same as those of Duffield silt loam, rolling phase.

Duffield silty clay loam.—Duffield silty clay loam occurs on slopes having a gradient of 15 percent or more, and in addition it includes all other badly eroded Duffield soils. In most places, except in wooded or permanent pasture areas, the original surface silt loam layer has been completely eroded away and only the silty clay loam subsoil remains as a shallow covering over the silty limestone bedrock. The depth of soil ranges from only a few inches to 2 feet, averaging about 15 inches. In a few places bedrock is exposed and gives rise to small areas of stony land having little or no agricultural value.

If used for clean-cultivated crops this shallow eroded soil soon becomes severely eroded and gullied (pl. 3, *A*), but it is suitable for pasture plants and hay crops (pl. 3, *B*). Mixtures of white clover, Kentucky bluegrass, timothy, redtop, and orchard grass produce a fair cover on this soil, but the capacity of the soil for absorbing and storing water is so low that plant growth is limited. In July and August moisture is usually deficient in the soil, and pasture plant growth is correspondingly reduced and may become dormant during prolonged dry periods.

Overgrazing of pastures increases the runoff, and erosion is severe during the dashing rainstorms characteristic of the region in July and August. It is thought that excessive runoff in summer might be reduced by a system of short contour furrows across the slope. The furrows would catch and hold the water until it was absorbed by the dry soil.

The reaction of this soil is only slightly acid, and fairly good stands of grass and alfalfa can be obtained without applying lime. For maximum production of alfalfa and clover small applications of lime and liberal applications of phosphate fertilizer are recommended.

FRANKSTOWN SERIES

The Frankstown soils are developed in the area of folded rocks on ridges and slopes lying from 25 to 150 feet higher than the associated areas of Hagerstown soils. Narrow belts of these soils parallel areas of the Hagerstown and Duffield soils adjacent to Nittany Valley, Shade Valley, and the valley traversed by Little Aughwick and Tuscarora Creeks. These soils were developed under an oak-chestnut forest. Before the land was cleared it supported a thick stand of large white and red oaks, huge chestnut trees, and a smaller proportion of white pine and pitch pine trees.

Members of the Frankstown series have surface soils that are grayer and more acid in reaction than the corresponding layer of the Hagerstown and Duffield soils. In general they are also less productive.

As classified and mapped in Huntingdon County, the Frankstown soils are developed from residual accumulations of materials derived from cherty dolomitic limestones, some of which have been classified as oolitic chert (*9*). This cherty material imparts a gritty or cherty character to the silts and clays, which form the body of the soil. The depth of the soil material to bedrock is as much as 30 feet or more in places, although it averages about 5 feet.

Approximately 75 percent of the Frankstown soils is cleared and cultivated. They are not so fertile or productive as the Hagerstown or Duffield soils, apparently because they are more thoroughly leached. Liberal quantities of lime and commercial fertilizers are applied to crops grown on them, and the response is good. The texture and consistence of the Frankstown soils are such that they are better suited to corn than to small grains, and more corn and less wheat are grown on them than on the Hagerstown and Duffield soils. Rather large applications of phosphate fertilizers must be made to the soil if satisfactory yields of small-grain crops are to be obtained. Degree of slope and differences in texture of the soil and in content of chert affect the agricultural usefulness of different members of the Frankstown series.

A number of areas mapped as Frankstown in the extreme northwestern part of the county, lying west and northwest of Tussey Mountain, consist of soils developed in place from hard dolomitic limestones. They differ from the more typical Frankstown soils in other parts of the county in having much less chert in the soil and parent materials and having heavier and tougher clay subsoils. Such soils probably will be recognized in the future as members of the Dunmore series.

Frankstown cherty silt loam.—In forested areas this soil, like the other Frankstown soils, is covered with an inch or two of forest litter and brownish-black organic humus, which in most places is medium acid in reaction. Below the organic material the following mineral soil horizons were observed in a forested area:

(1) 0 to 15 inches, yellowish-gray or light brownish-gray cherty silt loam having no well-defined structure. The color in the upper part is darker than in the lower part. Most of the chert fragments in the soil are small enough not to interfere greatly with cultivation, and the greater part of them range in diameter from 1/4 to 1/2 inch.

(2) 15 to 20 inches, pale pinkish-brown or yellowish-brown cherty silty clay loam.

(3) 20 to 26 inches, yellow or yellowish-brown cherty silty clay loam having a slight pink cast. The material is fairly friable and does not become very sticky when wet.

(4) 26 to 36 inches, yellowish-brown cherty silty clay loam with rusty-brown and nearly black streaks and splotches of iron and manganese compounds.

(5) 36 to 48 inches +, compact yellowish-brown silty clay or silty clay loam, which in places contains as much as 20 percent of chert fragments.

Strongly acid in the upper layers, the reaction becomes less acid with depth and is only slightly acid at a depth of 4 feet. The soil is fairly permeable to water, and subdrainage is provided by cavities in the underlying cherty limestone bedrock.

In cultivated fields the upper layers of the soil have been mixed by the plow and the original organic material of the forest has long since been exhausted.

Frankstown cherty silt loam occurs on ridge tops and fairly gentle slopes where losses of soil through erosion are at a minimum. This is the best and most productive member of the Frankstown series. Almost all of it has been cleared, is under cultivation, and is devoted to the production of corn, wheat, oats, barley, and clover and timothy hay. Corn is the leading crop mainly because the soil is sufficiently deep and loose to be cultivated without serious loss from water erosion. Corn yields from 40 to 70 bushels an acre, depending on the season and management practices. Wheat yields from 15 to 25 bushels where the soil is fertilized. Under good management, yields of clover and timothy hay range from 1¾ to 2¼ tons an acre, and occasional yields of as much as 3 tons are reported.

Frankstown cobbly silt loam.—Frankstown cobbly silt loam resembles the cherty silt loam in all characteristics except that the chert fragments are the size of cobblestones. These fragments make up from 10 to 20 percent of the soil mass and interfere considerably with the cultivation of crops and with the mowing of hayfields. The chert fragments are angular and range from 1 to 5 inches or more in diameter, averaging about 3 inches. Farmers frequently gather the chert cobblestones from the fields and pile them at the edges of the fields or in sinkholes. Some farmers run a heavy roller over their hayfields in the spring in order to sink the loose cobblestones into the soil so that they will be below the cutting level of the cutter bars of the mowing machines. In this way they are able to eliminate some of the hazards of mowing over cobbly ground.

Only about one-half of Frankstown cobbly silt loam is cultivated, and corn is the leading crop. The uncultivated areas are generally used for bluegrass, white clover, and timothy pasture or as woodland. The larger areas are on the tops of prominent hills or ridges, but a few areas are on eroded slopes adjacent to streams, sinkholes, or intermittent drainage channels.

Frankstown cherty silty clay loam.—Frankstown cherty silty clay loam occupies the more sloping areas of Frankstown soils where the slope is greater than 12 percent and where rapid runoff on cultivated areas removes the surface soil.

Only a small proportion of this land is cultivated; the rest is used for pasture or hay, as it should be if the surface soil is to be protected from further erosion. Corn, the most important cultivated crop, returns from 15 to 25 bushels an acre, depending on soil management, seasonal weather conditions, and the degree of erosion. Yields of corn are reduced by prolonged dry periods during July and August because the soil has a low moisture-holding capacity.

MURRILL SERIES

The Murrill soils generally occur at the edges of the valleys near the lower slopes of hills or mountains. The land is gently to fairly steeply sloping.

The Murrill soils have two important characteristics that differentiate them from all other soils: First, the upper part of the soil to a depth of 2 feet or more is transported soil material consisting of water-rounded gravels, sands, silts, and clays, all of which have been washed down from higher mountain areas and spread out as a mantle over the valley soils; and second, the subsoils are mostly clayey residual materials that have accumulated through the decomposition of limestones. Although the Murrill soils are not developed entirely from limestone residue, they are similar in agricultural usefulness to the Hagerstown and Duffield soils. Both surface drainage and subsoil drainage are very good. Erosion is not especially serious because the upper part of the soil material usually absorbs rainfall rapidly and reduces the amount of runoff and, in turn, erosion. This surface layer of transported soil material ranges from silt loam to sandy loam. It contains varying quantities of gravel. Some of the individual pieces are large enough to be classed as cobblestones. In general, the soils nearest the mountains or foothills contain the largest quantity of sand, gravel, and cobblestones.

The Murrill soils are much less extensive in Huntingdon County than in Franklin and Cumberland Counties, where many of the better commercial fruit orchards are situated on them. Very few if any areas of the Murrill soils in Huntingdon County are devoted to fruit. These soils were formerly covered by dense forest, mainly of tall, straight, white oak, red oak, chestnut, white pine, and, on the more moist areas, some hemlock.

Murrill gravelly silt loam.—Murrill gravelly silt loam is probably the best soil of the Murrill series for general farming. Slopes are gentle, and erosion is not a serious problem.

The following is a description of a typical soil profile of Murrill gravelly silt loam in a cultivated area:

(1) 0 to 12 inches, light brownish-gray or light brownish-yellow silt loam containing a moderate proportion of small angular stone fragments of gravel size. The soil is friable and is easily plowed. The reaction is medium acid.

(2) 12 to 24 inches, gravelly heavy silt loam or light silty clay loam, brownish yellow in the upper part, gradually grading to yellowish brown at the bottom.

(3) 24 inches +, yellowish-brown or brown silty clay loam that breaks into fine sharply angular granules when dry and is compact and plastic when wet. In the best drained areas the color is reddish brown instead of yellowish brown.

The lower subsoil layer is like that of the Hagerstown, Duffield, or Frankstown soils, according to the location, and grades into hard limestone, shaly limestone, or cherty limestone. In spite of the heavy texture of the subsoil material, internal drainage is good because of the granular structure.

The thickness of the different horizons varies from place to place. Depth to the material developed from limestones ranges from about 1 to 3 feet, but in most places it is between 15 and 20 inches. Depth to bedrock is generally more than 4 feet, and it exceeds 10 feet in places.

Almost all of Murrill gravelly silt loam is cultivated, and the important crops are corn, wheat (pl. 2, *B*), clover, and alfalfa. Except for a few areas near intermittent drainageways where some erosion may occur in clean-cultivated fields, surface drainage is good but not excessive. Crop rotations, fertilizer practices, and tillage methods for this soil type are about the same as for Hagerstown silt loam. In many places both soils occur in the same field, and it is difficult to determine the boundary between the two, except where rounded water-worn gravel indicates Murrill soils. Yields of crops are approximately as follows: Corn, 50 to 70 bushels; wheat, 20 to 30 bushels; and alfalfa, 2¾ to 3½ tons an acre. Variations in yields are due largely to differences in management practices.

Murrill cobbly loam.—Murrill cobbly loam has a more loamy surface soil than Murrill gravelly silt loam mainly because a larger proportion of the colluvial surface soil material has been transported from the coarser textured adjoining Gilpin and Dekalb soils. The color and depth of this soil are similar to those features of Murrill gravelly silt loam; but it occurs on the steeper slopes near the hills, where the surface is more rolling and sheet erosion is somewhat more active in removing the surface soil. The moisture-absorbing and moisture-holding capacities of Murrill cobbly loam are not so high as those of the gravelly silt loam.

In agricultural usefulness, Murrill cobbly loam is about the same as the gravelly silt loam. Crops such as potatoes are better adapted to the lighter textured cobbly loam, but corn, wheat, and alfalfa produce better yields on the gravelly silt loam. The surface soil in places contains as much as 5 percent of cobblestones and gravel, derived mainly from shale and sandstone. A few of the cobblestones are as much as 6 inches in diameter.

As mapped, Murrill cobbly loam includes a few areas of soil having a deeper layer of overwash than is typical. In these places the total thickness of transported soil material averages 3 feet or more, but the soil is practically the same as typical Murrill cobbly loam in color, structure, and texture. Depth to bedrock is 6 feet or more. Yields of the deeper rooted crops, such as corn, are probably 5 to 10 bushels an acre higher than on typical Murrill cobbly loam. In several places cobblestones and gravel, mostly of shale and sandstone, make up as much as 10 percent of the surface soil, and in some places they are abundant enough to interfere with cultivation. At the edges of many fields there are piles of cobblestones that have been gathered from the land.

Murrill gravelly sandy loam, deep phase.—Most areas of Murrill gravelly sandy loam, deep phase, lie at higher levels and closer to the bases of steep hillsides or mountain slopes than do areas of Murrill cobbly loam and Murrill gravelly silt loam. In the process of transportation by water and gravity, the coarser materials were not carried so far out over the valley soils as were the silts and clays. This soil also contains a larger proportion of gravel, and in some places the gravel in the surface soil makes up as much as 15 percent of the soil mass.

This soil and similar gravelly and sandy Murrill soils agriculturally are generally less productive than the heavier textured soils. They absorb rainfall rapidly, lose comparatively little water by runoff, and have lost a comparatively small proportion of surface soil through erosion. Since water percolates rapidly downward through this soil, it leaches the soil rapidly. This explains, in part, why this soil is not so fertile or so productive as Murrill gravelly silt loam. More than 80 percent of the land is under cultivation. The important crops grown are corn, wheat, clover and timothy, bluegrass, and redtop. Bluegrass does not grow so luxuriantly on this soil as it does on Murrill gravelly silt loam or on the Hagerstown and Frankstown soils. Fair yields of potatoes may be produced by proper soil-management practices including the use of complete fertilizers and crop rotation with legumes.

Owing to its greater depth, this soil is exceptionally well suited for fruit orchards, provided air drainage is good and the soil is not in an area of late spring frosts. In Franklin and Cumberland Counties some of the most productive apple and cherry orchards are on areas of Murrill gravelly sandy loam, deep phase. Small grains do not yield so well on this soil as they do on Murrill gravelly silt loam and Murrill cobbly loam, mainly because the more sandy surface soils are less fertile and do not always supply as much surface-soil moisture as small grains need in early summer.

Murrill cobbly sandy loam, deep phase.—Murrill cobbly sandy loam, deep phase, includes areas of deep gravelly sandy loam that contain rounded cobblestones, some of which are as much as 8 inches in diameter but most of which are about 4 inches. In addition the entire soil mass contains more gravel and sand than Murrill gravelly sandy loam, deep phase.

Cultivation of this soil is difficult in many places because of the large proportion of gravel and cobblestones in the soil. Probably about two-thirds of the total acreage is in pasture grasses and scattered clumps of trees. Corn and hay crops are grown on areas of this soil, from which most of the cobblestones have been removed and piled at the edges of cleared fields. This is the most acid and the least productive of all the Murrill soils.

SOILS OF THE SHALE HILLS

Soils of the shale hills comprise about 33 percent of the area of the county. They have developed almost entirely from weathered products of shales and fine-grained sandstones in the more hilly parts of the intermountain valleys where rapid geological erosion has cut deep V-shaped valleys and produced steep slopes and narrow ridges. Dissection of the land is thorough, so that level or gently sloping areas are few and occur only as narrow strips on ridge tops or in the sags or saddles between hills. Most of the soils of this group are shallow, averaging only about 30 inches in thickness even under the original forest cover. The maximum thickness in few places is more than 4 feet. Most of the areas have a slope steeper than 10 percent, and, where they have been cleared and cultivated for 30 years or more, water erosion has reduced the average thickness of soil to less than 20 inches. In abandoned fields the thickness of the surface soil is nearly everywhere less than 10 inches, and in many places practically no soil remains over the shale bedrock.

Less than 40 percent of the land in the shale hills has been cleared; the rest is under a forest cover from which mature trees have been repeatedly cut for lumber. The original trees were mainly scarlet, chestnut, and red oaks, chestnut, hickory, pitch pine and Virginia pine. Some white pine grows on the lower slopes, and hemlock and rhododendron are common in narrow valleys where moisture conditions are favorable for their growth. Apparently the original organic matter accumulated in the surface of the soils of this group was less than in the soils of the limestone valleys, for the total organic-matter supply in the soils of this group is very low.

About 15 percent of the cleared land has been abandoned, and in the abandoned old fields Virginia pine comes in rapidly. This tree is a prolific producer of seed, and if a few seed trees are in a neighborhood it will be but a short time before young pines will come up all over the old fields. These trees have little or no commercial value at present. although in the future they may possibly be used for pulpwood in paper making. They do, however, help to hold the soil, and in the natural succession of vegetation they will be replaced eventually by hardwoods in most places. A few white pines are growing in old fields, but they do not come in so rapidly as Virginia pine, except where they have been planted by hand. Hardwoods need more moisture than is available in the eroded soils of old fields. Therefore hardwood regeneration on old abandoned fields is very slow and in most places unsuccessful, even where plantings of hardwoods have been made.

The low moisture-storage capacity of these soils is due to three factors: (1) The soils are developed from shattered shale beds that lie at steep angles, and excess water that enters them passes away through the shales into deeper layers of the rock; (2) most of the soils are too shallow to allow the storage of a large moisture reserve within the soil itself; and (3) much of the soil is on very steep slopes that promote rapid runoff and prevent absorption of much water by the soils. Under forest cover the surface soil is protected from excessive water erosion by the leaf litter and by the roots of trees and undergrowth, but in cultivated fields erosion is very rapid.

Several kinds of shales contribute to the soil material in the shale hills. Some of the shales are red; others are yellow and gray. Most of them are acid in reaction, but a few contain enough free lime to give them an alkaline reaction.

The Berks soils are developed from dark brownish-gray or yellowish-gray medium-acid shales. They are much less extensive in Huntingdon County than in the Cumberland or Lebanon Valleys of Franklin, Cumberland, Dauphin, Lebanon, and Berks Counties in eastern Pennsylvania.

The Gilpin and Rayne soils are developed from soil materials that have been derived from fine-textured silty yellow and brownish-gray acid shales and fine-grained sandstones. These soils are extensive in central Pennsylvania and have many characteristics in common with the Dekalb and Clymer soils, respectively, which are developed from acid yellow and gray sandstones and shales.

The Calvin soils have developed over medium-acid red shales in Trough Creek Valley and nearby valleys.

In the southern and eastern parts of the county are several areas of acid reddish-brown and yellow shales, which are the parent materials of the Amberson soils. These soils are acid in reaction, and, although they are more productive than the Gilpin soils, they are less productive than the Calvin soils.

A belt of interstratified reddish-brown and yellow shales containing traces of lime is exposed from Alexandria north and east to McAlevys Fort. The Calvin and Edom soils have developed on these rocks in such close proximity to each other that it is impossible to map them separately; therefore they are mapped as Calvin-Edom complexes. They are the most productive soils of the shale hills.

Generally speaking, the organic-matter content of the surface soils in the shale hills is low. The water-absorbing and water-holding capacities of nearly all of the soils are low, and in many instances lack of soil moisture is responsible for pronounced restrictions in plant growth and limitations in crop yields, unless there is about an inch of rainfall each week throughout the growing season. A 2-week period of dry weather in July or August will generally stop the growth of pasture grasses, hay crops, and corn, unless rain was abundant up to the beginning of the 2-week period.

Soils of the shale hills can be cultivated without great difficulty, but erosion is so rapid and productivity is so low that they are very close to the margin between agricultural and nonagricultural land. Only by very good management including the use of fertilizers is it possible for farmers to make a good to fair living on the better soils of this group. Many of the steeper areas never should have been cleared and brought under cultivation, because erosion reduced their productivity very rapidly. Most of the abandoned areas of these soils are so seriously eroded and wasted that they have little value even for forestry.

On the smoother and more level areas, where the soils are 2 feet or more deep, the production of crops is not so much of a problem, and many fairly prosperous farms have been established. Productivity can be maintained or possibly improved by the use of lime and fertilizer. The important crops are corn, wheat, clover and timothy, and buckwheat. On the more level areas of these soils corn may yield a maximum of 40 bushels an acre and fertilized fields may produce 20 bushels of wheat.

BERKS SERIES

The slope of the Berks soils ranges from very gentle to steep. Internal drainage conditions vary somewhat but generally are good. On ridges, where internal and surface drainage are rapid, the surface soil and the subsoil are browner, and on areas where drainage is less rapid they are yellower. On the broader ridge tops, in depressions around the heads of drainage channels, and along the lower mountain slopes, subsoil drainage is not rapid, and in many such places the soil receives subsoil seepage water from higher levels. In such places the surface soils are brownish yellow or yellow and the subsoils are definitely yellow and in places splotched with brownish gray and rusty brown. Nearly all of the Berks soils in Huntingdon County occur in long narrow belts that follow exposures of parent shales. There are no broad areas of the Berks soils in Huntingdon County, such as those in the Cumberland and Lebanon Valleys of Pennsylvania. In general, the steeper the slope the shallower the soil. On the nearly level areas the soil in some places is as much as 36 inches thick, but on the steep slopes where geological erosion has been active the total thickness is no more than 6 or 8 inches.

Most of the Berks soils are soft, mellow silt loams that are easily cultivated. On the more level areas, where the surface has not been removed by erosion, the important crops grown are corn, wheat, oats, barley, rye, buckwheat, and clover and timothy hay. The Berks soils are better suited for small grains and hay crops than for corn or other crops requiring a long and moist growing season.

The Berks soils, because they are less fertile than the soils of the limestone valleys, are in need of very conservative soil-management practices, including selected crop rotations and liberal applications of lime and fertilizers. Conservation of soil moisture and organic matter is of great importance in the use of these soils. Certain selected areas are well suited for growing potatoes if the soil is well supplied with organic matter and fertilizers.

Berks silt loam.—Berks silt loam includes the more nearly level and less erodible areas of the more typical Berks soils. Most of it is on the tops of ridges or rounded hills where the removal of soil by water erosion is at a minimum. In wooded areas the average thickness of the soil is about 32 inches, but where the land has been cleared it is somewhat less. Where erosion has been active the total thickness does not greatly exceed 15 inches.

A typical profile of Berks silt loam under a forest cover is described as follows:

(1) 0 to 1½ inches, mixed mineral and organic material that is dark-gray or dark grayish-brown mellow silt loam. In most places it is covered by leaf litter and a thin layer of dark-brown acid humus. The reaction is medium acid.

(2) 1½ to 10 inches, brownish-yellow or yellowish-gray silt loam having no well-defined structure. The material is firm but not compact and is easily plowed. Plant roots and water penetrate this soil very easily in wooded areas. The reaction is medium acid.

(3) 10 to 16 inches, yellowish-brown friable silt loam containing a few chips of weathered shale and having a medium-acid reaction.
(4) 16 to 28 inches, yellowish-brown light silty clay loam. It contains many small fragments of weathered shale, which comprise about 2 percent of the upper part of the horizon and as much as 80 percent of the lower part. The reaction is slightly acid.
(5) 28 inches+, a mass of shattered weathered yellowish-brown shale that grades into yellowish-gray, dark-gray, or nearly black shale at a depth of several feet.

The thickness of the different soil layers is variable from place to place, but the depth to parent shale in few places exceeds 3 feet. In the vicinity of mountain slopes or old high stream terraces the surface soil of Berks silt loam contains rounded cobblestones and a few streaks of sandy materials. The cobbly materials are indicated on the soil map by stone symbols. The total quantity of stone in most places is not sufficient to interfere greatly with normal tillage of the soil. In some places subsoil drainage is not so good as in the more typical soil.

Almost all of the land is under cultivation. The important crops grown are wheat, oats, barley, corn, buckwheat, and clover and timothy for hay. A few of the better areas of this soil are used for growing potatoes. Yields of the various crops are approximately as follows: Corn, 25 to 35 bushels; wheat, 15 to 20 bushels; clover and timothy hay, from 1½ to 2½ tons an acre. A few areas have been limed and seeded to alfalfa, which yields from 1½ to 2½ tons of hay. Because most areas of Berks silt loam are nearly level, the soil can be limed and fertilized without much loss of material from erosion. If well managed, the soil will continue to be productive for many years.

Berks silt loam, rolling phase.—Berks silt loam, rolling phase, includes rolling areas in which the total thickness of soil ranges from 6 to 20 inches. Erosion has been active since the land was cleared and has removed much soil, apparently from 3 to 12 inches of soil, from cultivated fields. In forested areas the thickness of the surface soil in few places exceeds 8 inches, and fragments of weathered shale occur both in the surface soil and in the subsoil.

About 60 percent of the land is cleared; the rest supports second-growth timber. About one-half of the cleared area is used for cultivated crops, mainly corn, wheat, oats, barley, and buckwheat. Corn yields from 12 to 25 bushels and wheat 10 to 15 bushels an acre, depending on the kinds and quantities of fertilizers used. The yields of crops may also depend to a great extent on the amount and distribution of the rainfall. The other half of the cleared area is generally devoted to clover and timothy hay, which yields from ¾ to 1½ tons an acre.

The most important problem in the long-time use of this soil is the control of excessive runoff of rainfall, which is responsible for soil erosion. Many freshly seeded wheatfields or cultivated cornfields are badly scarred by rills and gullies.

Berks silt loam, heavy-subsoil phase.—This soil occupies some of the more level areas around the heads of natural drainage channels or along the lower slopes near such channels where drainage in the lower part of the subsoil is not good during late winter and early spring. The lower part of the subsoil is silty clay loam, in places mottled with gray and yellow. This soil is more valuable for hay or pasture crops than for cultivated crops, because it does not dry so rapidly after rains as the better drained Bérks silt loam. In a few areas, shown on the soil map by gravel symbols, the surface soil contains some gravel.

Berks silt loam, shallow phase.—This soil lies on the lower slopes of Bald Eagle Mountain at the edges of valleys and is affected by seepage water from the higher mountain areas. The silty clay loam materials of the lower part of the subsoil are compact and plastic. The total thickness of this soil over bedrock ranges from 10 to 20 inches. In early spring the soil is slow in drying, and in late summer it may become too dry for good growth of plants. In general this soil is better adapted to hay crops than to cultivated crops.

Berks shale loam.—All areas of the Berks soils that are too steep for agricultural use are classified as Berks shale loam. Nearly all of this soil occupies steep banks near streams or steep hillsides near the mountains. The total thickness of this soil ranges from 1 or 2 inches on steep cleared banks to about 15 inches on steep areas that have remained under a forest cover (pl. 4, *A*). Both the surface soil and the subsoil contain from 10 to 60 percent of weathered shale fragments. The water-holding capacity of this soil is very low. When the rainfall is heavy, the cleared land undergoes severe sheet and gully erosion. This soil has little or no agricultural value, but it supports a fair growth of oak, pine, and locust.

Some severely eroded areas of Berks shale loam consist essentially of raw shale banks. Virtually no soil remains in these places, and only in few places does the soil exceed 3 inches in total thickness. The vegetative cover for this land is mostly slow-growing Virginia pine and locust brush.

GILPIN SERIES

The Gilpin soils are the most extensive of the shallow soils of the shale hills in Huntingdon County. They have developed from acid residual materials accumulated through the weathering of the yellow, yellowish-brown, and gray silty shales and sandstones of the Chemung formation and Portage and Hamilton groups. These rocks have a total thickness of slightly more than 4,000 feet, and they are exposed at steep angles, so that the upturned edges weather to form soils. Geological erosion has been very uneven, giving rise to a very hilly relief. The thickness of the Gilpin soil material averages about 2 feet and in few places exceeds 30 inches. As long as the Gilpin soils remained in forest, the leaf litter and roots of the trees protected them against excessive water erosion, and the rate of accumulation of soil material equaled or possibly slightly exceeded the rate of removal by normal geological erosion. Where the Gilpin soils have been cleared and cultivated, water erosion in many places has been and is eroding the soil many times faster than new soil is being formed from the underlying shales. Field observations have shown that 40 years of agricultural use on many of the steeper slopes has reduced the thickness of soil from 30 inches to 6 or less. This is an average loss of about three-fifths of an inch of soil for each year of cultivation. Proof of this extravagant waste of Gilpin soil material lies in the fact that 20 percent or more of the cleared areas are now abandoned fields that are no longer suitable for crops or even for good pasture.

The original forest cover was mainly oak, chestnut, and pitch pine in which scattered stands of hickory, maple, hemlock, white pine, and Virginia pine also appeared. The litter produced by these trees becomes strongly acid on decomposing, and the acid material has a strong leaching effect on the soils.

The Gilpin soils are best suited for forestry, but about 35 percent of their area has been cleared and brought under cultivation. The rest is now occupied by cut-over and second-growth oak, hickory, maple, and pine. About one-fifth of the cleared area has been abandoned, three-fifths of it is used for hay or grass, and one-fifth for general crops.

Both the Gilpin soil material and the parent shale rocks are acid in reaction, and the soil is deficient in the more important plant nutrients. The water-holding capacity is low. With these limitations it is evident that the Gilpin soils are not very productive. Lime and fertilizers must be used in liberal quantities if crops are to be grown successfully, and, even though they are applied, there is no certainty of obtaining good crops, because it is possible for one heavy rain to wash a large proportion of the fertilizers down the slope, causing it to be carried away in floodwaters.

Gilpin shaly silt loam.—Gilpin shaly silt loam occurs in smoother areas where the slope of the land averages less than 15 percent. Under a forest cover the average thickness of soil material is between 20 and 30 inches, but many areas that have been cultivated have a much thinner soil (pl. 4, *B*). About 70 percent of the part of the soil that has been cleared is used for agricultural crops including corn, wheat, oats, barley, rye, and timothy and clover hay. Under a forest cover typical Gilpin shaly silt loam has the following characteristics:

(1) 0 to ½ inch, dark-brown or nearly black strongly acid humus.
(2) ½ to 7 inches, silt loam that is dark grayish brown in the upper part, grading rapidly to light brownish yellow and finally to light yellow.
(3) 7 to 12 inches, light-yellow silt loam that is porous and friable but has no well-defined structure. It is strongly acid in reaction.
(4) 12 to 18 inches, brownish-yellow heavy silt loam or light silty clay loam containing 10 to 20 percent of weathered shale fragments. The reaction is strongly acid.
(5) 18 to 30 inches, yellow silt loam containing a large percentage of weathered shale.
(6) 30 inches +, weathered shale rock, acid in reaction.

The thickness of the different soil layers varies from place to place, and in some places the silty clay loam layer is very thin or absent.

When this soil is brought under cultivation it loses organic matter very rapidly. The surface soil first becomes brown, then light brown, and, after several years of cultivation, light grayish brown. Cultivation and plowing bring up weathered shale fragments, which are mixed with the surface soil, and in places these fragments comprise as much as 10 percent of the soil mass.

Sheet and gully erosion are active on cultivated areas of Gilpin shaly silt loam. Many of the fields that have been cultivated for more than 30 years have lost 12 inches or more of surface soil.

The water-storage capacity of this soil is low, and a scarcity of soil moisture is usually the first factor that limits crop production. This is especially true for a crop like corn that must have an abundance of soil moisture during July and August. The next limiting factor for crop production is the deficiency in available plant nutrients. The soil is especially low in calcium, phosphorus, potassium, and nitrogen, and it must receive liberal applications of lime and fertilizers if it is to produce profitable yields of crops. Yields of corn on fertilized areas range from 15 to 30 bushels an acre; wheat yields from 8 to 15 bushels where the soil is fertilized, and only 5 to 8 bushels where it is not; and timothy and clover yield from ½ to 1 ton of hay an acre. The establishment and maintenance of pasture grasses on this soil is expensive and usually uneconomical.

The success or failure of agriculture on Gilpin shaly silt loam will depend almost entirely on the management practices that are used.

Gilpin gravelly silt loam.—Even though the total area of Gilpin gravelly silt loam is small, this soil is of agricultural importance. It occupies the tops of low hills and bench or terracelike positions where there is a thin surface mantle of old stream deposits. Much of the finer alluvial silt and clay materials has been gradually removed by geological erosion, but the coarser materials, including the gravel, have remained and have become a part of the surface soil material. The average depth of this soil is about 3 feet. The surface soil is grayish-brown gravelly silt loam to a depth of about 10 inches. The subsoil materials are brownish-yellow shaly silt loam. Both the surface soil and the subsoil are porous and permeable and have good internal drainage. About 80 percent of the area of this soil is under cultivation.

Wheat, corn, potatoes, and clover and timothy hay are the important crops. Corn yields from 25 to 40 bushels an acre, depending on the seasonal rainfall and the fertility of the soil. Potatoes commonly yield 100 to 125 bushels, although when the soil is heavily fertilized they sometimes yield as much as 250 bushels. Most of this soil is in Hares Valley south of Mapleton and in the valleys of Mill and Great Aughwick Creeks. Several areas are on and near Stone Creek Ridge northeast of Huntingdon.

Gilpin shale loam.—This soil is distinguished from Gilpin shaly silt loam mainly by steeper slope, greater erodibility, shallower soil, and larger content of weathered shale fragments. It occupies the steeper and more eroded slopes, ranging from 15 to 30 percent in gradient. Several areas of badly eroded or shallow soil are included in mapping, even though the slope is less than 15 percent, as the degree of suitability of the soil for cultivation and other uses is considered more important than the percent of slope in the establishment of soil boundaries between this soil and Gilpin shaly silt loam, which is much more valuable for either forestry or other agricultural use.

Less than 20 percent of the rest of the land is occupied by cutover forest, mainly an oak-pine mixture. On most of the wooded slopes the depth of this soil ranges from 15 to 25 inches. Where the land has been cleared and cultivated for 10 years or more the total thickness of soil in few places exceeds 10 inches, and in many of the old abandoned fields the total thickness is less than 6 inches. If this soil has no plant cover to protect it from dashing rains and water erosion, the more fertile silty and clayey materials of the surface soil are carried away by runoff, leaving behind the coarser shale particles to form the surface soil (pl. 5, *A*). In many of the old abandoned fields shale fragments comprise from 30 to 60 percent of the soil material.

If this soil is used for cultivated crops, the control or prevention of soil losses from water erosion is practically impossible (pl. 5, *B*). Cultivation on the contour, together with strip cropping, will reduce losses from erosion, but effective and complete control of erosion under cultivation might cost more than the land is worth. Any lime or fertilizer that is applied to increase the production of crops may be washed from the field by two or three heavy rains.

Much of the rain water that falls on this soil runs off, and the water-storage capacity of the soil is very low—probably never exceeds a total of 6 inches of water in wooded areas when the soil is totally saturated; in old abandoned fields where the soil is generally less than 8 inches deep, the water-storage capacity cannot be greater than 3 inches, according to unpublished data; and in the areas of shallower soil it is not more than 1½ inches. This quantity of water is not sufficient for most cultivated crops. Probably the moisture-storage capacity and the content of available nutrients of this soil in old abandoned fields is too low even for immediate success in reforestation with hardwoods. The water requirements per pound of dry matter produced for Virginia pine is less than one-third of the quantity of water required for hardwoods; therefore it is only natural that the Virginia pine is the dominant tree growth on many of the old abandoned fields (pl. 5, *C*).

The future long-time use of this soil should be for forestry, because it is naturally an acid soil of low fertility and occupies slopes that are too steep for agricultural use under present social and economic standards. Several farmers estimate that this soil, where cleared and cultivated, has about two-thirds the value of the same soil where it was occupied by oak timber. If land is worth less after clearing than it was worth before clearing, evidently it should have remained under forest cover and should be returned to forest, which will cover and protect the remaining soil from the ravages of water erosion and allow the building of a new soil.

Gilpin cobbly silt loam.—Gilpin cobbly silt loam differs from Gilpin shaly silt loam mainly in stone content and depth of soil. It occupies the tops of long narrow ridges where hard shales and mudstones have been exposed to form the crests of the ridges. Many of the areas are not more than 150 to 200 feet wide but extend the full length of the ridge.

More than 80 percent of this soil remains in forest because the quantity of angular cobblestones in most places is great enough to interfere with normal cultivation of the soil. The cobblestones are nothing more than detached blocks of hard shale and mudstone lying loose in the soil. They average about 3 inches in diameter, but some may be 8 or 10 inches. The best use of this soil is for forestry, although it has been cleared of trees and cobblestones in some places.

Yields of crops are about 10 percent below the average of those obtained on Gilpin shaly silt loam, which borders this cobbly soil in many places.

RAYNE SERIES

Developed from the same kind of parent materials, the Rayne and Gilpin soils are very closely associated. The Rayne soils occupy the more nearly level areas on the broader ridge tops where the slope in few places exceeds 5 percent, the soil material is deeper, and the soil layers are more strongly differentiated. The total thickness of the Rayne soils ranges from about 3 to 6 feet, averaging about 3½ feet. Although these soils are not very extensive in Huntingdon County, they are important in other counties in the Allegheny highlands in west-central Pennsylvania.

The Rayne soils are much more valuable and productive than either the Gilpin or the Amberson soils. Approximately 60 percent of the land has been cleared and is used for cultivated crops, mainly corn, wheat, barley, potatoes, and timothy and clover hay. The content of available plant nutrients is normally only slightly greater than that of the Gilpin soils, but the greater depth of soil provides greater capacity for the absorption and storage of water. Since soil erosion is of little importance to the Rayne soils, lime, commercial fertilizers, and manures can be applied without rapid losses of soil materials.

Rayne silt loam.—The surface layer of Rayne silt loam in cultivated areas is yellowish-brown or grayish-brown soft and friable silt loam to a depth of 8 or 10 inches. The subsurface layer consists of light brownish-yellow strongly acid silt loam having no well-defined structure. Between depths of 15 and 28 inches the subsoil is yellowish-brown silty clay loam that breaks into nutlike aggregates from one-fourth to one-half of an inch in diameter. This material is sticky and somewhat plastic when wet but is firm when dry. Below this the size and quantity of soft weathered shale fragments gradually increases, and below a depth of 36 inches these fragments make up more than 30 percent of the soil mass. Parent rock lies from 3 to 6 feet below the surface. The entire soil is strongly acid in reaction, and the parent rock is medium to strongly acid.

This soil produces from 25 to 35 bushels of corn and from 1½ to 2 tons of clover hay to the acre. If it is heavily limed and phosphated (4 tons of limestone and 400 pounds of superphosphate an acre), sweetclover and alfalfa can be grown. Wheat returns from 15 to 20 bushels an acre, and buckwheat 18 to 25 bushels, where fertilizers are applied at the time of seeding.

As mapped, Rayne silt loam includes a number of areas, closely associated with areas of the Amberson soils, in which the subsoil is brown and the parent material consists of red and yellow acid shales like those beneath the Amberson soils. This included soil occurs in long narrow strips in the valley between Hunting, Big, Pine, and Jerrys Ridges. The textural and structural characteristics of the soil are almost the same as those of normal Rayne silt loam, although the subsoil in places is slightly more sticky and plastic. A few areas contain scattered fragments of reddish-brown or red fine-grained sandstone and mudstone, both of which are locally called ironstones because of their dark color and heavy weight. This soil is about 10 percent more productive than the normal soil, and it would have been mapped separately if it had been more extensive.

Rayne gravelly silt loam.—Rayne gravelly silt loam resembles Rayne silt loam in most respects, except that the surface soil contains from 10 to 15 percent of subangular hard shale and sandstone fragments. Some of the farmers in western Pennsylvania and in West Virginia use the old Scotch word "channery" to describe this material. They call the individual fragments "channer" and speak of the soil as a "channery" soil. The word originally was applied to river gravel in Scotland, northern England, and Ireland, but in the United States it has been applied to more angular fragments of sandstone and shale in the uplands. The subsoil layers of Rayne gravelly silt loam also contain a fairly high proportion of angular fragments of hard shales and fine-grained sandstones, and the proportion of this material increases with depth.

This soil is somewhat less productive than Rayne silt loam; yields are reported to be about 10 percent less.

Rayne cobbly silt loam.—Only a few areas of Rayne cobbly silt loam are mapped. This soil is very similar to Rayne silt loam, except that cobblestones are scattered over the surface, in most places in sufficient quantity to interfere with cultivation, and about one-half of the land remains in forest. The cleared land contains 5 to 15 wagonloads of cobblestone to the acre, and much of the land is used for pasture. Where cultivated, it is used for the same crops as are grown on Rayne silt loam, but the yields are about 15 percent less.

CALVIN SERIES

The Calvin soils as mapped in Huntingdon County have dark-brown or brownish-red surface soils and yellowish-red or light reddish-brown subsoils. They are comparatively shallow soils that have been developed chiefly from the acid red shales of Mauch Chunk shale and the Catskill formation. The most extensive areas of the Calvin soils developed from Mauch Chunk shale are in Trough Creek Valley, and smaller ones are along the lower edges of Round Knob and Broad Top Mountain.

Mauch Chunk shale is red or yellowish red and in places is streaked with greenish gray. The formation consists of fairly soft fine-textured silty shales that crumble and erode rapidly when exposed to weathering. Geologists estimate the total thickness of the formation to be about 1,100 feet. The upper stratum of Mauch Chunk shale is more acid in reaction than the lower ones; and near the bottom of the formation there is a thin stratum of red limestone.

Geologists estimate that the total thickness of the Catskill formation is 3,625 feet. In most places the beds are exposed at very steep angles, and they form narrow belts of steep rough hills that flank Terrace and Sideling Hill Mountains. The Calvin soils are mapped only in the smoother areas underlain by Catskill shales, and the Lehew soils and the Lehew-Dekalb complex cover the steeper areas.

The Calvin soils have developed under a forest cover consisting chiefly of chestnut, oak, hickory, maple, beech, and various pines. In a few places red oak completely dominated the forest. Of the pines, pitch pine was the principal one on the higher slopes and white pine on the lower slopes where the soil was deepest and where it contained more moisture. Red maple was generally restricted to the lower slopes. Trees were taller and made a more vigorous growth on the Calvin soils than on the Berks and Gilpin soils.

The relief ranges from comparatively smooth and rolling in the valley uplands to steep and hilly. The soil is very easily eroded where cleared, and erosion is difficult to control where the slope is greater than 10 percent.

The agricultural use and value of the Calvin soils are largely determined by total thickness of the soil and topographic position. Where the slope is gentle and the soils are fairly deep, they may be used safely for cultivated crops for many years; but where the slope exceeds 15 percent they cannot be cultivated continuously without danger of serious damage by erosion.

In fertility the Calvin soils rank slightly higher than the Berks soils. They are normally deficient in humus and lime, and the moisture-holding capacity is low. Several farmers have reported that such crops as corn and alfalfa are frequently in need of more moisture than the Calvin soils are able to supply during July and August. Effort should be made to increase the organic-matter reserve by applying manures, plowing under green cover crops or weeds, and using fertilizers to stimulate greater plant growth on the soil. A soil well supplied with organic matter will always hold more soil moisture than a similar soil deficient in organic matter. Most of the lime for the Calvin soils must be brought from distant valleys because very little of it occurs nearby.

These soft mellow soils are easily plowed and cultivated. The important cultivated crops are corn, wheat, oats, barley, buckwheat, and potatoes. Hay is made mainly from red clover and timothy, but the acreage of alfalfa is increasing on the areas of thicker soil and where lime may be purchased and applied to the soil at a reasonable cost. Commercial fertilizers are used extensively at rates ranging from 150 to 200 pounds an acre wherever small grains, especially wheat, barley, and oats, are to be grown.

Calvin silt loam.—Calvin silt loam includes all the least erodible more nearly level areas of Calvin soils where the gradient is nearly everywhere less than 10 percent. The total thickness of the soil and soil material above bedrock ranges from about 2 to about 4 feet. The litter produced by forests on this soil is slightly less acid than the litter and humus of the Gilpin and Berks soils. Decomposition of litter appears to be about as rapid as on the soils of the limestone valleys. The humus layer beneath the litter is dark-brown to almost black loose spongy material, ranging from ½ to 1 inch in thickness. The lower half of the humus layer grades into the surface mineral soil without a definite line of separation between the two layers. The humus layer has a medium-acid reaction. Beneath the layer of leaf litter and humus are the following layers, where the soil still remains in forest:

(1) 0 to 5 inches, light reddish-brown mellow silt loam composed of weak fine crumblike aggregates.

(2) 5 to 18 inches, light brownish-red or pale-red friable silt loam having a well-defined structure. The proportion of organic matter is less than in the layer above. The reaction is medium to strongly acid.

(3) 18 to 30 inches, light-red slightly compact medium-acid silty clay loam containing from 5 to 25 percent of weathered red shale fragments.
(4) Red medium-acid shale.

Both internal and external drainage are rapid, but the soil has a good moisture-holding capacity considering the fact that it is comparatively thin.

In cultivated fields the forest litter and the humus layer have been destroyed by plowing and cultivation, and the plow has mixed the soil to a depth of 8 or 10 inches. Erosion has removed a small part of the surface soil but has not greatly influenced productivity in most places. The total clay content in the subsoil increases downward almost to the parent material. The increase in clay is more marked where the slope is less than 5 percent and the total thickness of soil above the parent material is greater than 3 feet.

Originally Calvin silt loam supported nearly pure stands of tall straight red oak, white oak, and white pine trees, but now almost all of the land has been cleared and is used for crops (pl. 6, *A*). Corn, wheat, oats, and barley are the leading grain crops. Clover and timothy are the most popular hay crops. The acreage of alfalfa is increasing rapidly where the farmers can afford to purchase lime for the soils. Crops respond quickly to applications of lime and fertilizers, and commercial fertilizers are used extensively in the production of wheat, oats, barley, and potatoes. Losses of soil fertility from water erosion are not especially serious on this soil but should not be ignored entirely, because sheet erosion occurs on the steeper slopes.

Corn yields from 30 to 50 bushels an acre, depending on soil management. When the soil is fertilized, wheat returns from 15 to 25 bushels. Oats yield 20 to 40 bushels, barley slightly more than oats, and clover and timothy hay 1½ to 2½ tons. On deep soil that has been limed and fertilized with superphosphate, yields of alfalfa range from 2 to 3 tons an acre. Potatoes are not grown extensively on this soil, but yields of 150 to 200 bushels are obtained when the soil is liberally supplied with organic matter and fertilizers and when the rainfall is normal and evenly distributed throughout the growing season.

The better farms in Trough Creek Valley owe their existence largely to this soil, which is the best agricultural soil in the Calvin series.

Calvin gravelly silt loam.—Several bodies of Calvin gravelly silt loam occur in the more level areas of old alluvial deposits high above the present level of the streams. The finer silts and clays of these old deposits have long ago been washed away, but the water-rounded pieces of gravel, which in some places are nearly large enough to be classed as cobblestones, have remained to become mixed with the residual soil materials developed from shale of the Catskill formation. This old alluvial gravel is nearly everywhere limited to the surface soil, and in no place is it abundant enough to affect materially the productivity of the soil. The agricultural use and value of these gravelly areas are practically the same as those of the nongravelly Calvin silt loam.

Calvin gravelly silt loam, colluvial phase.—This soil is mapped where eroded Calvin soil materials from higher steep slopes have been deposited as colluvial material on the more gently sloping areas at the foot of the slope. This colluvial material is generally a heterogenous mixture of reddish-brown silts, clays, sands, and subangular water-rounded fragments of shale, ranging in thickness from 2 to 10 feet or more. Areas of this soil are not extensive, and each is generally less than 4 acres in size. This soil is subject to frequent overflows of very short duration. Internal drainage is good, and any excess water drains from the soil in a few hours.

The surface soil is rich-brown loose gravelly or shaly silt loam. The subsoil is an open porous slightly compact yellowish-brown gravelly and shaly silty clay loam. Almost all of the land is used for cultivated crops. The depth of the soil provides plenty of space for development of plant roots; it also provides for an abundant storage of soil moisture. Even though it is overflowed after heavy rains, this is a very productive soil. Yields of corn range from 40 to 60 bushels an acre. Where the soil has been limed, clover and timothy yields from 1½ to 3 tons.

Calvin cobbly silt loam.—Several areas of Calvin cobbly silt loam occur along Great Trough Creek, where gushing water flowing down small intermittent mountainside streams has carried cobblestones and dropped them on areas of the Calvin soils. The presence of these cobblestones does not materially affect the productivity of the soil except in a few areas where the stones are so numerous as to interfere with plowing and cultivation. Only about one-half of the area of this soil is cultivated; the rest is used for pasture and woodland, because the soil, even though cobbly, is usually well supplied with moisture.

Calvin shaly silt loam.—Calvin shaly silt loam and Calvin silt loam are everywhere closely associated. Calvin shaly silt loam occupies the steeper slopes below Calvin silt loam where runoff is more rapid. The slope ranges from 10 to 20 percent but averages about 12 percent. Where the land is not cleared the soil is from 15 to 30 inches thick.

Nearly all of this soil has been cleared and used for agricultural crops. Wherever it is cleared and cultivated the problem of controlling erosion will ever be present, because the soil is soft and susceptible to water erosion. One heavy rain or the accumulated erosion of a single season may leave this soil seriously rilled and gullied (pl. 6, *B*). The total thickness of this soil in cultivated fields commonly ranges from 10 to 20 inches. The finer silts and clays are washed away, and as the surface soil becomes shallower it also becomes more shaly. Continued cultivation brings up and mixes shaly subsoil materials with the surface soil. In many cultivated fields the plowed layer contains from 10 to 30 percent of partly weathered shale fragments.

The agricultural use of this soil is about the same as that of Calvin silt loam, because these soils occur together in many fields. Yields of crops, however, on the thinner and more droughty Calvin shaly silt loam are from one-half to two-thirds of those obtained on the thicker Calvin silt loam. The greatest difference is in yields of corn. If the rainfall is below average during the growing season, yields of corn may be less than a third and are not more than a half of the yields obtained on the deeper silt loams in the same field.

The future agricultural value of this soil will be determined largely by an intelligent use of crop rotations that will reduce the proportion planted to cultivated crops and increase the proportion in hay crops and grasses. In addition, it is necessary to adopt soil-management practices that will preserve the soil for future agricultural use; otherwise this soil will eventually become too shallow for the economic production of cultivated crops or even of pasture grasses. The moisture-holding capacity of most of this soil is now too low to provide a vegetative growth equal to that which the climate of the region allows.

Calvin shaly silt loam includes areas near the bases of mountains where cobblestones are scattered over the surface. These stones have gradually worked down from higher mountain areas in response to the forces of gravity, frost, and water erosion. The quantity of cobblestones present on these cobbly areas varies from 2 to 15 wagonloads an acre. The total thickness of the soil in the cobbly areas is below average for the soil. Erosion is excessive.

Many areas are devoted to grazing. The important forage consists of mixtures of white clover, Canada and Kentucky bluegrasses, timothy, redtop, and some poverty grass.

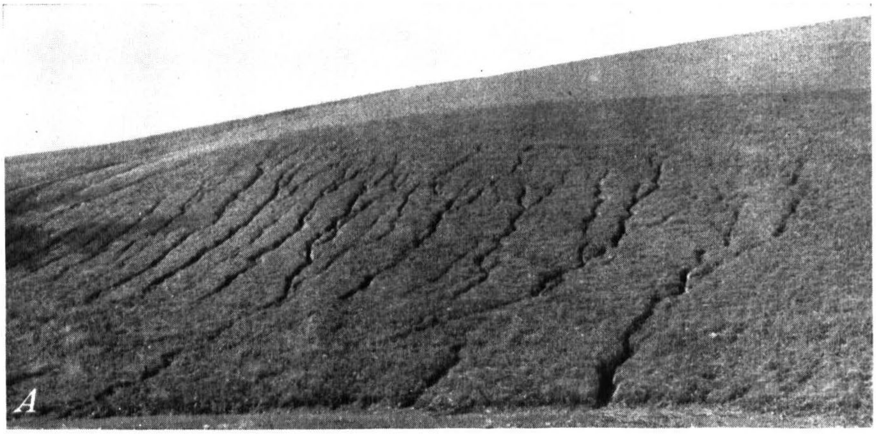
Calvin loam.—Only 192 acres of Calvin loam is mapped, mainly on the terraces or benches along Little and Great Trough Creeks. This is a transitional soil that is intermediate in character between Calvin silt loam and the sandy soils of the Barrens of Trough Creek Valley.

Both the surface soil and the subsoil are browner than the corresponding layers of Calvin silt loam. The thickness ranges from 3 to 6 feet or more. This soil has developed from red shales but rests on the upper members of the Pocono sandstone, which are exposed all the way across the barrens and form the crest of Terrace Mountain.

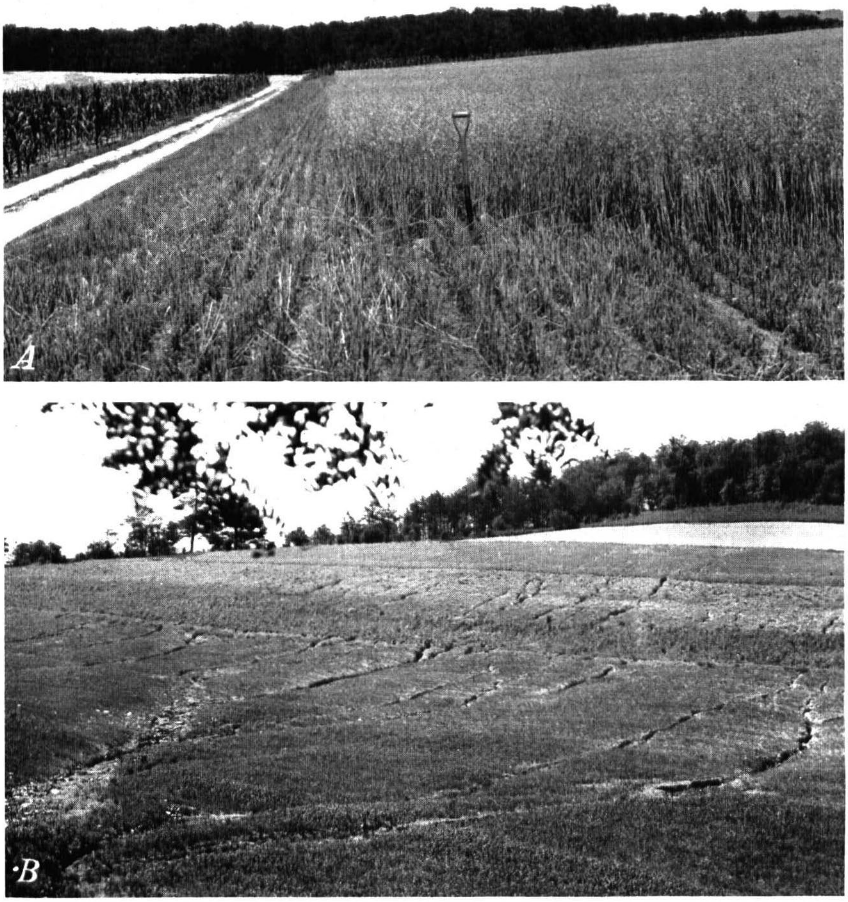
The texture of the surface soil ranges from loam to sandy loam, and a considerable proportion of fine sandy loam is included. The surface soil and the subsoil are loose and porous. Areas occupied by this soil are smoothly rolling to nearly level. Erosion is not especially serious because the loamy surface soil and sandy subsoil absorb rainfall rapidly. On the other hand, more rapid absorption of rainfall encourages more rapid leaching of the soil, and this soil is somewhat more acid than the heavier textured Calvin soils. The normal fertility of this soil is a little below that of Calvin silt loam, but it responds quickly to applications of lime and fertilizer. Where this soil is well supplied with organic matter, lime, and fertilizer, it produces good crops.

Most of this soil is under cultivation. The main crops grown are corn, wheat, oats, hay, and barley. Yields are about the same as those obtained on Calvin silt loam, except where the fertility has been neglected.

Calvin shale loam.—Calvin shale loam is an extensive erodible soil that occupies steep slopes rising from the heads of channels of deep small intermittent streams. The gradient varies from 20 to 40 percent. Angular red shale fragments make up 40 to 60 percent of the soil mass on these steep slopes, and the total depth of soil ranges from 1 to 3 feet. It is deepest at the bottom of the slopes. Most of



A, Cultivated hillside of Gilpin shale loam, rilled and gullied by one hard rain because the vegetative cover was insufficient to hold the soil in place *B*, Effects of repeated heavy rains and erosion on cultivated areas of Gilpin shale loam. *C*, Virginia pine (scrub pine) and poverty grass reclaiming an abandoned and eroded steep area of Gilpin shale loam.



A, Corn and oats on Calvin silt loam, which occupies the more level areas of Calvin soils. Red oak forest in the background on Calvin soils. *B*, Visible effects of 1 year's erosion on Calvin shaly silt loam, where strip cropping alone proved inadequate to hold the soil. Slope of field at center of picture is about 15 percent.

this soil is covered by trees or brush. Wherever it has been cleared, erosion is very severe, and farmers have found it difficult to re-establish vegetation of any kind. This soil has little or no agricultural value, but it will support a fair growth of trees unless erosion has exposed the shale.

AMBERSON SERIES

The Amberson soils are developed primarily from the transitional shales of the Catskill and Chemung formations. These rocks are fine-textured interstratified red and yellow acid shales. The alternate strata of red and yellow shale range in thickness from less than 1 to 30 feet or more. When they disintegrate, these shales give rise to reddish-brown and yellow soil materials, which, when mixed or blended, produce varicolored soil areas. The color profile characteristics of the Amberson soils are indefinite. In general, the Amberson soils as mapped in Huntingdon County may be considered complexes or blends of the reddish-brown Calvin soils and the grayish-yellow Gilpin soils. Very narrow strips of brown and yellow soils extend all the way across some fields. In other places the soil is uniform yellowish brown, having no red or yellow strips for several hundred feet.

The surface soils to a depth of 8 or 10 inches are mostly yellowish-brown silt loams, and the subsoils are brownish-yellow heavy silt loams or silty clay loams in which there is from 10 to 30 percent of small weathered red and yellow shale fragments. Like the Gilpin and Calvin soils, the Amberson soils are generally shallow. The Amberson soils are less acid than the Gilpin soils but more acid than the Calvin soils. They occupy very rolling to steep hilly land, where both accelerated and geologic erosion are very active. The natural fertility of the Amberson soils is slightly above that of the Gilpin soils but is below that of the Berks and Calvin soils. They are acid soils and are deficient in lime, phosphorus, and organic matter.

Approximately 20 percent of the Amberson soils have been cleared. The rest of the land is occupied by forests, mainly of red oak, scarlet oak, red maple, pitch pine, and Virginia pine.

The suitability of different areas of the Amberson soils for farming is determined largely by the total thickness of the soil, the slope, and the topographic position. On the more level areas not too subject to sheet and gully erosion, fair yields of small-grain and hay crops may be obtained where the soil has been limed and well supplied with commercial fertilizers or manures. Conservative soil-management practices must accompany the cultivation and agricultural use of this soil; otherwise more of the steeper areas will have to be abandoned in the near future.

Amberson shaly silt loam.—Amberson shaly silt loam includes the more level areas, mainly ridge tops or hilltops, where runoff and rate of erosion are below the average for the Amberson soils. Very little of this soil occupies slopes that are steeper than 12 percent. In the more level wooded areas where the soil has never been cultivated, a surface layer, about 2 inches thick, of very dark brown loose shaly loam or silt loam is underlain to a depth of about 6 inches by pale yellowish-brown leached shaly silt loam. Below this the color gradually becomes darker and the texture gradually becomes heavier, and between depths of 12 and 20 inches is a layer that represents a gradual transition from the surface soil to the subsoil. To a depth of 28 inches the subsoil is a compact mixture of silty clay loam and small fragments of soft weathered shale. The color of the lower part of the subsoil is largely inherited from the parent shales, which range from red to yellow. This layer, lying between depths of 28 and 30 inches, is reddish-brown or yellowish-brown silty clay loam containing from 40 to 60 percent of coarse subangular fragments of the weathered parent shale.

The depth of this soil ranges from 2 to 4 feet and depends to a considerable extent on the steepness of slope and the rate of geologic erosion.

Approximately 40 percent of the land has been cleared and cultivated. Corn, wheat, oats, rye, barley, and buckwheat are the more important grain crops, and clover and timothy are the main hay crops. Yields of crops are about the same as, or slightly greater than, those obtained on Gilpin silt loam. The normal fertility level of this soil is comparatively low, and consequently good stands of native grasses are obtained only where the soil has received liberal applications of lime and fertilizer. The soil tends to dry rapidly, and deficiencies of soil moisture in midsummer are not uncommon for crops such as corn, clover, and pasture grasses. This is especially true where the thickness of the surface soil has been reduced by sheet erosion.

Amberson shale loam.—Amberson shale loam includes areas of very shaly loam and silt loam on steep hillsides where the slope generally exceeds 12 percent and the rate of erosion is much greater than it is on Amberson shaly silt loam. The total thickness of the soil ranges from 1 to 2 feet. The surface soil to a depth of 6 inches contains from 10 to 30 percent of the weathered particles of shale, and the subsoil below a depth of 10 inches contains more than 40 percent of subangular fragments of shale.

Approximately 20 percent of the land has been cleared and cultivated. The most important grain crops are wheat, rye, barley, and buckwheat. Hay crops are mainly clover and timothy. Yields average about one-half of those obtained on the more nearly level Amberson shaly silt loam. About one-fifth of the cleared land has been so seriously eroded and leached that it is no longer suitable for farming, and many of these areas are now abandoned and are becoming thickly covered with Virginia pine.

The future value of the steeper areas of the Amberson soils will be determined largely by the ability of the soil to store water and produce trees. Amberson shale loam is potentially forest land, and many farmers value the forested areas of this soil more highly than they do the cleared and cultivated areas.

Amberson gravelly loam.—This soil is not extensive. Most of the areas are small and occur mainly in narrow strips across the tops or slopes of hills or ridges where coarse-textured shales and sandstones have been exposed to weathering. This soil differs from Amberson shaly silt loam only in texture and in quantity of angular fragments of shale present in the soil. Gravel-sized angular fragments of shale and fragments of sandstone ("channer") make up 15 to 30 percent of the entire soil mass. In many parts of West Virginia and in some parts of Pennsylvania farmers call this a "channery" soil.

The agricultural value of this soil is only slightly below that of Amberson shaly silt loam, and the content of the fragments of shale and sandstone is not enough to interfere greatly with tillage of the soil, although it does interfere in places with the mowing of hay crops.

Amberson cobbly sandy loam.—This soil occupies small areas on the tops of high ridges and near the bases of higher mountains. The soil material has been derived from reddish-brown and red coarse-textured shales and sandy mudstones. These rocks have weathered unevenly. The harder strata are more resistant to weathering but have been broken into angular cobblestones.

The thickness of this soil ranges from 2 to 3 feet, and it is deep enough for agricultural use; but the presence of cobblestones in most places prevents it from being cultivated unless the stones are removed. A few areas approach what might be called a stony sandy loam. The slope of this soil ranges from 10 to 40 percent. The fertility is equal to that of Amberson shaly silt loam, but the presence of cobblestones in most places prevents the land from being used for cultivated crops. Less than 10 percent of the land has been cleared, and the cleared areas are used mostly for grazing. Redtop, timothy, and poverty grass are the leading forage plants. There is some red clover and white clover associated with this plant cover in places where the soil is deep and well supplied with moisture.

The principal trees on the uncleared areas are red oak, scarlet oak, chestnut oak, cherry, pitch pine, and Virginia pine.

CALVIN-EDOM COMPLEXES

The Calvin-Edom complexes include varicolored brown and yellowish-brown soils developed from the weathered products of interstratified red, brown, yellow, and grayish-green shales containing a small proportion of lime. These shales disintegrate very rapidly when exposed to processes of weathering. They are known to the geologists as Onondaga limestone and Bloomsburg redbeds and have a total thickness of about 1,200 feet. They have been carved by geologic erosion to form a system of well-rounded hills and small open valleys. The largest and most extensive areas of the shales form a belt of hills that extends from the Tussey Mountain loop northward past Alexandria and Neffs Mills and terminates in a narrow mountain valley north of McAlevys Fort. Small areas of a similar shale are exposed in the vicinity of Center School about 5 miles southeast of Mount Union on the opposite side of Johnstown Ridge. The unweathered yellow and greenish-gray strata of the formations in many places contain sufficient quantities of lime to effervesce when the shale is submerged in dilute hydrochloric acid; and, although the red strata contain little or no lime, the soils developed from the interstratified calcareous and noncalcareous shales show the effects of the small quantity of lime present in the parent rocks. The soils are not so deficient in lime as members of the Amberson, Gilpin, and Rayne series.

The soil mantle overlying the shales ranges from 2 to 5 feet but averages about 3 feet in thickness, depending on the density of vegetative cover, the steepness of slope, and the intensity of past geologic and accelerated erosion. The Calvin-Edom soils have inherited much of their color from the parent shales. Where the shales are brown or reddish brown, the soils are generally brown or reddish brown; and where the shales are yellow, most of the soils are brownish yellow.

More than 80 percent of the land has been cleared and used for cultivated crops or pasture grasses. When the soils were first cleared and cultivated they produced good yields of corn, wheat, and clover. Later, after soil erosion had removed the fertile surface soil, the thickness of the remaining soil on many slopes was reduced to less than 15 inches and the productivity was correspondingly lowered. In places where the soils are now too shallow for the production of grain, they generally revert to pasture, and a fair growth of Kentucky bluegrass, white clover, lespedeza, and other pasture plants is obtained. Growth is very slow during midsummer, because of insufficient soil moisture unless the rainfall is above normal and is well distributed throughout the growing season.

The depth of soil and soil material in about 15 percent of the area has been reduced to 10 inches or less, and where this is true the maximum water-holding capacity is not greater than 2 inches, which really means that any rapid rainfall in excess of 2 inches will be accompanied by runoff and erosion. Runoff accelerates erosion on these soils, and erosion accelerates runoff, so that a vicious circle is established. Originally the Calvin-Edom soils were forested, but they can be successfully used for pasture if cleared areas on the steeper slopes are kept under the cover of a good mixture of grasses and legumes. Under these conditions the agricultural value of the soils is greatest. Cultivation of steep slopes should be discontinued and grass sods should be established, so that the remaining soil may continue to be useful for a long time.

Calvin-Edom silt loams.—This complex includes Calvin silt loam and Edom silt loam.

The reader is referred to the description of Calvin silt loam (p. 53) for information concerning the characteristics of that soil. It need only be added here that the surface organic layer in forested areas is only slightly acid in reaction and may actually be approximately neutral because of the influence of lime that may have been carried in solution from the nearby areas of Edom soils or because of the calcium that may have been reached by the roots of trees and brought to the surface through the sap to the leaves and eventually to the leaf litter on the ground. Other layers of the Calvin soils in many places are somewhat less acid than where they are separated geographically from the Edom soils.

Edom silt loam in forested areas has a surface litter of leaves and a thin layer of humus that in few places exceeds 2 inches in thickness. In cultivated fields this layer is lost through plowing and oxidation. Beneath this are the following layers in forested areas:

(1) 0 to 4 inches, grayish-brown or brownish-gray friable silt loam having no well-defined structure. Organic matter decreases downward in this layer. The reaction ranges from approximately neutral in the topmost 2 inches to slightly acid at the 4-inch depth.

(2) 4 to 12 inches, grayish-yellow or yellow shaly silt loam of medium-acid reaction.
(3) 12 to 30 inches, yellowish-brown slightly compact silty clay loam that breaks into nutlike aggregates from about ⅜ to ¾ of an inch in diameter. The material is somewhat sticky when wet and fairly friable when dry. The quantity of weathered fragments of shale increases with depth, and at the bottom of the layer these fragments compose about 60 percent of the soil mass.
(4) 30 inches +, weathered yellowish-gray shales that are neutral in reaction in many places and in some places contain sufficient lime to effervesce with dilute hydrochloric acid. Depth of leaching ranges from 3 to 4 feet.

In cultivated areas the upper layers of the soil are thoroughly mixed, and on all but very gentle slopes some of the surface soil has been removed by erosion. The thickness of the surface soil in areas having a 5- to 10-percent slope ranges from 6 to 12 inches. The total thickness of the soil and weathered parent material ranges from 2 to 5 feet but averages somewhere between 30 and 36 inches. Erosion is not excessive on Calvin-Edom silt loams, because the slope is gentle and the soil absorbs water fairly rapidly. The soil can be used for cultivated crops 2 years out of 5 without serious loss of surface soil by erosion. Where the soil is used for growing corn or potatoes, the rows should be planted on the contour rather than up and down the slope, because cultivation on the contour reduces erosion and aids in holding the water on and storing it in the soil.

Yields of crops on this soil complex where management is good are approximately as follows: Corn, 30 to 45 bushels; wheat (following corn), 12 to 18 bushels; buckwheat, 10 to 20 bushels; and barley, 18 to 35 bushels an acre. Clover and timothy hay precedes corn in the rotation. Under less careful management, yields are considerably less.

Calvin-Edom silt loams probably can be used to a limited extent for cultivated crops for another 50 years without serious soil erosion; but lime, commercial fertilizers, and organic matter will need to be supplied if present crop yields are to be maintained. If the soil is well supplied with lime and phosphorus, alfalfa may be grown with a good degree of success where the soil mantle is 2 feet or more thick.

As mapped, Calvin-Edom silt loams include some areas where the Calvin soils take up a larger proportion of the area than the Edom soils so that the somewhat red color of the Calvin soils dominates the landscape. This variation is derived from the thicker strata of the redder members of the Onondaga shales. Most of these redder soils are at the bases of the mountains. In agricultural use and value the areas of this variation are about the same as other areas of the complex. In some areas many cobblestones are scattered over the surface and are indicated on the map by stone symbols. One such area is east of Blacklog Mountain near Valley Point. Most of the cobbly areas have remained in timber. Red oak, scarlet oak, maple, hickory, and white pine are the principal trees, and there is some pitch pine.

Calvin-Edom gravelly silt loams.—This complex resembles Calvin-Edom silt loams, except that the surface soil has a content of approximately 10 percent of hard fragments of shale and the percentage of hard shale in the subsoil is even higher. The same crops are grown as on Calvin-Edom silt loams, but yields are somewhat less.

Calvin-Edom silty clay loams.—Calvin-Edom silty clay loams have the largest total area of any of the Calvin-Edom complexes. They occupy the more rolling areas and the hillsides where the slope ranges from 10 to 25 percent and averages about 15 percent.

In wooded areas where sheet erosion is held in check by the trees and leaf litter, the 6- or 8-inch surface layer is mellow silt loam; but on cleared and cultivated areas much of the original surface soil has been removed by sheet and gully erosion and the silty clay loam subsoils have been plowed up and mixed with the remaining surface soil to form a silty clay loam surface soil. The total thickness of the soil mantle on these strongly sloping lands above loose shaly material ranges from 1 to 2½ feet but averages about 20 inches.

A thickness of about 12 inches of weathered shale marks the transition between the lower subsoil layer and the consolidated shales. The weathered shale in this transitional zone is a soft porous mass of material from which plant roots may obtain an appreciable quantity of mineral nutrients and some soil moisture. Small irregular but soft particles of shale are present in both the surface soil and the subsoil, but the quantity of these particles in the surface soil is generally not great enough to be of importance except in areas of shallower soil, where in some places as much as 30 percent of the subsoil is occupied by weathered shale fragments.

Approximately 75 percent of the Calvin-Edom silty clay loams complex is devoted to bluegrass pastures, and there is a general trend to even more pasture. This trend in use is in the right direction, because grasses form a sod that holds and protects the soils from erosion.

These soils are very susceptible to sheet and gully erosion, and in fact they should be plowed and cultivated only when the reestablishment of pasture grasses becomes necessary or when an emergency production of certain cultivated crops is necessary.

Two factors are of vital importance in the growing of grasses on this as well as other Calvin-Edom soils complexes. The first is soil moisture. Wherever the total thickness of soil is less than 20 inches the growth of grasses in midsummer is greatly reduced because of a lack of an abundant reserve of soil moisture. The second is soil fertility. After these soils have been farmed and eroded for a number of years, they are not only badly eroded and leached but most of the original organic matter has been lost from the soil. In building up the fertility level of these eroded and leached soils, lime and phosphate are the first materials that should be applied. Then legumes, mainly clovers, should be included with the bluegrass. If the soils fail to produce a good growth of grass after they have been limed and fertilized with phosphate, they should be allowed to revert to forest, because further expense for the production of grasses for grazing is not justified under present dry land use needs.

Calvin-Edom shaly clay loams.—This soils complex includes areas of shallow, shaly, and steep soils that are of little or no agricultural value. The soils are on steep hillsides where the slope is generally greater than 30 percent. The surface soils in wooded areas are shaly silt loams, but where the land has been cleared and the original surface soils have been washed away the remaining soil is mainly a shallow shaly clay loam, which in many places contains 20 percent or more of weathered fragments of shale. The total thickness of the soils ranges from 2 or 3 inches on steep eroded areas in pastures to 15 to 20 inches in forested areas where erosion has never been very great.

About 50 percent of the land has been cleared, but because of its steepness very little of it has ever been used for cultivated crops. In most places the soils are too shallow and too steep for the economical production of pasture grasses. Therefore they should in most places revert to the production of timber.

SOILS OF THE COLLUVIAL FOOT SLOPES

The soils of the colluvial foot slopes and high terraces are developed chiefly from heterogeneous mixtures of transported materials consisting of silts, clays, sands, gravel, and stone, most of which were originally deposited in the form of colluvial-alluvial fans at the edges of valleys and at the foot of steep slopes. Some of these deposits have been dissected by streams and now are remnants of former complete fans. Most of the material in these soils came largely from local sandstone and shale beds—the greater part of it from higher mountain areas of the Dekalb and Lehew soils and of the Dekalb-Lehew soils complex. Members of the Laidig, Buchanan, and Ernest series compose this group. All are medium to strongly acid in reaction.

The soils of this group that are developed on old high terraces and remnants of alluvial fans cover only a small area, but those that form deep deposits along the foot slopes of the higher mountains are much more extensive.

The size and quantity of gravel and stone fragments present in the soils of this group vary greatly. Some of the more gently sloping areas are nearly free of gravel and stone, whereas those near the foot of the mountains contain as much as 60 percent of stone and gravel. The water-holding capacity is less where the proportion of stone and gravel is highest. Some of the soils have slow internal drainage because they are underlain by shale, which water penetrates slowly.

LAIDIG SERIES

Some of the Laidig soils occupy old high terraces and isolated benches above the present stream valleys, and others form coalescing fans at the bases of steep mountain slopes where DeKalb soils are dominant. Most of the gravel and stone in these soils came originally from gray, yellow, and brown acid sandstone and shale beds. The quantity of gravel and stone in the surface soil ranges from 10 to 20 percent of the soil mass except in the stony soils, where it is higher. In general, the lower part of the subsoil, below a depth of 4 feet, contains two or three times as much gravel and stone as the surface soil.

The Laidig soils were originally covered by dense forests of oak, chestnut, maple, white pine, and hemlock. Part of the land has been cleared and is used for the production of farm crops, but a much larger part remains in forest. The soils do not support good pastures, because the surface soil dries out too rapidly in midsummer.

Severely leached, the Laidig soils are especially low in lime, potash, and nitrogen, and they are deficient in organic matter. In cultivated areas frequent applications of lime, organic matter, and commercial fertilizers are necessary to maintain good yields of cultivated crops.

Laidig silt loam.—Under cultivation, Laidig silt loam is brown or grayish-brown mellow silt loam to a depth of 6 inches. This material has no well-defined structure. The reaction is medium to strongly acid. Between depths of 6 and 18 inches the subsurface layer is brownish-yellow silt loam that is strongly acid in reaction. The upper subsoil layer, which reaches to a depth of about 36 inches, consists of yellowish-brown or slightly reddish brown clay loam or silty clay loam that contains a fairly high proportion of grit and small angular or rounded fragments of sandstone. The color in the lower part of this layer is considerably darker and the texture is coarser than in the upper part. Below a depth of 3 feet the proportion of gravel and stone increases and the proportion of clay decreases.

Laidig silt loam occupies the broader and more nearly level areas of old high terraces and foot slopes where little of the surface soil is removed from cultivated fields by sheet erosion. Even though the total area of this soil is small, it is agriculturally important. Approximately 90 percent of it is used for corn, clover, and potatoes. Corn yields from 30 to 35 bushels, potatoes 150 to 250 bushels and occasionally as much as 300 bushels, and clover from 1½ to 2½ tons an acre, where the soil has been well fertilized and well managed.

Laidig gravelly loam.—Laidig gravelly loam is fully as deep as Laidig silt loam, but both the surface soil and the subsoil contain two to three times more gravel. The surface soil is a light-colored loam containing from 10 to 30 percent of gravel. The individual pieces of gravel range from ¼ inch to 4 inches but average about 2 inches in diameter.

The land is more rolling than Laidig silt loam. The slope ranges from 3 to 8 percent, and if the steeper areas are cultivated they may be susceptible to some sheet erosion when rainfall is torrential.

Approximately 60 percent of the land is cleared and used mainly for the production of corn, wheat, and clover and timothy hay and to a less extent for the production of potatoes and buckwheat. The gravel in this soil makes it somewhat droughty, and yields of crops are from 15 to 20 percent lower than those obtained on adjacent areas of Laidig silt loam.

Laidig gravelly loam, shallow phase.—Laidig gravelly loam, shallow phase, represents the shallow remains of old terrace soils that now overlie shaly Gilpin, Calvin, Amberson, and Calvin-Edom soil materials. This soil occupies rolling land where geological erosion has removed more than one-half of the original deposit of transported soil material. Both the surface soil and the subsoil contain from 10 to 30 percent of water-rounded and subangular gravel. Surface drainage everywhere is good, but subsoil drainage in a few places is restricted by the underlying shale beds.

Laidig gravelly loam, shallow phase, is thoroughly leached. The surface soil is grayish-brown or brownish-yellow gravelly loam or silt loam to a depth of about 6 inches. Below this the material is pale brownish-yellow nongranular gravelly silt loam. At a depth of about 15 inches the soil changes abruptly to pale reddish-yellow compact gravelly silty clay loam. The total thickness of transported soil material ranges from 18 to 40 inches but averages about 2 feet. This material lies over weathered shale soil material that is generally compact and may or may not be well drained.

Approximately 60 percent of the land has been cleared. In agricultural value, areas of this soil are about the same as the adjacent and deeper areas of soils of the shale hills. This soil is probably best suited to small-grain and hay crops, but if there is plenty of rainfall throughout July and August fair crops of corn may be produced. When the soil is fertilized, wheat yields from 12 to 18 bushels an acre; where no fertilizer is used, it yields from 8 to 12 bushels. On areas that have been limed and fertilized yields of clover range from 1¼ to 1½ tons an acre. Lime is essential to the obtaining of good clover stands on this leached acid soil.

Laidig cobbly loam.—Laidig cobbly loam, except for differences in texture and content of large pieces of gravel and cobblestones, is similar to Laidig gravelly loam. Areas of this soil are more common on the higher benches or terraces at the edges of the valleys and near the bases of steep mountains where the slope ranges from 5 to 15 percent. It is fully as gravelly as Laidig gravelly loam, and in addition the plow layer in most places contains from 10 to 30 wagonloads of cobblestones to the acre. On the old high terraces most of these cobblestones are gray, yellow, or brown water-rounded hard sandstones ranging from 2 to 8 inches in diameter, but on many of the foot slopes the cobblestones are more angular than rounded. Numerous piles of these stones may be seen at the edges of cultivated fields of this soil.

Only about 30 percent of this land is cleared, and the rest is occupied by cut-over forest. Because this soil is a coarse porous loam that contains large quantities of gravel and cobblestones, it has been thoroughly leached and is the most acid of the Laidig soils. When cultivated it leaches rapidly. The soil has a low moisture-holding capacity, and even though it is a deep soil it dries out rapidly. About one-half of the cleared land is abandoned.

The soil frequently becomes too dry for corn in midsummer. The best use of cleared areas is probably for clover and timothy hay, provided the large pieces of gravel and cobblestones are gathered from the surface before mowing is attempted. The porosity and excessive subsoil drainage of the soil make it difficult to build up the fertility, as any lime or fertilizer that is applied is rapidly leached away. A few of the less stony areas are used for growing corn, rye, barley, buckwheat, and timothy hay. Clover is not extensively grown because the soil is strongly acid and most of the cleared areas have never been limed. Corn yields from 15 to 20 bushels an acre, buckwheat 10 to 15 bushels, and timothy one-half to two-thirds of a ton.

Wherever cleared and cultivated this soil is subject to rapid sheet and gully erosion. It should be considered a forest soil and is most valuable when occupied by a growing hardwood forest consisting mainly of red oak, scarlet oak, white pine, and pitch pine.

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Laidig cobbly loam includes a few areas of soil in which the thickness of transported material averages only 2 feet above the shale bedrock.

Laidig stony loam.—Laidig stony loam occurs along the lower slopes of those mountains where much of the higher mountain area is occupied by soils developed largely from fine-grained shales rather than from coarse-textured sandstones. Naturally the accumulated talus at the foot of these slopes contains more silt and shale and less sand and stone than would the talus below soil areas underlain by coarse-textured sandstones.

Laidig stony loam is a very deep soil. It contains enough brown sandstones to warrant calling it stony, but the quantity of stone is only about one-third of that in and over the surface of Laidig stony sandy loam.

The surface soil is dark-brown mellow silt loam or loam. It is everywhere well covered with loose spongy medium-acid decaying forest litter. The humus layer is loose semigranular dark-brown material that absorbs rainfall very rapidly. The subsurface layer is light brown or yellowish brown, and from a depth of 18 inches downward the color of the subsoil ranges from dull reddish brown to pinkish brown or yellowish brown, depending on the subsurface drainage conditions.

In most places this soil is well drained, but during the wet seasons it may have a comparatively high water table near the place where the small intermittent mountain streams flow down from higher areas.

The great depth of this soil gives it a large moisture-storage capacity, and this feature is valuable to growing forests throughout the summer when an abundant supply of moisture is needed, especially by hardwoods. The dominant trees on this soil originally were red oak and scarlet oak; and red maple, white ash, white pine, hemlock, beech, tuliptree (tulip poplar), and hickory were also abundant. This is a deep and productive soil, and it is probably the best soil for forests in the mountains in this county.

Laidig stony sandy loam.—This is the most extensive soil of the Laidig series. In most places it occupies areas immediately below the steeper and higher areas of the Dekalb soils. The slope ranges from 15 to 40 percent, but in most places it is between 20 and 25 percent. The parent soil materials are derived mainly from hard yellow and brown sandstones, which account for the stoniness of the surface soil. Beneath the leaf litter and thin humus layer the surface mineral soil consists of stony sandy loam that is brownish gray, fading to grayish yellow. There is no well-defined structure. The thickness averages about 15 inches. The subsoil contains more silt and clay than the surface soil and is stony sandy clay loam to a depth of 30 inches. Beneath this is yellowish-gray stony sandy loam. Hard sandstones, ranging from a few inches to several feet in diameter, occupy from 10 to 30 percent of the surface.

Very little if any of this soil has been cleared and cultivated, and so far as land use is concerned it is better adapted to forestry. It ranks next to Laidig stony loam in its capacity to produce forests of commercial importance.

A brown variation of Laidig stony sandy loam occurs along the lower slopes of those mountains where much of the higher slopes is occupied by soils developed largely from brown mudstones and coarse-textured sandstones rather than fine-grained brown shales. Naturally such talus contains more stone and sandy soil material than the talus that gives rise to Laidig stony sandy loam. This variation of Laidig stony sandy loam contains a large quantity of rather large and blocky fragments of brown and yellowish-brown sandstone. Approximately 20 percent of the surface of this soil is covered by these stones, which range from 6 to 24 inches in diameter.

In general, the profile characteristics of this soil are similar to those of Laidig stony loam, but the soil material contains more sand, which imparts to it the sandy loam texture. This soil has very good surface and subsurface drainage and a good moisture-storage capacity. It is a very good soil for forestry, rating about second or third to Laidig stony loam in this respect.

The kind and distribution of species of trees on this soil are about the same as on the other Laidig soils.

Laidig loamy sand.—Laidig loamy sand, which also includes areas of gravelly sand, generally occupies areas below areas of Dekalb loamy sand. It is merely a deep accumulation of loamy sand and small rounded fragments of soft brown and yellow sandstones. It is potentially a soil for forestry and supports a good tree growth. Only 64 acres are mapped, mainly near Saltillo.

BUCHANAN SERIES

The Buchanan soils are developed from transported silt, clay, sands, and gravel. They occupy the more level parts of old high terraces adjacent to some of the Laidig soils. The soil material nearly everywhere overlies shale formations. This rock restricts or inhibits the downward movement of excess subsoil water, and in most places such restriction of the movement of water is responsible for the imperfectly drained subsoils of this series. Many areas of the Buchanan soils have an underflow of seepage water that comes from higher elevations during wet seasons. Where areas of the Laidig and Buchanan soils are adjacent, the Buchanan soils generally occupy a slightly lower position.

The Buchanan soils are not extensive in Huntingdon County, but several areas are mapped in the valleys of Great Aughwick, Blacklog, Crooked, and Standing Stone Creeks, and at the base of Bald Eagle Mountain.

The original forest cover was mainly oak, beech, maple, hemlock, and tuliptree; and rhododendron formed the undergrowth.

The agricultural value of the Buchanan soils is comparatively low, and not more than one-half of the total area has been cleared and used for crops. Because of the imperfectly drained subsoil, these soils do not warm so quickly in the spring as the Laidig soils. Where cleared, they are used primarily for the production of hay and corn. If lime and phosphate are applied, clover and timothy make a good stand, and yields of 1¼ to 2 tons of hay may be obtained in normal seasons. Other areas are used for grazing. Kentucky bluegrass and white clover are the leading pasture plants where this soil has been limed, but where no lime has been applied the cover is mainly redtop, poverty grass, some bluegrass, ragweed, and sedges.

Buchanan silt loam.—The total area of Buchanan silt loam is small. The areas as mapped are typical of the Buchanan series.

The surface soil to a depth of 4 or 5 inches is grayish-brown or yellowish-brown strongly acid silt loam. A few areas having a sandy loam surface soil are included in mapping. The subsurface soil below a depth of 5 inches is more yellow and less brown. At a depth of 12 inches it is yellow very acid silt loam. There is little change in the color of this soil between depths of 12 and 18 inches, but below that the upper subsoil layer is yellow silty clay loam or silty clay that is hard when dry, but when wet it is a dense sticky semiplastic structureless soil mass. The lower subsoil layer, below a depth of 36 inches, is mottled or splotched rusty-brown, yellow, and bluish-gray silty clay loam or silty clay that has a puttylike consistence when wet. In midsummer when the soil becomes dry the lower subsoil layer has a tendency to shrink and if dug into it comes out in the form of hard clods. The lower subsoil is strongly acid.

Nearly all of this land is cleared and is used for cultivated crops, principally corn and hay. Corn ordinarily yields from 25 to 35 bushels an acre but generally less in wet seasons. Clover and timothy hay yields from 1½ to 2 tons. A few areas of this soil could be improved by placing diversion ditches above the edges of the fields for the purpose of intercepting and diverting runoff from higher areas, thereby preventing temporary flooding.

Several areas of Buchanan silt loam contain appreciable quantities of water-rounded fragments of shale and gravelly materials. These gravelly areas are indicated on the soil map by gravel symbols. One such area is along Hares Valley Creek near Lincoln School. The gravelly soil generally is slightly better drained than the nongravelly soil, and the better physical condition offsets any disadvantage that may result from the presence of gravel.

Buchanan silt loam, shallow phase.—The shallow phase of Buchanan silt loam generally overlies shale and in most places its total thickness is less than 2 feet. It occupies rolling land near the foot of mountains. This soil includes areas of water-rounded shale and gravel. Not more than 20 percent of it is used for agricultural purposes. When cleared and cultivated it is susceptible to considerable sheet and gully erosion. In wet weather the soil tends to be wet; in dry weather it bakes and becomes hard. The best use for it is probably for the production of the forest trees that are less affected by seasonal variations in soil moisture.

Only 64 acres of this soil are mapped, mainly between Blacklog and Blue Mountains.

Buchanan cobbly loam.—Buchanan cobbly loam is developed from old alluvial-colluvial deposits on old high terraces that have been subjected to considerable erosion, and much of the original and finer soil material has been removed by geological erosion. Except for the coarser texture and the content of cobblestones, this soil is similar to Buchanan silt loam. The presence of cobblestones discourages clearing of this land. Much of it is occupied by forest, and a few areas are used for pasture. If it is heavily limed a fair growth of bluegrass and white clover can be obtained, but on cleared areas that are unlimed the principal cover plants are redtop, poverty grass, ragweed, and sedges. The agricultural value of this land is low, and its best use probably is for forestry.

The largest area of this inextensive soil is along Standing Stone Creek near Cornpropst Mill.

ERNEST SERIES

Soils of the Ernest series have developed from the weathered products of acid sandstones and shales containing much gravel and cobblestones, on the colluvial slopes, alluvial fans, and outwash plains along and around the heads of small stream channels and gulches in the mountains and in the shale hills.

All the Ernest soils are strongly acid in reaction and are subject to periodic floods and overflows by runoff from steep mountainous and hilly areas. They are kept moist throughout the year by seepage water from nearby hill and mountain slopes. The surface soils have a considerable range in color. They are brown, yellow, yellowish gray, or mottled brown, gray, and yellow. They also have a considerable range in texture. The subsoils are mottled bluish-gray and yellow poorly drained compact silty clay loams, clay loams, or clays.

Originally the Ernest soils were covered by dense forests of hemlock, beech, maple, and birch. About one-half of their total area has been cleared, and the other half remains in forest. Most of the cleared areas are used for pasture, and the main pasture plants are redtop, white clover, timothy, poverty grass, and various sedges. Some of the soils are best suited to forest, and others may provide fair grazing.

Ernest silt loam.—Ernest silt loam occurs mainly along and around the heads of small drainage channels in the shale hills. The soil materials are chiefly silts, clays, and shale fragments that have been washed down into the lower areas from the adjacent shale hills. The surface soil is dark-gray or brownish-gray silt loam. Small weathered shale fragments are scattered throughout the soil mass. The subsoil is poorly drained wet soggy compact silty clay loam.

More than 80 percent of this soil has been cleared and is used as grazing land. Most of the forage cover is wet-land sedges, with a little redtop and white clover in the better drained places.

In the early spring this soil is very wet, and water frequently stands on or oozes from the surface. In late summer it dries out, cracks open, and gets hard; and vegetation dies down until the soil is wet again by early fall rains.

Ernest gravelly silt loam.—Most areas of Ernest gravelly silt loam are along the edges of the wider valleys where the mountain streams emerge from the forests. Nearly all of the land has been cleared and is used for pasture.

The surface soil is brownish-yellow gravelly silt loam to a depth of 8 or 10 inches. The subsoil is yellow and gray compact and plastic very gravelly silty clay loam that is wet throughout most of the year. In a few areas this soil has developed from soil materials washed from areas of Lehew and Lehew-Dekalb soils. The surface soil of these areas is brown or reddish-brown gravelly loam, but the subsoil is yellow, brown, and gray mottled gravelly silty clay loam.

Ernest cobbly loam.—Ernest cobbly loam lies mostly in narrow stream valleys at the edges of and within the forest areas. The surface soil is brownish-yellow cobbly loam, and the subsoil is poorly drained mottled yellow and gray compact silt loam or clay loam.

About one-half of the land is cleared and used for pasture; the rest is occupied by willow, maple, hemlock, and similar trees that normally inhabit low moist valley areas. This soil is subject to periodic flooding by swift-flowing waters that come down from higher mountain areas. It is most valuable when it is supporting a maple-hemlock forest cover.

Ernest stony sandy loam.—Ernest stony sandy loam occurs largely along the swift-flowing streams, drainage channels, and gulches within the forest-covered mountain valleys. Most of the land is occupied by alder, willow, hemlock, maple, and similar trees. It has very little value for grazing because it is too sandy and too stony for forage plants. Heavy rains in the mountains send swift floods down over most areas of this soil.

SOILS OF THE RIVER TERRACES

Soils of the river terraces have developed from materials deposited by streams many years ago. Some deposits were made when the climate was warmer than at present and when mastodons and other animals common to warmer climates roamed the mountain valleys of what is now Pennsylvania. Mastodon tusks, teeth, and bones have been removed from some of the older terrace deposits near Saltillo (*33*).

The parent materials of the Elk soils were washed mainly from the limestone valleys. Although these alluvial materials originally gave rise to productive soils of the first bottoms, they now occupy old higher terraces, where the soil materials have been subjected to leaching for a long time, with consequent decrease in fertility. These soils, however, are more productive than those of the Holston, Monongahela, and Cassville series, which have developed from acid alluvial materials. The parent materials of the Holston and Monongahela soils were washed very largely from areas of soils developed from yellowish-gray and yellow shales and sandstones, whereas those of the Cassville soils were washed from areas of red shales and sandstones.

The terraces are no longer subject to overflow, except that the low terraces may be flooded once in about 100 years or more (pl. 7, *A*). The great flood of March 1936 not only covered all the high bottoms but also about half of the terraces. This flood was the most widespread and destructive flood recorded since white men settled in the area of the Appalachian valleys and ridges. It destroyed or damaged many bridges, buildings, houses, and railroad tracks. The floodwaters reached the second floors of houses in Barree, Alexandria, Petersburg, Smithfield (South Huntingdon), Ardenheim, Mapleton, and parts of Mount Union.

ELK SERIES

The Elk soils, closely associated with the Huntington and Lindside soils of the alluvial flood plains, are developed from old deposits of alluvial soil materials transported largely from soils of the limestone valleys. Being much older than the Huntington or Lindside soils, however, these soils occupy old high terraces that are now high above normal overflow. All the Elk soils are well drained. A few areas are subject to a mild form of sheet and gully erosion when cultivated.

Being much older than the Huntington or Lindside soils, the Elk soils have been subjected to a much longer period of leaching, and, as one would expect, they are more acid in reaction and less fertile.

The total area of Elk soils is comparatively small, and the largest areas occupy the river terraces along the Frankstown Branch Juniata River.

Nearly all of the area of the Elk soils is under cultivation. These soils have about the same agricultural use and value as Murrill and Hagerstown silt loams. They are capable of producing any or all of the farm crops or pasture grasses that-are normally grown in the county; but a few areas of the older deposits may need lime, phosphate, and potash if they are to produce maximum yields of alfalfa or sweetclover.

Elk silt loam.—Elk silt loam includes all the better grades of the Elk soils. The surface soil is almost free of gravel. The lower part of the subsoil may contain some angular chert and a little water-rounded gravel, but the quantity is not sufficient to affect the moisture-holding capacity of the subsoil. Most areas of this soil are along the Frankstown Branch Juniata River, along the Little Juniata River, along the Juniata River itself as far as Huntingdon, and along other streams in the northern part of the county.

The surface soil of typical Elk silt loam, to a depth of 5 or 6 inches, is light-brown slightly acid silt loam that is soft and porous and has little or no well-defined structure. The texture of the surface soil becomes somewhat lighter with depth, and between the 6- and 15-inch depth the color, depending on location, ranges from yellowish brown to strong brown or slightly reddish brown. In general the reddish-brown color is associated with good internal drainage conditions. The subsurface soil is medium acid. The subsoil gradually becomes more compact with increase of depth below 20 inches. At a depth of 40 inches it is generally reddish-brown or yellowish-brown compact silty clay loam that is slightly acid.

Nearly all of this soil is under cultivation. It is a very good soil for corn or alfalfa. Partly because of the scarcity of good cornland, this soil is devoted almost entirely to the production of corn. Yields of corn range from 50 to 60 bushels an acre where fertility has been maintained by the addition of barnyard manure. Yields of alfalfa range from 1½ to 3 tons an acre a year from three cuttings. These yields may be increased as much as 20 percent by applying plenty of lime and phosphate to the soil a few weeks before the alfalfa is sown.

Elk gravelly silt loam.—The color and reaction of the surface soil and subsoil of Elk gravelly silt loam are like those features of Elk silt loam, but the soil mass contains more sand and gravel. The surface soil contains an appreciable quantity of water-rounded gravel, the individual pebbles of which range in diameter from 1/8 to 3 inches but average about 1½ inches. The content of gravel in the subsoil below a depth of 3 feet ranges from 15 to 40 percent. The lower part of the subsoil contains coarser gravel than does the surface soil, and it contains small cobblestones, 3 to 4 inches in diameter.

The presence of gravel in the lower part of the subsoil gives this soil more rapid internal drainage, which induces more rapid leaching. This condition makes it more difficult for the surface soil to hold or store any lime or fertilizer that may be applied to increase crop yields on this soil.

Only a very small area is mapped. The largest bodies are along Shaver Creek south of Neffs Mills.

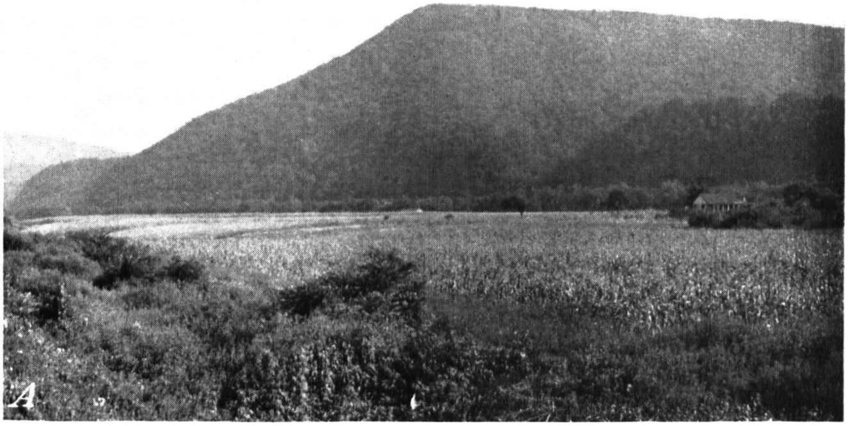
Nearly all of the land is under cultivation. This soil has about the same agricultural use as Elk silt loam, but the yields of crops are from 10 to 20 percent lower, depending on the fertility of the soil, the content of gravel, and the quantity and distribution of rainfall during the growing season.

CASSVILLE SERIES

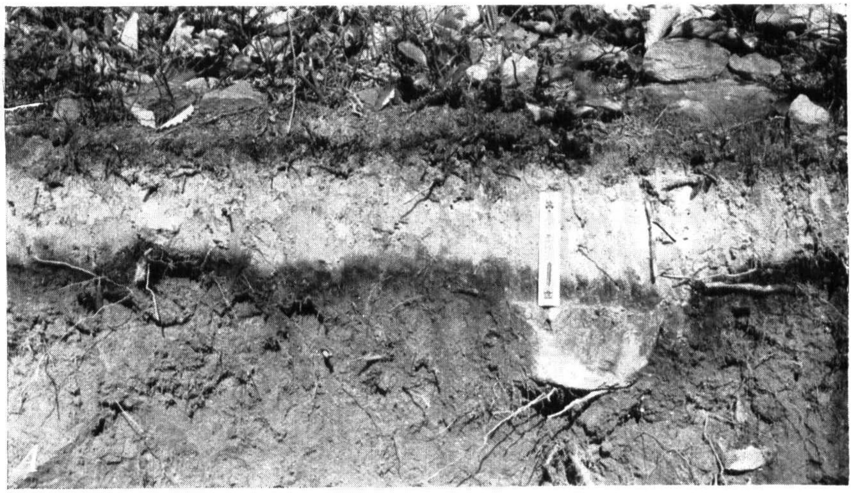
The Cassville soils include all the soils developed on old high terrace deposits of reddish-brown soil materials. Several of these old terraces are more than 50 to as much as 150 feet above the terraces occupied by Moshannon silt loam, high-bottom phase.

Cassville silt loam.—The surface soil of Cassville silt loam is brownish-gray or light yellowish-brown strongly acid soft mellow silt loam to a depth of 6 or 8 inches. It is underlain to a depth of 15 to 18 inches by slightly red heavy silt loam, although the material is not definitely reddish brown above a depth of 2 feet. Below this the subsoil is brown or reddish-brown silty clay loam that in places contains a few pebbles. The position of this soil provides excessive surface and subsoil drainage.

Because of the long exposure to leaching, the fertility of this soil is low. In addition, the soil contains very little organic matter and its moisture-holding capacity is much less than that of Moshannon silt loam, high-bottom phase. This soil has a marked deficiency of nitrogen, phosphorus, potassium, and calcium (lime). Almost all of the land has been cleared and cultivated. Several areas are susceptible to sheet and gully erosion. Originally this was a fair soil for corn, but the fertility of many areas has been badly depleted. At one time most of the high terrace areas were devoted to the production of clover and timothy hay. The fertility of a few areas of this soil in the valley of Raystown Branch Juniata River was so badly depleted that the soil was no longer used for agricultural crops, and the land was overgrown with weeds and some surviving timothy. Where corn is grown on these old terraces, the yields range from 20 to 25 bushels an acre. Wheat yields from 8 to 15 bushels without fertilizer, and clover and timothy ¾ to 1¼ tons. This soil responds readily to applications of lime and fertilizer by producing considerably higher yields.



A, Pope soils on the narrow flood plain of the Juniata River near Ardenheim. The northern tip of Terrace Mountain rises boldly above the river. Cottages on right were washed away by the flood of 1936. *B*, Philo soils on typical alluvial flood plain along a stream emerging from high mountain areas. Most of such areas are used for pasture because the soils are fertile and are well supplied with moisture during summer from the perennial mountain streams.



A, Podzol profile of Leetonia stony fine sand The alidade is 7½ inches long. Note nearly white A horizon (surface soil) The forest cover on this soil is mainly chestnut, oak, and pitch pine (Taken in Franklin County but typical of Huntingdon County) *B*, Uncleared area of Dekalb soils covered by a thick mat of forest litter and acid humus material that protects the soil from erosion and reduces runoff after heavy rains Drainage water from forest areas is usually clean and clear, whereas that from cultivated areas is frequently dirty and may contain large quantities of silt and clay

HOLSTON SERIES

The Holston series includes a group of acid soils of the stream terraces, developed from old alluvial deposits of soil materials that have been transported from higher areas of the acid Dekalb, Gilpin, Amberson, and Lehew-Dekalb soils, which, in turn, are developed from acid shale and sandstone materials.

These soils have been subjected to a long period of leaching, which has removed most of the more soluble compounds. They are deficient in phosphorus, potash, and lime. The organic (humus) content of the surface soil in cultivated fields is generally very low, and naturally these soils are also deficient in nitrogen.

Both the surface soil and the subsoil are strongly acid. The Holston soils, being older and more leached, are not so fertile or productive as the Pope soils, yet they are considered reasonably good agricultural soils. They have good surface and subsoil drainage, and a few areas are subject to considerable sheet and gully erosion.

Practically all of the Holston soils are cleared and used for cultivated crops. The major grain crops are corn, wheat, barley, oats, and buckwheat. The main hay crop is clover and timothy, and soybeans are also being grown for hay on these soils. Alfalfa and sweetclover can be grown successfully on the Holston soils provided the soils receive 3 to 4 tons of lime and from 250 to 350 pounds of bonemeal or superphosphate to the acre. Sweetclover may be used successfully as a green-manure crop on these soils.

Holston silt loam.—Holston silt loam is typical of the Holston series but generally occupies the lower terraces and has not been leached for so long a period as some of the soils of the older and higher terraces. The surface soil in places contains a few water-rounded river pebbles, but the quantity is usually not sufficient to affect the use or fertility of the soil.

The surface soil of typical Holston silt loam is light-brown, grayish-brown, or yellowish-brown soft mellow silt loam that is easily cultivated but shows evidence of considerable leaching. This soil below the 2-foot depth is yellowish-brown or brownish-yellow slightly compact silty clay loam that in some places contains appreciable quantities of water-rounded sandstone gravel.

A large part of this soil is used for the production of corn, which yields from 35 to 50 bushels an acre, depending on the season and the quantity of fertilizer applied to the land. Wheat also is a rather important crop, and where the land is fertilized the yields range from 20 to 30 bushels an acre. Clover and timothy produce from 1½ to 2 tons of hay an acre and even more on fields that have been limed and fertilized. Alfalfa can be grown successfully if the soil is given a treatment of 3 to 4 tons of ground limestone and 300 pounds of superphosphate to the acre several weeks before the alfalfa is seeded.

Some areas of Holston silt loam have a rich-brown soft silt loam surface soil, 15 to 18 inches deep, underlain by mahogany-brown or pinkish-brown silty clay loam. This soil is slightly less acid and a little more productive than typical Holston silt loam, but it is just as deficient in organic matter as the other Holston soils. Most of this brown inclusion is used for the production of three major crops—corn, wheat, and hay (mostly clover and timothy). Corn yields from 40 to 55 bushels an acre, and wheat 22 to 30 bushels. A few selected areas are used for the production of potatoes and vegetables, and these areas, if treated with organic matter and fertilizer, produce from 175 to 250 bushels of potatoes an acre.

Another inclusion with Holston silt loam contains appreciable quantities of water-rounded river gravel and a few rounded cobblestones in the surface soil. The subsoil contains from 20 to 40 percent of water-assorted sands, gravel, and cobblestones. This included soil occupies the low terraces and has the same general use as typical Holston silt loam, although the gravelly condition of the surface soil makes plowing and cultivating more difficult. Corn is the major crop grown on this soil, and the yields are 10 to 20 percent lower than they are on typical Holston silt loam.

Holston silt loam, high-terrace phase.—The high-terrace phase of Holston silt loam occurs on old high terraces lying from 100 to 250 feet above the present level of streams. This soil is developed on the very oldest of the river terraces. It is very strongly acid, having been subjected to excessive leaching long before the lower terraces were formed.

The surface soil is grayish-brown or grayish-yellow soft porous very acid silt loam to a depth of 6 inches and is more compact and definitely brownish yellow below. At a depth of 15 to 18 inches the soil material is yellowish-brown compact silty clay loam, and in some places below a depth of 3 feet it is compact silty clay containing splotchings of rusty brown and bluish gray. It is well drained and strongly leached throughout.

Nearly all of the typical soil has been cleared and is used for cultivated crops. The fertility and productivity are much below the average of the Holston soils. The greater part of the land is used for the production of hay, mainly clover and timothy. Wheat, barley, oats, and buckwheat are the principal grain crops. The soil frequently becomes too dry in midsummer for profitable yields of corn. Wheat returns from 12 to 20 bushels an acre if the land is fertilized, and 8 to 14 bushels if the land is not fertilized. Cultivated areas of the soil are very deficient in nitrogen, phosphorus, potash, lime, and organic matter.

Holston silt loam, high-terrace phase, includes the older alluvial high-terrace deposits of materials washed from areas of red shales and sandstones. This included soil is very deficient in lime, potash, and phosphorus. The supplies of nitrogen and organic matter also are very low. The surface soil is light brownish-gray very strongly acid silt loam. Below a depth of 20 inches the subsoil in most places is reddish-brown strongly acid compact silty clay loam, which becomes more compact with depth. Drainage is good to excessive, and the edges of some areas, if cultivated, are subject to considerable sheet and gully erosion. Only about half of this included soil is used for cultivated crops, and the rest is occupied by clover and timothy for hay. Yields of crops are below the average for the Holston soils. Corn yields 20 to 30 bushels an acre; wheat, if the soil is fertilized, 10 to 15 bushels; and clover and timothy hay ½ to 1 ton.

Holston gravelly sandy loam.—Holston gravelly sandy loam occupies both high and low terraces. The surface soil is yellowish-brown or brownish-gray loose gravelly sandy loam. The subsoil is yellowish-brown gravelly sandy clay loam. This soil has excessive drainage, dries out rapidly, and does not retain sufficient moisture for growing crops during dry periods. Most of this soil is under cultivation, but the total area is small. The land is best suited for growing small grains and hay, as these crops mature in early summer before the dry periods of midsummer reduce the soil-moisture supply to the point where normal growth and maturity of plants is inhibited.

One of the largest areas of this inextensive soil is near Saxton in the southwestern part of the county.

MONONGAHELA SERIES

The Monongahela soils are associated with the Holston soils on the terraces, and generally are situated immediately above the Pope and Philo soils, which occur on the bottom lands. They have been developed from the same kind of alluvial materials as the Pope and Philo soils, but they have been above overflow for a longer time and have been exposed to leaching and imperfect drainage conditions much longer.

Nearly all of the Monongahela soils are above average floods, but the flood of 1936 overflowed several areas of these soils. Almost all of the land has been cleared and placed under cultivation but yields of crops are rather low unless the soils have been limed and fertilized. These soils are usually wet and cold in early spring, then in midsummer they often dry out, become hard, and do not contain sufficient soil moisture for growing crops. They are better adapted to small-grain and hay crops than to corn or pasture.

Monongahela silt loam.—Monongahela silt loam is the most typical soil of the Monongahela series mapped in Huntingdon County. The 4- or 5-inch surface layer is brownish-gray or dark brownish-gray silt loam. It is underlain by a subsurface layer of yellow slightly compact silt loam that is well leached and weathered. The subsoil, lying between depths of 18 and 30 inches or more, is yellow, brown, and bluish-gray mottled or splotched silty clay loam or silty clay that is plastic but not especially sticky when wet, and is hard, compact, and difficult to dig through when dry. The organic-matter supply of this soil is very low, and the soil has been leached until it has a great deficiency of nitrogen, phosphorus, potash, and lime.

This soil has a little better surface and subsoil drainage than Monongahela silty clay loam. Naturally a larger proportion of it is cleared and used for either pasture or agricultural crops. About 40 percent of the land is under cultivation, 35 percent is in pasture, and 25 percent is in timber. The major crops are corn, wheat, rye, barley, buckwheat, and clover and timothy hay. Corn yields from 20 to 40 bushels an acre; wheat, when the soil is fertilized, 12 to 20 bushels; clover and timothy hay 3/4 to 1 1/4 tons, or, when the soil is heavily limed, 1 1/4 to 1 3/4 tons.

Monongahela silty clay loam.—Monongahela silty clay loam includes the more level areas of the slightly darker Monongahela soils that do not have such good surface drainage as Monongahela silt loam. The 3- or 4-inch surface layer is brownish-yellow or yellowish-gray silt loam or light silty clay loam. Below this is the subsurface layer of yellow silty clay loam. At a depth of 8 or 10 inches the upper part of the blue, gray, and yellowish-brown imperfectly drained compact clay begins, and it continues to a depth of 3 to 4 feet. The substrata are clay and silt.

One of the largest areas of this inextensive soil is northwest of McAlevys Fort.

About 60 percent of this soil is cleared. The greater part of the cultivated acreage is used for clover and timothy hay. The soil is not well adapted to pasture grasses, because it is very acid, it is wet in early spring, and in midsummer it dries out and has an insufficient moisture supply for growing grasses. Wheat or barley are grown on some areas, but yields of wheat are usually less than 15 bushels an acre.

Monongahela silty clay loam includes a few undifferentiated areas of silt loam, clay loam, silty clay, and clay soils where drainage is poorer than normal. Some of these soils contain gravel; others do not. The gravelly areas are differentiated by use of gravel symbols on the soil map. One such area is northwest of Neffs Mills. The surface soils of these inclusions are very strongly acid, thoroughly leached, and yellowish-gray or ashy gray silt loam or silty clay loam, underlain at a depth of 4 or 5 inches by blue, gray, yellow, and rusty-brown compact plastic heavy mottled clay that is also strongly acid. This clay extends to a depth of several feet.

Most of the areas of this soil that were at one time cleared are now abandoned fields because the physical condition of the soil does not lend itself to soil amendments or soil-improvement practices. The land is best suited to forestry and will support dense stands of hemlock.

SOILS OF THE ALLUVIAL FLOOD PLAINS

Soils of the alluvial flood plains occupy the low narrow valleys. Runoff in Huntingdon County is very rapid. All the streams flow swiftly through these narrow valleys, and they are actively carving their channels deeper and deeper into the underlying rock strata. Much of the finer sediment that enters the floodwaters of these streams leaves the county, and only a small proportion is left behind with the sand and gravel to form very narrow strips of stream alluvium. A few high bottoms and low and high terraces remain along some of the larger streams.

The deposits of present overflow land have been made very recently, and new materials are received or removed by every flood. The lower bottom lands are subject to seasonal overflow, and the high bottoms are flooded once in about 10 years.

The soil survey of Huntingdon County was made before the great flood of March 1936, which affected the character of the soil throughout the flood plains. Many areas of alluvial soils that consisted of silt loam before the flood may now be covered with sand and gravel; and in other areas the silt loam surface soil has been washed away completely. The changes wrought by the flood on the alluvial soils could only be determined by a new survey of the flooded areas.

The following example illustrates the changes in soil conditions that took place at the time of the flood. Before the flood the island in the Juniata River between Huntingdon and Smithfield was a very productive area of Huntington silt loam and Huntington fine sandy loam. After the flood the island was covered with a layer of sandstone and gravel ranging in thickness from a few inches to more than 2 feet. Much of this debris has been removed, so that most of the island is again being used for vegetable crops. Many other areas of good soils have been buried under a similar overburden of sand and gravel, and their suitability for use is now very different from what it was in 1935.

The alluvial soil materials originating in the limestone valleys generally make more productive soils than do the alluvial materials washed from areas of acid sandstones and shales. Therefore, wide differences in fertility exist among soils of the first bottoms. The Huntington, Lindside, and Warners soils receive most of their materials from the limestone valleys, whereas the Moshannon and Senecaville soils receive most of their materials from areas of red shales and sandstones. The Pope, Philo, and Atkins soils receive most of their materials from areas of yellow and gray shales and sandstones. Nearly all of these acid alluvial soils are low in calcium and potash, both of which are very important plant nutrients. The color is determined largely either by the character of the parent rock minerals or by local drainage conditions. The well-drained soils are grayish yellow, yellowish brown, or reddish brown; the more poorly drained soils are gray or mottled gray and rusty brown.

HUNTINGTON SERIES

The Huntington soils are developed from alluvial deposits of soil material that originated largely in the limestone valleys and, before being transported to its present position, may have been the surface or subsurface soils of the Hagerstown, Duffield, Frankstown, and Calvin-Edom soils.

The Huntington soils occupy both high- and low-bottom lands. The terms "first bottoms" and "second bottoms" are sometimes used when referring to these soils. In general the soil on the first bottoms is more alkaline than the soils on the second bottoms or high bottoms.

The low-bottom lands are subject to frequent floods. The high-bottom areas may be flooded on an average of once in 10 years. Except during periods of flood, surface drainage of these soils is good but not excessive. Subsoil drainage is also good, and there is no need for tile drainage in any of the typical Huntington soils.

The content of gravel in the Huntington surface soils is nearly everywhere very low, but some gravel is present in places in the lower part of the subsoil. Both the surface soil and the subsoil are mellow, friable, and easy to plow and cultivate.

The Huntington soils are the most productive and most valuable agricultural soils of Huntingdon County. They are exceptionally good for corn and alfalfa. In many low-bottom areas these soils are too fertile for the production of small grains. Air drainage is often poor in the lower areas, and wheat or oats in these areas are subject to frequent attacks of the rust diseases that attack small grains. Small-grain crops when grown on the Huntington soils of the low bottoms generally grow too tall and may lodge or become badly twisted if hit by heavy winds and rain after the grain is headed. In many places the Huntington soils are used for pasture. Bluegrass and white clover grow luxuriantly on these soils because the soils are very fertile and the soil-moisture reserve is ample for all growing seasons.

Huntington silt loam.—The surface soil of Huntington silt loam is rich-brown or dark-brown silt loam. The dark-brown color generally extends down to or below a depth of 12 inches. The subsoil in most places is light-brown or yellowish-brown well-drained silt loam or loam. In most places the surface soil is neutral in reaction, but in a few places it is mildly alkaline. The subsoils are neutral or mildly alkaline.

In soil fertility and productive capacity Huntington silt loam is without question the best soil in Huntingdon County. It occupies first bottom lands along streams. A number of small areas of Huntington loam are included on the map with this soil. The land may be overflowed once or twice a year, but the floods are of short duration. This soil is well supplied with plant nutrients. Nearly all of it is used for the production of agricultural crops and pasture grasses. Corn commonly yields from 50 to 80 bushels an acre, occasionally as much as 100 bushels, and alfalfa yields 3 to 4 tons an acre a year from three cuttings. This soil is good for the production of vegetables. It can be used for the production of potatoes if potato scab is not present or introduced into the soil.

Huntington silt loam, high-bottom phase.—The high-bottom phase differs very little from normal Huntington silt loam except that it lies at higher levels—10 feet higher on the average—and is subject to less frequent flooding. This soil is older than the soils of the first bottoms. It has been exposed to leaching longer, and its surface soil is slightly acid in reaction. The normal fertility of this soil is slightly less than that of the lower lying soils, but it produces excellent yields of all the farm crops that the climate and seasons of the region allow. The reserve of moisture in this soil, because of its higher position, is a little less than that in soils of the low bottoms. Corn, wheat, oats, alfalfa, and vegetables are the major crops grown. This soil produces better yields of wheat, barley, and oats than the soils of the low bottoms, mainly because it is higher and has better air drainage, and because the rust diseases are less severe on the higher and better drained areas. Corn returns from 50 to 70 bushels an acre, wheat 25 to 35 bushels, and alfalfa 3 to 3½ tons in three cuttings each year.

Most of the areas of this soil lie along the Frankstown Branch Juniata River and the Little Juniata River near the confluence of these two streams.

Huntington silt loam, colluvial phase.—This soil is developed primarily from recent colluvial and alluvial deposits of soil materials that have been washed from adjacent and nearby areas of Hagerstown, Duffield, and Frankstown soils, and deposited by intermittent streams. Most of this soil occupies small irregular areas along intermittent drainage channels, around the heads of such channels, and in depressions or around sinks that are surrounded by sloping areas of soils of one or more of the above-mentioned series.

Nearly all the areas of this soil are subject to frequent shallow flooding, but they are never under water more than 1 or 2 hours at a time unless the rainfall is heavy and of several hours' duration. Each flooding adds a layer of new soil material to the flooded areas. After the floodwaters recede these soils drain rapidly, and damage to crops from water is generally restricted to the effects of flowing water or silting.

The surface soil in most places is brown or dark-brown mellow silt loam to a depth of 15 inches or more. The subsoil below a depth of 2 feet is light-brown or yellowish-brown silty clay loam. The total thickness of the soil is everywhere more than 4 feet. Both the surface soil and the subsoil typically are neutral in reaction. The soil moisture reserve of this soil is ample for any crop that may be grown. This is a very productive and valuable agricultural soil. Approximately 40 percent of the acreage is used for growing corn, yields of which range from 50 to 80 bushels an acre. The uncultivated areas are used mostly for bluegrass and white clover pasture. Farmers have found this to be an excellent soil for midsummer pastures.

Huntington fine sandy loam.—Huntington fine sandy loam lies in narrow strips near and along the larger streams. It occupies low bottom lands, is generally less than 10 feet above the normal level of the streams, and is subject to seasonal floods. The texture of this soil ranges from very fine sandy loam to coarse sandy loam, which in places may contain appreciable quantities of river gravel in the surface soil; but the dominant texture is fine sandy loam. Nearly everywhere this soil is underlain by sandy or gravelly strata, which are responsible for the very rapid and, in some places, excessive subsoil drainage. Moisture may be deficient in this soil during prolonged dry periods. The entire soil in most places is about neutral in reaction.

Approximately 40 percent of this soil is occupied by trees—mainly ash and willows—under which there is nearly everywhere a tall, dense growth of weeds. This soil, being more sandy, is not so productive as Huntington silt loam. It is a loose mellow soil and is easily cultivated. Almost all of the cleared areas are used for the production of corn, and some areas have been devoted to corn continuously for many years. Yields range from 30 to 50 bushels an acre.

Huntington fine sandy loam, high-bottom phase.—Nearly all areas of this soil occupy high bottoms lying, on the average, from 10 to 20 feet higher than the low bottoms. The land is above seasonal overflow but may be flooded once in about 10 to 15 years. The total area of this soil is very small, but practically all of it is used for general farm crops. It has been subjected to considerable leaching because the soil is open and porous. Nearly all of the water that falls on it percolates down through the soil, and very little runoff occurs. The surface soil in most places is slightly acid.

Only 64 acres of this soil is mapped, mainly along the Little Juniata River and Spruce Creek.

This is the least productive Huntington soil in Huntingdon County. Corn, wheat, oats, rye, and barley are the major crops. Red clover is the dominant hay crop. This soil dries out rapidly after rains, and deficiency of moisture during prolonged dry periods may reduce the yields of crops. Corn yields range from 25 to 50 bushels an acre and clover 1¼ to 1¾ tons. Yields of other crops are in proportion.

LINDSIDE SERIES

The alluvial soil materials from which the Lindside soils are developed had their origin in limestone valleys, and before these materials were transported to their present location they were probably the surface soils of Hagerstown, Duffield, Frankstown, and Calvin-Edom soils. These soils are nearly everywhere neutral or mildly alkaline, both in the surface soils and in the subsoils. They are imperfectly drained, and in many places the permanent water table in the lower part of the subsoil moves up and down, depending on the season, between the 3- and 5-foot depths.

The Lindside soils occur mostly along small streams within or near areas of the soils of the limestone valleys. They are nearly everywhere confined to low bottoms and are subject to seasonal overflow. Floodwaters rarely cover them for more than 2 or 3 hours at a time, unless the rainfall is heavy and continues for several hours. In most places each overflow leaves a thin deposit of new soil material that has been eroded from the nearby uplands.

Both the surface soils and the subsoils are generally free of water-worn gravel, but some areas contain small quantities of angular chert that have been washed in from nearby areas of the Frankstown soils.

Lindside silt loam.—The surface layer of Lindside silt loam is rich dark-brown neutral to alkaline silt loam, well supplied with humus. The subsurface layer, between depths of about 10 and 20 inches, is yellower and less brown. Below this the subsoil in most places is splotched dark-brown, yellow, and bluish-gray silt loam or clay loam, which is imperfectly drained. As mapped, this soil includes small areas of fine sandy loam and sandy loam, but in general it is silt loam. It is somewhat better drained than Lindside silty clay loam.

Although this is a very fertile and productive soil, less than 20 percent of its total area is used for cultivated crops. Its greater value is for white clover and bluegrass pastures. Soil moisture is never lacking in the subsoil, and in midsummer when other pastures are wilting and are in need of soil moisture the pastures on this soil, as on all the Lindside soils, are not only green but are growing rapidly and are producing a large amount of forage at a time when good pasture for dairy cows is needed.

About 10 percent of the acreage is used for corn and vegetables; most of the rest is occupied by pasture grasses, weeds, or trees. If the land is not flooded too frequently in the spring, corn yields from 50 to 80 bushels an acre. Because of the abundant soil-moisture supply, a few areas of this soil have proved to be very valuable for the production of vegetables. If earth dikes are used to keep the seasonal overflows off the cultivated fields, this soil can be made to produce large yields of vegetable crops, mainly tomatoes, cabbage, snap beans, cucumbers, and potatoes.

Small areas of Lindside silt loam occur in depressions, at the foot of slopes, or around the heads of and along small drainage channels where recent erosion and sedimentation have deposited appreciable quantities of silts and clays. Drainage is imperfect, and most areas are subject to intermittent overflow after heavy rains; but floodwaters rarely cover the land for more than 2 or 3 hours. The soil is used mainly for either permanent clover and bluegrass pasture or for corn. Corn may yield as high as 60 or 80 bushels an acre in favorable seasons; on the other hand, if the early part of the growing season is wet, the planting date may be rather late and corn may not fully mature before frost in the fall.

Lindside silty clay loam.—Lindside silty clay loam includes undifferentiated areas of silty clay loam and clay loam and a few very small areas of clay. It occurs along small drainageways where stream flow is comparatively slow. Drainage of this soil is not so good as that of Lindside silt loam, and mottling or splotching of soil colors may be evident within 6 inches of the surface of the lower areas. Certain areas might be improved by tile drainage. Nearly all of this soil is used for pastures or woodland.

WARNERS SERIES

The Warners series includes dark imperfectly drained calcareous alluvial soils that have been developed in situations subject to seepage from lime-water springs. They occur in the limestone valleys. The subsoils especially contain a very high percentage of lime and approach travertine in character.

Warners silt loam.—The surface soil of Warners silt loam is either dark-gray, dark-brown, or black soft silt loam or silty clay loam containing sufficient lime to produce effervescence when treated with dilute hydrochloric acid. The subsoil, below a depth of 20 inches, in most places is yellow very loose calcareous silty clay containing from 20 to 60 percent of lime material.

The depth to the ground-water table varies, but it is ordinarily between 3 and 6 feet. The largest area of this soil lies immediately southeast of McAlevys Fort. It is included in pastures, but extensive areas of this soil, like those in Franklin County, are very valuable for the production of alfalfa and truck crops if artificial drainage is provided for the wetter spots.

MOSHANNON SERIES

The Moshannon series includes red and reddish-brown well-drained acid soils developed from alluvial flood plain deposits that occupy low bottoms and high bottoms. Much of the soil material originally came from areas of Lehew, Calvin, Amberson, and Lehew-Dekalb soils, most of which were developed from red acid shales and sandstones of the Mauch Chunk and Catskill formations.

Moshannon silt loam.—Moshannon silt loam is typical of the Moshannon series. It is most extensive along the flood plains of Sideling Hill Creek. Less typical areas are in Trough Creek Valley and in the valley of Raystown Branch Juniata River. This soil occupies low bottoms where it is subject to seasonal overflows. It is a deep soil and is comparatively free of gravelly materials.

The color of the surface soil varies from place to place, but the typical surface soil is reddish-brown or brownish-red silt loam to a depth of 18 inches or more. Where the soil is well supplied with humus the color is darker—a rich brown. Below this the color gradually becomes lighter as depth increases. At a depth of 5 feet the soil material is brownish-red, soft, porous, and well drained. This soil is everywhere mellow and permeable. The reaction of the surface soil and subsoil is medium to slightly acid.

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About 80 percent of the land is under cultivation; the rest is occupied by stream-bank weeds and trees. This is the most productive soil in the Moshannon series. Corn, the major crop, yields from 50 to 70 bushels an acre. A few areas are used for production of vegetables, mainly cabbage and potatoes.

Moshannon silt loam, high-bottom phase.—This phase is similar to the typical soil, but it occupies high bottoms or low terraces that are generally just above floods. The flood of March 1936, however, covered many areas of this soil. The soil material has been in place much longer than that of the lower areas of Moshannon silt loam. Naturally this soil has been leached more and is slightly more acid than the lower lying typical Moshannon silt loam. The surface soil is reddish-brown loose mellow silt loam to a depth of 15 to 20 inches. Below this the subsoil is yellowish-brown slightly compact silty clay loam.

Approximately 90 percent of the land is under cultivation. The main crops are corn, wheat, clover, barley, and potatoes, and some buckwheat is also grown. Corn yields from 35 to 60 bushels an acre; wheat, where the soil is fertilized, 25 to 35 bushels; barley 40 to 50 bushels; and clover and timothy hay from 1¾ to 2¼ tons.

A few small areas, totaling about 40 acres, included in this soil comprise soils developed from very recent colluvial and alluvial deposits of material eroded from adjoining sloping areas of Calvin and Lehew soils and deposited at the foot of steep slopes. The depth of new fill, which is being constantly added to, averages about 15 inches but in places is as much as 3 feet. This new material is lighter colored and contains less organic matter than the soil that it covers. About half of this included soil is under cultivation, and the rest is in white clover and bluegrass pasture. Corn, the main crop, produces from 40 to 70 bushels an acre.

Moshannon sandy loam.—Most of Moshannon sandy loam occupies low bottom lands bordering the streams and forming long narrow areas adjacent to or immediately below Moshannon silt loam. It is a deep soil, but it is subject to more frequent flooding than the silt loam. This soil is more sandy than the silt loam and is not so productive. Only about 40 percent of the land is used for cultivated crops; the rest is under a cover of weeds, low willows, or other stream-bank trees. Corn is the main crop grown, and the yields range from 40 to 50 bushels an acre if the land is not flooded too frequently during the growing and harvesting season.

SENECAVILLE SERIES

Associated with the Moshannon soils, the Senecaville soils are developed from the same kind of reddish-brown alluvial deposits. They are subject to frequent overflow and are imperfectly drained.

Senecaville silty clay loam.—Senecaville silty clay loam has a 12- to 18-inch dull brownish-gray more or less granular silty clay loam surface soil, the lower part of which is mottled with gray and yellowish brown in places. The subsoil consists of mottled gray, yellow, rusty-brown, and reddish-brown silty clay loam and thin layers of silt loam and fine sandy loam. The deep substrata are light reddish brown and are variable in texture.

The soil is medium to strongly acid in reaction in the upper part, but the substrata are only slightly acid. The same crops are grown as on Philo silty clay loam, and yields are about the same or slightly higher. About 80 percent of the land is used for pasture. The important forage crops are redtop; alsike clover, some timothy, white clover, and bluegrass.

POPE SERIES

The Pope series includes soils of the well-drained bottoms and high bottoms. They are developed from alluvial flood-plain deposits of medium acid soil materials that have been washed from areas of DeKalb, Laidig, Gilpin, Amberson, and Lehew-Dekalb soils, which in turn are developed mainly from yellowish-brown and gray acid sandstones and shales. Some areas of the Pope soils are gravelly and others are comparatively free of gravel. The lower part of the subsoil nearly everywhere contains appreciable quantities of sand and gravel. The gravelly strata provide good but not excessive soil drainage. The more gravelly areas are shown on the soil map by gravel symbols. These soils have developed from recent alluvial deposits, have been subjected to leaching for only a comparatively short time, and, as one would expect, are fertile and productive. Nearly all of the land has been cleared and used for agricultural crops. The Pope soils are good for corn and are used chiefly for this crop, which yields from 30 to 60 bushels an acre. In general the soils of the low bottoms are more fertile than those of the high bottoms; the low-bottom areas, however, are inundated by floodwaters more frequently, which reduces the usefulness of the soil.

Pope silt loam.—As mapped in Huntingdon County, the most typical areas of the Pope soils are included in Pope silt loam, which occupies the first or low bottoms along the larger creeks and rivers. It is subject to seasonal flooding by overflowing streams.

The 4- or 5-inch surface layer of Pope silt loam ranges from brown to light brown or yellowish brown, but typically it is light-brown medium-acid mellow silt loam. The subsurface layer and the subsoil are lighter colored than the surface soil and in most places are yellowish-brown or brownish-yellow noncompact medium-acid silt loam, loam, or sandy loam.

The surface soil contains comparatively little gravel, but the lower part of the subsoil in most places contains an appreciable quantity of sand and gravel, which provides good but not excessive soil drainage. A few gravelly areas are included, however, as the one southwest of Alexandria. There is a permanent water table from 5 to 10 feet below the surface in most places, and this aids in maintaining the supply of soil moisture during dry periods.

Approximately 80 percent of the land is under cultivation; the rest is occupied by weeds, grasses, and stream-bank trees. Because of the frequent flooding, corn is the major crop. Yields range from 40 to 60 bushels an acre unless floods interfere with the normal growth, development, or maturity of this crop. A few selected areas of this soil are used for potatoes and vegetable crops.

The areas of Pope silt loam in the valleys of Great Aughwick Creek and the Raystown Branch Juniata River are browner than normal and higher in fertility. These areas are subject to periodic overflows by the larger streams. They are used chiefly for the production of corn, but a few areas are used for the growing of vegetables. Corn yields from 45 to 60 bushels an acre.

Pope silt loam, colluvial phase.—This soil is developed mostly from very recent colluvial and alluvial deposits of soil materials that have been eroded recently from sloping and exposed areas of Berks. Gilpin, or Amberson soils and redeposited at the foot of steep slopes or along the small intermittent drainage channels that project fingerlike far up into the uplands where rapid surface runoff is responsible for active erosion and deposition.

This soil is subject to frequent overflow. Each overflow is of short duration but generally deposits an additional thin layer of new sediments over the older deposits. The depth of the new fill that has been deposited since the adjacent land has been cleared of forests ranges from 10 to 30 inches. The original virgin surface soil contains more organic matter, is much darker, and is easily differentiated from the overlying layer and lighter colored sediments.

This soil is well drained, fertile, and productive, and it generally contains an abundant supply of moisture. About 70 percent of the total acreage is under cultivation. Nearly all of the cultivated areas are used for the production of corn because the soil is deep and retains a good supply of moisture, which is needed by the corn plant in midsummer. Corn yields from 30 to 50 bushels an acre if it has not been flooded too frequently in early spring when it is small and likely to be buried by silt. The uncultivated areas are used for pasture. The principal pasture grasses are redtop, timothy, bluegrass, and some white clover.

Pope silt loam, high-bottom phase.—This soil is most extensive along the larger streams, where it occupies high bottoms and low terraces that are above the level of normal floods. The flood of March 1936, however, covered much of the land. This soil is older than the low-bottom soils and has been subjected to a longer period of leaching, therefore it is not so productive.

The surface soil is light-brown or yellowish-brown silt loam, and the subsoil at and below the 2-foot depth is brownish-yellow silty clay loam. The soil is everywhere well drained, and almost all of it is under cultivation. It is used for the production of all the common farm crops, but corn, clover and timothy hay, wheat, and barley are the major crops. When the soil is fertilized, corn yields from 40 to 60 bushels an acre, wheat 20 to 30 bushels, and clover and timothy hay 1½ to 2½ tons.

Pope silt loam, high-bottom phase, includes a variation that has a browner surface soil and a pinkish-brown subsoil. It is not everywhere so acid as the more typical Pope soils. Agriculturally it is a better soil than Pope silt loam, high-bottom phase. Corn, wheat, clover and timothy, barley, and oats are the major crops.

Pope sandy loam.—Pope sandy loam occupies low bottom lands where the sediments are laid down by swiftly flowing water, which does not allow the finer silts and clays to settle rapidly. Areas of the sandy loam include some gravelly sandy loam and generally border the streams and lie adjacent to or immediately below areas of

Pope silt loam. This is a deep soil but is subject to frequent flooding, which sometimes causes considerable damage to growing or maturing crops. Only about 40 percent of the Pope sandy loam and 30 percent of the included areas of gravelly sandy loam are used for cultivated crops. The rest is under the cover and protection of pasture grasses, weeds, low willows, and other stream-bank trees, mostly maple, elm, ash, walnut, hickory, and sycamore. The main crop grown on Pope sandy loam is corn, yields of which range from 30 to 50 bushels an acre, depending on the frequency of flooding and the condition of the soil.

Pope sandy loam includes areas of a browner and more productive soil. The larger areas of this variation are on the low bottom lands that are subject to frequent overflow by stream floodwaters. About half of this included soil is cleared and under cultivation. Corn and clover are the major crops. Corn yields from 30 to 50 bushels and clover from 1 to 1½ tons to the acre. The uncleared areas, most of which border the streams, are occupied by weeds, brush, and trees.

A fairly large body of this soil borders Standing Stone Creek in the extreme northeastern part of the county. The total area of the soil, however, is small.

PHILO SERIES

The Philo series includes a large proportion of the imperfectly drained acid alluvial soils in Huntingdon County. These soils occupy the low-bottom and high-bottom lands along both the large and the small streams (pl. 7, *B*). Much of the Philo parent soil material has been eroded and transported from areas of Dekalb, Gilpin, Berks, Amberson, and Lehew-Dekalb complex soils in the shale hills and sandstone mountains.

Many areas of the Philo soils would be more valuable for agriculture if they were better drained, and the drainage of many areas can be improved either by surface ditches or by tile drains. The surface ditches should be constructed in such a way that they will intercept the runoff from higher areas and prevent it from flowing over or flooding the lower and more level areas. Open ditches are also valuable after floods, for they will speed up the removal of excess water that is left behind after the stream flow recedes to normal. The major variations in the general characteristics of the Philo soils are texture, color, and gravel content.

Some areas of the Philo soils contain appreciable quantities of gravel. These areas are shown on the map by gravel or stone symbols.

Philo silty clay loam.—Most areas of Philo silty clay loam border the outer edges of the wider flood plains, at the foot of the uplands, where the finer sediments are dropped by the slower moving or slack waters during flood periods. Many areas of this soil are very wet during the wet season, and when dry periods arrive the soil dries out, becomes very hard, and cracks deeply.

The surface soil to a depth of about 6 inches is brownish-gray silty clay loam. Below this the soil is yellow, blue, and gray mottled tough silty clay loam or silty clay that does not allow such rapid movement of soil moisture as a coarser textured soil would.

Nearly all of this soil has been cleared, and it is used mainly for the production of alsike clover and timothy hay and pasture. Its best use probably is for hay. Surface drainage through open ditches is essential if maximum use of this soil is to be obtained.

Philo silty clay loam includes small areas of soils in low flat depressions. In such places the texture of the surface soil is clay loam and the soil is much darker than the normal Philo soils. This darker color is due to the large quantity of organic matter in the surface soil. The subsoil below the 10-inch depth is the mottled blue, gray, yellow, and rusty-brown silty clay loam characteristic of the Philo soils. The total area of this included soil is very small, and not more than one-third of it is used for the production of crops. Most of it is suitable for pasture or forest.

Another included soil is developed from the same kind of materials as the Moshannon soils, but it has a poorly drained subsoil. The most extensive areas are along Little Trough Creek in Trough Creek Valley. The surface soil is dull-brown or somewhat reddish-brown silty clay loam to a depth of 6 or 8 inches. Below this depth the soil is less brown and more yellow. At or just below the 10-inch depth the soil is mottled or splotched yellow, brown, and bluish-gray silty clay loam that is poorly drained. The water table fluctuates up and down, but it is usually between depths of 3 and 6 feet.

Practically all of this included soil is used for pasture. White clover and Kentucky bluegrass are the dominant forage plants. A few of the wetter areas are occupied by swamp sedges and wet-land grasses. The common trees along the stream are willow, hickory, ash, pin oak, elm, and sycamore. Some of the better drained areas are used for the production of corn. The best use of this soil is probably for pasture, because it is fertile and contains an abundant reserve of moisture, which is important in maintaining the growth of pasture plants in midsummer.

Philo silt loam.—The surface soil of Philo silt loam is normally grayish-brown or yellowish-gray silt loam to a depth of 8 or 10 inches. Below this the soil is nearly everywhere mottled or splotched yellow, brown, and gray poorly drained silty clay loam or silty clay, which, if dug out and allowed to dry, becomes very hard and cloddy. During wet seasons the water table may rise to a level within 2 feet of the surface, but in the drier part of the year it moves downward to a depth of 6 feet or more.

Philo silt loam occupies the bottom land areas along both large and small streams. The surface soil is comparatively free of gravel, except in a few areas, indicated on the soil map by gravel symbols, as the area in the southeastern part along the Huntingdon-Fulton County line. Practically all of this soil is subject to occasional flooding by overflowing streams. Surface drainage is fair, and water seldom stands on areas of this soil for more than 3 or 4 hours after rains. Many areas of this inclusion are subject to frequent floodings by waters that rush down the small drains after heavy rains. Each flooding usually leaves an additional deposit of silts and clays wherever there is sufficient vegetation to slow up the flow of silt-laden waters.

Less than 20 percent of the area covered by this variation is under cultivation, about 50 percent is included in pastures, and 30 percent is occupied by brush, willows, and ash trees or weeds. This soil has good moisture-storage capacity, and the fertility is not specially low.

Most areas, however, are too small and too narrow to warrant separation from the adjacent steep areas of shale hill soils by fences in order that they might be placed under cultivation. Therefore the use of this land is generally the same as that of the steeper shale hill areas. However, 1 acre of this soil will produce as much or more pasture than 5 or 6 acres of the steep phases of Berks or Gilpin soils, which generally occupy the adjacent areas. A few small areas are used for the production of corn.

Philo silt loam is the best agricultural soil in the Philo series. Approximately 80 percent of its total area is used as cropland. The major crops are hay (clover and timothy) and corn. Where the soil is not flooded too frequently, yields of corn range from 30 to 50 bushels an acre, and a few of the better drained areas produce as much as 60 bushels if the soil is not flooded during the growing season. Open-ditch and tile drainage would increase the suitability for use and the productivity of about one-fourth of the total area of this soil.

Philo silt loam, high-bottom phase.—The total area of Philo silt loam, high-bottom phase, is small. It occupies stream terraces that are from 30 to 50 feet or more above the soils of the first bottoms. The surface soil is brownish-gray acid silt loam, which is underlain by a mottled yellow, brown, and gray acid silty clay subsoil. About one-half of the land is occupied by timber; the rest is used for clover and timothy hay. Probably the best use of the soil is for hay, pasture grasses, or timber.

The largest bodies of this soil are near Shirleysburg. A variation of this soil, occupying a total area of about 50 acres, is developed mainly from very recent colluvial and alluvial deposits of soil materials that now occupy low positions along the small intermittent streams that rise high up in the shale hill soil areas. Much of the soil material has been eroded recently from the nearby sloping areas of Berks, Gilpin, Amberson, and Dekalb soils and redeposited at the foot of steep slopes around heads of intermittent drainage channels or along such channels.

Philo sandy loam.—Philo sandy loam occupies low bottom lands along both small and large streams. Many areas of this soil occupy long narrow strips between Philo silt loam and the streams. Both the surface soil and the subsoil in places contain appreciable quantities of river gravel. The lower part of the subsoil in many places contains fairly large rounded cobblestones, some of which may be 6 or 8 inches in diameter.

This soil is overflowed more frequently than Philo silt loam, and not more than 40 percent of it is suitable for cultivation. Corn is the major crop grown on the cultivated areas, and most of the uncultivated areas are occupied by stream-bank weeds, willows, ash, elm, sycamore, and similar hardwood trees, or are used for pasture.

ATKINS SERIES

The Atkins soils are typically acid wet alluvial soils that have but little if any agricultural value. They occur on low bottom lands. Two types and one phase, the silty clay loam and the clay, the latter with a high-bottom phase, are mapped. They include some areas of undifferentiated soils having considerable range in texture.

Atkins silty clay loam.—Atkins silty clay loam includes undifferentiated areas of silty clay loam, silt loam, gravelly silt loam, and gravelly silty clay loam. Some areas even contain cobblestones. The gravelly and cobbly areas are differentiated on the soil map by gravel or stone symbols, as in the area near Neelyton in the southeastern part of the county. The surface soils are gray, and the subsoils are bluish gray mottled with yellow and rusty brown.

About 50 percent of the land is cleared; the rest is occupied by hemlock, ash, beech, elm, pin oak, and alder. The cleared areas are used for pasture, from which livestock get some feed in the form of wet-land sedges and grasses. Some areas of this soil might be improved by artificial ditch or tile drainage. The cost would probably be greater than any profits that might be obtained from draining areas of this soil; and drainage alone is not enough. Heavy applications of lime and fertilizer would have to be made before this soil would produce crops or grasses that would be of much value.

Atkins clay.—Atkins clay is typically a gray wet soggy poorly drained clay soil that has little or no agricultural value—drained or undrained. Most of the areas of this soil border Standing Stone Creek. Movement of water through the soil is slow. In wet seasons it is waterlogged, and, when it does dry, it shrinks, cracks open, and becomes hard and physically unsuitable for the production of agricultural crops or grasses. It is best suited to hemlock forest.

Atkins clay, high-bottom phase.—This soil includes areas of gray poorly drained alluvial clay deposits associated with the high-bottom phases of Pope and Philo soils. The soil has little agricultural value, but it may furnish some poor pasturage.

SOILS OF THE MOUNTAINS

More than 60 percent, or approximately 600 square miles, of Huntingdon County is forest land, much of which is mountainous. Huntingdon County lies well within the northern part of the southern hardwood forest area, which is an oak-chestnut forest region, (*35*). The southern hardwoods forest area includes all or parts of 12 States that are within or adjacent to the Appalachian Mountain region of the eastern part of the United States. It extends from New York to northern Georgia and from the Ohio Valley eastward to the Piedmont Plateau and the Coastal Plain. The original tree growth in this region was mainly oak and chestnut, but between the years 1912 and 1930 the oriental chestnut blight killed practically all of the chestnut trees and oak is now the dominant tree. Some of the world's finest hardwoods, including chestnut and oak, grew in this region. Huntingdon County originally had its full share of oak and chestnut forests. In addition, there were also fine specimens of white pine, tuliptree (yellow poplar), beech, maple, black walnut, cherry, and other trees that were very valuable as a source of finishing lumber.

Lumbering, forest fires, and disease have changed the picture. Today fully 95 percent of the forest area is covered with cut-over and second-growth timber that has little commercial value. Possibly by the year 2000 half of this forest will have grown to be of value for lumber if it is not cut for other purposes before that time.

More than 60 percent of the area of the county has never been cleared for cultivation and may be considered to have soils under a virgin forest cover, even though some disturbance has taken place through lumbering and burning. The soils of the whole county formerly were forested, but approximately 40 percent of the area has been cleared, and much of the cleared area has been cultivated. Plowing and cultivation have caused serious wastage of soils by erosion on the more strongly sloping land. Probably about 20 percent of the cleared area will eventually have to be abandoned and will be turned back to forests if enough soil is left to produce a forest growth.

Nearly all of the well-drained forested soils on medium to gentle slopes belong either to what are known as Gray-Brown Podzolic soils or to the Podzols (*28*). On steeper areas, which comprise the greater part of the soils of the mountains, the soils are for the most part very shallow and do not have well-developed Gray-Brown Podzolic or Podzol profiles. Nearly all of the soils of the mountains are medium acid to very strongly acid in reaction, because they have been leached of most of the soluble compounds containing basic elements and because many of them have developed from rocks that were acid in reaction to begin with.

Most of the forested soils are covered with a layer of leaf litter varying in thickness somewhat according to the time of year and also according to the type of forest. This is underlain by a nearly black humus layer, 1 or 2 inches thick. The humus layer and the leaf litter together make a sort of mat that is penetrated by roots of trees, which hold the humus mat in place to form a complete blanket over the mineral soil. The surface mineral soil immediately under the humus layer is thoroughly leached and strongly acid in reaction. It is light-colored, but the color varies somewhat according to the kind of parent material and the length of time the soil has been in place. Where the soils are developed from weathered sandstones, it is not uncommon to find a nearly white layer beneath the humus. Elsewhere the surface mineral soil is light brown, light brownish gray, or yellowish gray. The subsoils above the weathered parent rock generally contain slightly more clay than the surface soils, but the difference is not very marked and in many places there is no appreciable difference in clay content. Nearly everywhere the subsoil contains broken fragments of rock like that which lies beneath the soil.

The kind of parent rock has had more influence on the characteristics of the soils of the mountains than any other one factor. The color and the fertility level of any one of these soils are mainly the result of leaching by acid waters and the resistance that the parent soil materials offer to the leaching process. Where the parent materials contained only a small amount of iron and basic elements, the leaching processes have removed practically all of the potassium, calcium, and magnesium and much of the iron, leaving the soil of a gray color. Where the parent material contains an abundant supply of iron and basic elements and where the content of clay in the parent rock is medium to high, the leaching process is much slower and less complete and the soils retain a larger proportion of the plant nutrients that were originally in the parent rock.

The soils of the mountains of Huntingdon County have developed from two great groups and one less important group of rock materials. The more important groups are (1) the brown, reddish-brown, and red materials derived from brown and red sandstones and shales; and (2) the brownish-yellow and yellow soil materials derived from gray and yellow shales and sandstones. The Lehew soils are developed from the first kind of parent rocks, and the Dekalb, Clymer, Leetonia, Laidig, Gilpin, Rayne, and Lickdale soils are developed from the second kind. The Gilpin, Rayne, and Laidig soils have been discussed in former sections of this report, as they occur in the shale hills and on high terraces and foot slopes of the lower parts of the county, as well as in the mountains. A third minor group of soil materials has been formed from a heterogeneous complex of yellow and gray sandstone and sandy dolomitic limestone rocks, which, when weathered, give rise to a complex of silts, sands, and clays. The Morrison soils have developed from this kind of material, and the depth of weathered rock is very great.

LEHEW SERIES

The Lehew soils have developed from reddish-brown and Indian-red medium-acid sandstone and shale materials that are rather resistant to leaching. The parent rocks are derived from red sandstones and shales of the Juniata and Catskill formations and some areas from Mauch Chunk shale. The parent soil and rock minerals are rich in iron, which imparts both to the soil and to the rock a reddish-brown or red color. Practically all of the Lehew soils are in rather high mountainous areas in belts between exposures of the hard gray Tuscarora sandstone and grayish-brown Oneida (Oswego) sandstone at a somewhat lower level in benchlike positions. The Lehew soils that occupy the broad high terracelike position on the northwestern slope of Tussey Mountain are typical of the Lehew soils as found on Bald Eagle, Stone, Blacklog, Shade, and Jacks Mountains.

Originally the Lehew soils were covered by a splendid forest of chestnut trees and red and scarlet oaks, together with a smaller proportion of other hardwoods; but now most of the good timber has been cut, and all of the chestnuts have been killed by the oriental chestnut blight.

The forest trees on the Lehew soils appear to be more healthy and more vigorous than the same species growing on Dekalb soils. They grow taller and straighter, and the forest canopy is fully 10 feet higher than on adjacent areas of Dekalb soils.

Lehew stony loam.—Lehew stony loam occupies high mountainous areas and comprises deep but stony soils. Although a very productive soil for hardwoods, among which red and scarlet oaks dominate, this soil is not suitable for farming.

A typical profile of Lehew stony loam under a forest cover has the following characteristics:

(1) A thick mat of leaf litter overlying nearly black medium to strongly acid humus about 1 inch thick. The humus is a soft spongy mass and is not so tough and peaty as the humus layer on the more strongly acid Dekalb and Leetonia soils.

(2) 1 to 7 inches, pinkish-brown or light reddish-brown soft porous loam having a very thin layer of light-gray material immediately beneath the humus layer. The reaction is very strongly acid.

(3) 7 to 25 inches, reddish-brown light clay loam or sandy clay loam, which breaks into subangular crumbs or nutlike aggregates that may be easily crushed in the fingers. The reaction is strongly acid.

(4) 25 to 72 inches or more, reddish-brown sandy clay loam or sandy loam containing many fragments of red weathered acid sandstone and shale. It is streaked in a few places with yellow.
(5) Parent geological material, acid brown or reddish-brown sandstone lying at steep angles.

The surface soil is strewn with many large and small fragments of rock, and the entire soil and weathered parent rock also contain fragments of only slightly weathered stone. The depth to bedrock ranges from about 6 to 15 feet, and in most places the parent material has been shifted downhill somewhat through the action of frost and gravity. On very steep slopes the rock fragments almost cover the surface.

Lehew shale loam.—Lehew shale loam is redder and less brown than Lehew stony loam. It has developed from sandstones and shales of the Catskill formation, which occupies very steep mountainsides. Several areas of this soil are mapped on the steep slopes that front on the valley of the Raystown Branch Juniata River. Much of the stone in this soil has worked down the slopes from higher exposures of the Pocono sandstone and similar sandstones.

This soil occupies very steep slopes. As the litter does not stay in one place long enough to form a humus mat, it remains a loose, spongy mass of organic material.

The 2-inch surface layer is reddish-brown silt loam that is loose and spongy and has a porous granular structure. The subsurface layer, which reaches to a depth of about 12 inches, is reddish-brown soft shale loam. Below this the subsoil consists of rich reddish-brown slightly compact shaly and stony silt loam. The parent soil material, from a depth of 36 inches downward, is red shaly silt loam or, in places, shaly silty clay loam.

Like Lehew stony loam, this is a deep soil, but it contains more red shale material, and is not so strongly acid.

This soil supports a dense cover mainly of red oak, scarlet oak, and red maple, and, to a less extent, of hickory, beech, walnut, and other trees. It is a good soil for forestry, but clearing should be limited to the cutting of mature trees. Clean cutting would promote a serious and destructive type of erosion, because this soil occupies very steep slopes.

Lehew-Dekalb stony loams.—The Lehew-Dekalb stony loams complex comprises undifferentiated stony silt loams, loams. and sandy loams, although stony loam is the dominant texture. The parent materials are a complex of red and gray sandstones and shales of the Pocono, Catskill, and Chemung transitional formations. Part of the sandstones are the same as those from which the Dekalb soils are formed, so that in fact the areas mapped are partly Lehew soils, partly Dekalb soils, and partly soil developed from a mixture of Lehew and Dekalb soil materials. The reader is referred to descriptions of Lehew and Dekalb stony loams (pp. 90 and 94) for detailed information concerning the kinds of soil profiles represented in this complex. Flat slabs and blocks of brown, reddish-brown, red, or gray sandstones are scattered over the surface, and the surface soil has a content of 30 to 50 percent of smaller fragments of stone. The thickness of the soil above bedrock ranges from about 3 to 10 feet. Drainage is good, but the soil retains somewhat more moisture than the Dekalb soils, and for this reason it is a better soil for forest than the Dekalb soils. The dominant trees are scarlet oak, red oak, red maple, and white pine. There are many other less important species; for example, beech, hickory, poplar, pitch pine, and chestnut oak.

Tree cutting on this soil should be limited to the removal of mature trees, because clean cutting would induce rapid sheet and gully erosion.

LEETONIA SERIES

The Leetonia soils are not very extensive. They are light-colored strongly leached soils known as Podzols. They occupy comparatively level areas where light-colored sandstones have been exposed to the agencies of weathering and soil formation. The original forest cover was mainly chestnut, scrub oak, scarlet oak, pitch pine, and chestnut oak, and there was some black birch. The humus produced from the leaf fall from these trees was extremely acid and had a powerful leaching effect on the surface soil minerals. All the Leetonia soils are developed from very sandy parent soil materials. Two types, the stony sandy loam and the stony fine sand, are mapped.

Leetonia stony sandy loam.—Most of the Leetonia stony sandy loam occupies the more level high mountain areas, chiefly in the northeastern part of the county. This soil has developed from finer textured parent materials than has the sandier Leetonia stony fine sand, and leaching has been less rapid. The acid dark-brown tough raw humus lies like a mat over the surface soil. The leached surface soil that lies immediately under the humus layer is ashy gray. The thickness of this gray layer in Huntingdon County ranges from 1 to 8 inches and averages about 5 inches. It is separated from the yellow parent material by a 1- to 3-inch dark coffee-brown subsoil.

Now that the chestnut, which tolerated very strongly acid soils, has been killed, the value of this soil for forest is questionable, because the remaining tree cover is mostly chestnut oak, pitch pine, and scrub oak.

Leetonia stony fine sand.—Leetonia stony fine sand includes those areas of the Leetonia soils where the parent soil materials are largely sands. The ashy-gray mineral surface soil has a maximum thickness of 8 to 10 inches in some places but averages about 3 inches (pl. 8, *A*). This soil occupies the more level and very sandy areas in the northeastern part of the county and in other minor low mountain areas.

The moisture-holding capacity of this sandy Podzol soil is rather low. This soil has but little value for forestry and at present is nearly everywhere occupied by low-growing scrub oak. Above these trees tower a few pitch pines that have been able to survive the repeated sweep of forest fires.

This soil might have some value for forestry if forest fires were prevented from sweeping over the area and destroying the organic matter that should be allowed to accumulate and enrich the soil.

DEKALB SERIES

The Dekalb series includes a large total area of soils. The parent soil materials were derived from brown, gray, and yellow acid sandstones and shales. The soils have a wide range in texture and in content of shale and stone fragments. Most Dekalb soils of Huntingdon County are on steep mountainsides, but they also occur on the more level areas of mountaintops and foothills. They are strongly acid, and most of them are so stony that they are suitable only for forestry. A large proportion of the original forest on the Dekalb soils was chestnut, but now that all the chestnuts are dead, other hardwoods, mainly chestnut, red, scarlet, and post oaks, red maple, and birch, have come in to take their place. In addition there are a few patches of pitch pine, white pine, and some hemlock on the lower slopes. The undergrowth is mainly dogwood, mountain-laurel, azalea, blueberries, huckleberries, and ferns.

The forest litter from the hardwoods and pines is acid, and when it decays it forms a tough mat of very strongly acid humus over the surface of the mineral soil (pl. 8, *B*). The humus layer ranges from 1/4 to 3 inches in thickness if the partly decayed litter above the black finely granular humus is considered.

All the Dekalb soils are well drained, and some are droughty. Nearly all of the cleared areas are subject to excessive sheet and gully erosion, and partly for this reason it is likely that the Dekalb soils generally will continue to be used almost entirely for forestry. In the past they have produced valuable hardwood forests, and they will do it again if kept under good forest management, which must include the control of fires.

The usefulness of the Dekalb soils is determined by the steepness of slope, the quantity of stone present, and the texture and depth of the soil, all of which influence its value for growing trees.

Dekalb stony sandy loam.—Dekalb stony sandy loam is the most extensive soil in the Dekalb series. Most of it has been developed from weathered exposures of the hard gray and yellow Tuscarora and Oneida (Oswego) sandstones. It occurs on steep mountain slopes, and most of it lies from 1,400 to nearly 2,400 feet above sea level. Practically all of it is occupied by a hardwood forest of chestnut oak and scarlet oak, and there are scattered stands of red maple, pignut hickory, pitch pine, hemlock, white pine, and birch.

A typical profile of Dekalb stony sandy loam has the following characteristics:

(1) 2 or 3 inches of forest litter and very strongly acid humus, which, with the feeder roots of trees, form a matlike cover over the surface of the mineral soil (pl. 8, *B*). Beneath the most recently fallen leaves is a layer of light-brown fermented and rotten leaves, and beneath this is black thoroughly decomposed humus that is very acid, tough, and peatlike.

(2) 0 to 1½ inches, grayish-yellow or yellowish-gray thoroughly leached sandy loam.

(3) 1½ to 12 inches, acid yellow very sandy loam that has not been so severely leached as the material in the layer above. It contains a considerable quantity of angular stone.

(4) 12 to 36 inches or more, grayish yellow to yellow weathered sandstone soil material that has a sandy loam or loamy sand texture and contains a large proportion of large and small fragments of rock.

The entire soil is very stony. Subsoil drainage conditions vary from season to season and from place to place, resulting in some variation in the color of the subsoil. The better drained areas generally have yellow subsoils that are tinted with brown or slightly reddish brown. Where drainage is not quite so good during wet periods following heavy rains or snows, the subsoil is yellow, splotched with rusty brown and gray.

Where the surface of the rock strata is approximately at right angles to the mountain slope, internal drainage is more rapid than where it is parallel to the slope (pl. 9, *A*).

The soil contains from 20 to 50 percent of loose angular pieces of sandstone and shale, ranging from very small to as much as 2 feet in diameter. The total thickness of the soil material ranges from about 3 to 10 feet or more.

Dekalb stony sandy loam absorbs moisture very rapidly where it is covered by forest, and it retains sufficient moisture to support a good forest cover. Although it is a fairly good soil for hardwoods, it does not produce so vigorous a growth as soils that contain a higher proportion of clay and a smaller proportion of quartz.

The best uses of this soil are for hardwood forests, game preserves, and recreational areas.

Dekalb gravelly loam.—Dekalb gravelly loam includes comparatively smooth or depressed areas of the Dekalb soils in which the soil has developed from soft yellow shales and sandstones. Most of this soil is mapped either on or near Warrior Ridge. The 12- to 15-inch surface soil is fluffy loam, in many places containing small rounded fragments of soft shale or sandstone. This grades into the subsoil, which, below a depth of 20 inches, is an open porous sandy loam and in most places has very rapid subsoil drainage.

This soil has developed from deep soil material and includes small areas of silt loam and loam soils that are considered suitable for farming by some farmers because they are comparatively free of small rounded fragments of sandstone. In general the areas of silt loam and loam have been cleared and are now under cultivation. At one time some of the gravelly areas were cleared, but they have been turned back to forest. As a whole, this is a leached and weathered submarginal soil that is best suited to forestry. A few of the areas, however, if heavily limed and fertilized, can be made to produce fair yields of corn, potatoes, buckwheat, and other crops that tolerate acid soils.

Dekalb stony loam.—Dekalb stony loam occupies small but distinct comparatively flat areas on the tops of low mountains and hills where geological erosion is of little importance. The largest areas are near Huntingdon Furnace in the northwestern part of the county. Except for the loose stones it contains, it is practically the same soil as Dekalb gravelly loam. It has a good moisture-holding capacity, and where forested it supports a thick stand of oaks, pitch pine, red maple, sugar (hard) maple, and tuliptree (yellow poplar), together with a few black gum (pl. 9. *B*).

Dekalb cobbly sandy loam.—Dekalb cobbly sandy loam is extensive on the more level parts of Broad Top Mountain and the Barrens of Trough Creek. Very little of it has a slope greater than 10 percent. The soil material is deep but contains sufficient rounded and subangular sandstone cobblestones to discourage clearing and cultivation of the land. Although a few areas have been cleared and some have been cultivated, the soil is best suited to forestry and recreational purposes (pl. 10, *A*).

The surface soil is brownish-yellow very acid sandy loam, or, in some places, loam. The subsoil consists of yellow somewhat compact loam or silt loam and generally has good drainage.

Dekalb shale loam.—Dekalb shale loam includes numerous steep areas of soils that have some characteristics of both the Gilpin and the Dekalb soils. All these soils have developed from residual soil materials derived from yellow and yellowish-brown interstratified coarse-textured shales and fine-grained sandstones and mudstones. The parent soil materials are either yellow or brownish-yellow acid silts, sands, and clays that contain a large proportion of small partly disintegrated soft fragments of weathered shale sandstone and mudstone. This soil occupies the lower mountain slopes, the high and steep hills along the edges of the intermountain valleys, and some of the steeper escarpments of smaller ridges that lie well out in the larger valleys. It is shallow, the total thickness under a forest cover being from 2 to 3 feet; and in most places it rests on hard shale sandstone or mudstone.

The surface mineral soil in wooded areas is grayish-brown, yellowish-brown, or yellowish-gray shaly loam, 10 to 12 inches thick. It is thoroughly leached and strongly acid. Approximately 30 percent of the surface soil consists of small fragments of weathered shale. More than 50 percent of the parent material below a depth of 15 inches consists of yellow or yellowish-brown fragments of shale embedded in silt loam soil materials having a similar color.

Because it is shallow and occupies steep slopes, this soil is subject to serious sheet erosion even under a forest cover. It dies out rapidly, as it has a low moisture-holding capacity. The shallowness of the soil, together with its low moisture-storage capacity, makes it one of the least valuable soils for forestry in the county.

Trees grow slowly, they appear less healthy and vigorous than the trees on the deeper Dekalb, Lehew, or Lehew-Dekalb soils, and the forest canopy is nearly everywhere comparatively low.

If cleared, this soil would be subject to rapid erosion; therefore it should remain in forest. The present forest cover is mainly chestnut oak, scarlet oak, pitch pine, some white pine, and similar species of trees that tolerate a deficiency of moisture in midsummer and early fall.

Dekalb loamy sand.—For the most part, Dekalb loamy sand occupies more level or depressed areas where the soil materials have been derived from the soft coarse-textured Oriskany sandstone that caps Warrior Ridge and many other low ridges paralleling several of the narrower mountain valleys.

This is a deep soil, but owing to its high content of sand in both surface soil and subsoil it does not retain so much soil moisture as the finer textured Dekalb soils. Normally it is very acid and has a grayish-brown or brownish-yellow surface soil and a yellow or grayish-yellow very sandy subsoil. A few areas have been cleared, and the major crops grown are potatoes and corn. This soil responds quickly to heavy applications of fertilizer, and if rainfall is uniformly distributed throughout the growing season it can be made to produce fair yields of corn and potatoes, both of which tolerate acid soils. As this soil leaches rapidly, the productivity is determined largely by the quantity of fertilizer that is applied. It is a low-grade soil for forestry.

Dekalb stony loamy sand.—Dekalb stony loamy sand has developed from very sandy soil materials derived from the soft Oriskany sandstone. It occupies a sag-and-swell type of topography that dominates the plateau areas of Warrior Ridge. The soil is both deep and sandy. The surface soil consists of brown or yellowish-brown very loose loamy sand and overlies a yellow, yellowish-brown, or pinkish-yellow very sandy subsoil.

Even though the soil is deep, it has a very low moisture-holding capacity. Large sandstone boulders occupy from 5 to 10 percent of the surface.

The natural forest cover is mainly scrub oak with small stands of tuliptree, scarlet oak, chestnut oak, and pitch pine. This soil is too sandy to be of any great value for forestry, and, with its scrub oak cover, it is most valuable when used as breeding grounds for game and wildlife.

CLYMER SERIES

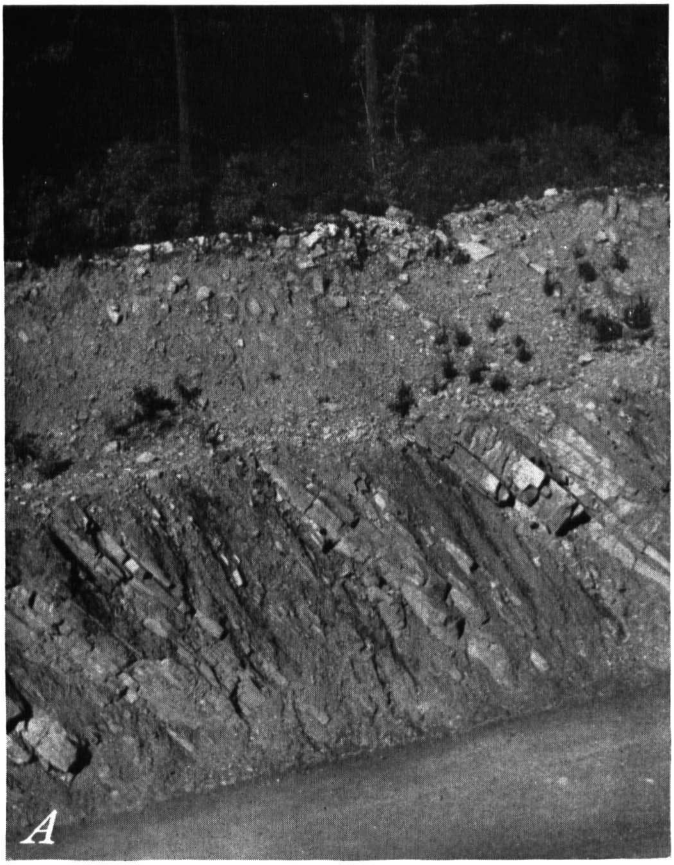
The Clymer soils in Huntingdon County have developed in the higher mountains from the same kinds of parent materials as the Dekalb soils, but they occur on more nearly level areas where the soils are more strongly developed, deeper, and less stony. Brown, yellow, and gray sandstones and some hard shales comprise the parent rocks. The principal difference between the Dekalb and Clymer soils is that the latter have a well-defined heavy-textured subsoil between the surface soil and the weathered parent rocks.

The original forest cover consisted of a mixture of chestnut; scarlet, red, and chestnut oaks; red maple; hemlock; and a few beech. About one-half of the land has been cleared, and, as the land is comparatively level and erosion is not serious, the cleared areas have been placed under cultivation and produce fair crop yields when the soil is limed and fertilized. The major crops are wheat, corn, oats, barley, buckwheat, potatoes, and timothy hay. Clover can be grown successfully when lime is applied liberally. Crop yields are approximately as follows on fertilized areas: Corn, 20 to 35 bushels; oats, 25 to 35 bushels; and potatoes, 100 to 125 bushels an acre. The Clymer soils on Broad Top Mountain are more productive than most Clymer soils because they are treated with manure from the mule barns near the coal mines.

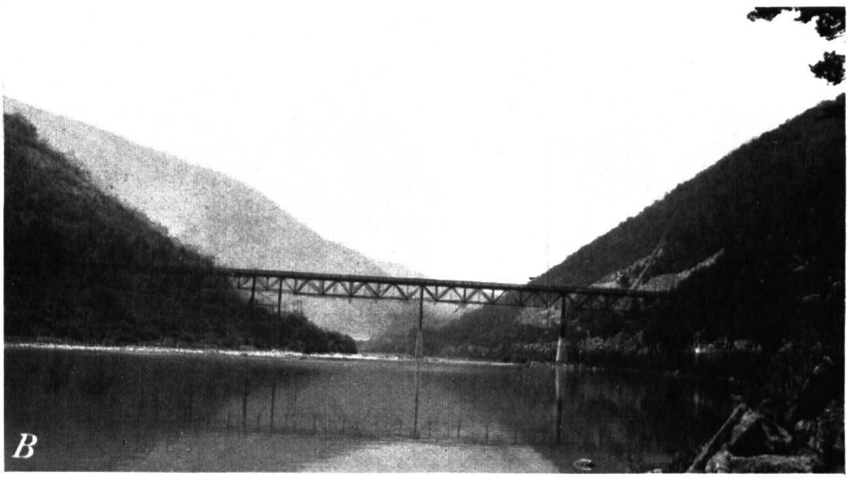
Clymer gravelly loam.—In cultivated fields Clymer gravelly loam has the following profile characteristics:

(4) 24 to 48 inches+, yellowish-brown or rusty-brown clay loam or sandy clay loam, containing some gray streaks.
(2) 12 inches, yellow or grayish-yellow gravelly loam also having no well-defined structure.
(3) 12 to 24 inches, light-yellow or light yellowish-brown silty clay loam that breaks into ill-defined nutlike aggregates from ¼ to ¾ inch in diameter. The texture is considerably heavier than that of the surface soil, and the material is sticky and somewhat plastic when wet.
(4) 24 to 48 inches+, yellowish-brown or rusty-brown clay loam or sandy clay loam, containing gray streaks.

The reaction is strongly acid throughout. Normally the soil is well drained, but temporarily during wet seasons the subsoil in some very level areas is saturated with water. The soil absorbs and retains large quantities of moisture and holds it for growing crops or for forests during the drier summer months. Under forested conditions the soil has an organic mat like that on the Dekalb soils.



A, Profile of Dekalb stony sandy loam Note the underlying strata of rock exposed at steep angles Total depth of soil material at this site is about 8 feet.
B, Young hardwood forest on Dekalb stony loam, in Diamond Valley



A, Typical mountain cottage in the northern part of the county in an area of Dekalb cobbly sandy loam—a vacation retreat in summer and hunting lodge in the deer-hunting season *B*, The Juniata River gorge through Jacks Mountain near Mount Union At this point the river has cut downward through about 1,800 feet of hard sandstone materials Rough stony land (Dekalb and Lehew soil materials) on mountainsides, typical of the rough, rugged mountainous areas throughout the county

Clymer gravelly loam includes several small areas of Clymer silt loam and loam on nearly flat or level areas where there is no gravel. Here, the soils are deeper and more productive; but the total area is not sufficient to warrant an additional separation on the map.

The term "gravelly" as applied to this soil is a misnomer, in that the rock pieces are not water-rounded but are angular and subangular fragments of broken sandstones and hard shales. This is the kind of material that some West Virginia and perhaps some Pennsylvania farmers call "channer," and this kind of soil is called "channery" soil by many of the Scotch-Irish people of the western Appalachian region.

The slope in few places exceeds 8 percent. About one-half to three-fourths of the land has been cleared, and about three-fourths of the cleared land is under cultivation. The main crops are corn, barley, and hay, (chiefly timothy except where the soil has been limed, where clover is mixed with the timothy). Yields of crops are about the same as those given in the discussion of the Clymer series.

Clymer cobbly loam.—Clymer cobbly loam is typical of the Clymer series. It contains sufficient cobblestones to discourage cultivation, but more than half of the acreage has been cleared and is used as pasture. The main cover is redtop, poverty grass, and sedges, and there is some timothy and white clover. This is not a desirable soil for farming, but it could be developed into pasture land if heavy applications of ground limestone (4 tons to the acre) and phosphate (400 pounds to the acre) were applied. Normally the soil would be worth more if it were producing hardwood forests.

This soil occupies more rolling land than Clymer gravelly loam. Most of it is a little better drained than the other soils of the Clymer series. Most areas are very stony. This is potentially forest land, and if placed under good forestry management it would produce valuable forests much more quickly than the associated Dekalb soils.

Clymer sandy loam.—Clymer sandy loam occupies flat areas where subsoil drainage is not always good. During wet seasons the subsoil from a depth of 18 inches downward is either imperfectly or poorly drained. The surface soil is grayish-yellow loam or sandy loam 2 or 3 inches thick. Below this the soil is yellow, and at a depth of 15 to 18 inches it is definitely heavy compact to somewhat plastic silty clay loam mottled yellow, bluish gray, and rusty brown.

This soil is probably best suited to forestry, but about half of it is used for pasture. The original tree cover was hemlock, beech, hickory, oak, maple, and some chestnut.

LICKDALE SERIES

The Lickdale series includes areas of wet, soggy soils around the heads of high mountain drainageways and in the swales of the mountains. A few areas of seepy mountain slopes are also included. The soils have developed principally from acid sandstone and shale materials that have accumulated in low places. Both surface and internal drainage are poor, and the reaction is very acid.

Lickdale stony silt loam.—This soil has a leaf litter and humus mat somewhat like that of the Dekalb soils, but the material is somewhat thicker and in places it is much like a thin layer of peat or muck. Normally it is not more than 3 or 4 inches thick and is underlain by mottled gray or grayish-yellow silt loam to a depth of 10 to 15 inches. Beneath this is gray and yellow mottled compact silty clay loam, which extends to a depth of 2 to 3 feet. The substratum consists of gray or bluish-gray stony silty clay loam.

This soil occurs in depressions or on wet slopes in the higher parts of the mountains. It is stony throughout, and the land is most suitable for forestry. Although some of it has been cleared, it provides poor pasture.

Lickdale stony sandy loam.—This soil is much like Lickdale stony silt loam, except that both the surface soil and the subsoil are somewhat more sandy. The surface soil is gray and yellow mottled stony sandy loam, and the subsoil, beginning at a depth of 15 to 20 inches, is gray and yellow mottled clay loam or sandy clay loam. A few very small areas of peaty muck are included on the map with this soil. Lickdale stony sandy loam occurs in wet areas at the heads of or along slowly flowing streams of the high mountains. It is subject to periodic overflow and is not suitable for cultivation. Most of it has a forest cover of hemlock.

MORRISON SERIES

The Morrison soils are developed from a complex mixture of sands, silts, clays, and iron oxide compounds that have accumulated through a long period of geologic time over the anticlinal dome of Nittany Valley. The accumulations are very deep, and in many of the old pits from which iron ore was taken there is no evidence of hard rock even at a depth of 50 to 100 feet. Much of the material rests loosely on hard bluish-gray dolomites. The whole surface of the barrens of Nittany Valley is pitted by sinks and depressions, and there are few surface drainageways within the area. Surface and subsoil drainage is through the soil and the underground drainage channels made by dissolution of the underlying dolomites and limestones. Farm supplies of water in the barrens are obtained largely from rain water that is caught from house or barn roofs and stored in cisterns. A few farmers have gone to the expense of drilling deep wells in order that they may have adequate supplies of water in these areas.

The Morrison soils, as well as the Morrison-Frankstown complex, occur in two major areas in Huntingdon County. They occur chiefly in the barrens of Nittany Valley, an area that overlies both the Mines dolomite and Gatesburg formations, which are mixtures of dolomite, shaly and sandy dolomites, and brown ferruginous sandstones. The other area is known as the barrens of Trough Creek Valley. Here, the soils are developed primarily from transitional members of lower Mauch Chunk red limestone and shale materials that have been disintegrated and laid down over exposures of the brown members of Pocono sandstone. The barrens of Nittany Valley are the oldest geological strata in Huntingdon County, and they are separated from the barrens to the south by more than 25,000 feet of geological strata. Geologically and mineralogically the parent soil materials of the two areas are not of the same origin, but the soils as developed have certain general characteristics that are similar.

The soils of both areas have two common characteristics. Both are sandy, and both have been thoroughly leached. Each occupies comparatively smooth low plateau areas, and the subsoils of both are reddish brown or yellowish red. At present both areas support a thick stand of scrub oak together with a few pitch pines that have survived repeated forest fires.

The original forest on the Morrison and Morrison-Frankstown soils was chestnut, white pine, chestnut oak, tuliptree, pitch pine, and other trees. Large stumps and charred trunks of dead chestnuts show that there was once an excellent growth of chestnut and white pine in this area previous to the days of lumbering and land clearing.

Repeated fires that have swept through the barrens have destroyed the organic matter and humus layers and have killed many of the young trees that otherwise might have produced good lumber. It will take a long time for the leaf litter to accumulate sufficiently to provide good moisture conditions and to furnish nutrients for the growth of trees.

The Morrison soils dominate the barrens of Nittany Valley, but there are also small areas of Dekalb and Leetonia soils and of the Morrison-Frankstown complex. Soils of the barrens of Trough Creek Valley are not exactly the same as those of the Nittany Valley, but they have been included with the Morrison soils chiefly because of similar topographic and land use characteristics. Although the underlying geological formations are different, the mineralogical contents of the soil materials are similar.

The iron deposits underlying many areas of the Morrison soils were of great commercial importance before the iron deposits of Minnesota and northern Michigan were discovered, and it was from these deposits that the iron ore was obtained during the early American iron age. One of the most important of the early ore pits was at Scotia, just beyond the Huntingdon-Centre County line and 4 miles west of State College.

The Morrison soils generally are not suitable for farming, although Morrison silt loam when liberally limed and fertilized is fairly productive.

Morrison silt loam.—The original humus layer and leaf litter on Morrison silt loam has been destroyed either by forest fires or by cultivation, and now the soil has the following characteristics:

(1) 0 to 3 inches, light brownish-gray very acid loose silt loam.
(2) 3 to 18 inches, pale brownish-yellow loose gritty silt loam, very thoroughly leached and strongly acid in reaction.
(3) 18 to 30 inches, soft sandy clay or clay loam, pinkish yellow grading to yellowish red or brownish red.
(4) 30 inches+, a yellowish-red mixture of silt, sand, and clay, held together by colloidal films of iron oxides and clays. The texture approximates sandy clay loam.

The subsoil has an imperfectly to poorly developed coarse-granular or small nutlike structure. When wet the soil is sticky and plastic and can be molded into a mass that will be hard and not easily broken when dry. The lower part of the subsoil, from a depth of about 3 feet downward, is a reddish-yellow or yellowish-red mixture of sand, silt, and clay in varying proportions. It is streaked and splotched with red, brown, black, and light gray and contains soft concretions of iron and manganese oxides that are either brown or black.

Although of minor extent, Morrison silt loam is the most productive soil in the Morrison series. Areas of this soil occur chiefly in the valleys of Little and Great Trough Creeks and to less extent in Nittany Valley. About half of the land has been cleared and used for cultivated crops, mainly buckwheat, corn, rye, and other small grains.

Trees on uncleared areas of Morrison silt loam are mainly red oak, scarlet oak, and white pine, and there is some pitch pine. Although the soil is best suited for forestry, it can also be used for farm crops if it receives plenty of lime, commercial fertilizers, and organic matter. It is the best of the Morrison soils for forestry.

Included with Morrison silt loam on the map are a few areas of Morrison loam. This inclusion in Nittany Valley occupies depressions. A few areas are cleared and used for cultivated crops, but their location is such that they warm late in the spring and are subject to early fall frosts. Crops are often damaged by frost. The surface soil of this inclusion ranges from 18 to 24 inches in thickness and is thicker than the average for the series.

Morrison sandy loam.—Morrison sandy loam occupies depressed areas of the barrens of Nittany Valley and comparatively flat ones in the barrens of Trough Creek Valley. In the latter areas the surface soil is brown or reddish brown and the subsoil is rather firm or compact. All the cleared areas of this soil are submarginal land. The soil is very sandy and loose and dries out rapidly after rains. Several of the areas in Nittany Valley, cleared or uncleared, are located in frost pockets, and frosts have been known to kill vegetation here as late as June and as early as the first week in September. Most of the uncleared land is occupied by scrub oak, pitch pine, and possibly tuliptree.

Morrison stony sandy loam.—Morrison stony sandy loam occupies the higher parts and a large proportion of the total area of the barrens (both north and south). The soil is typical of the Morrison series. It is very sandy and dries out rapidly. The areas in the barrens to the south are nearly flat, and the soil has a much better moisture-retaining capacity than in the barrens to the north. Stones scattered over the surface in the barrens of Trough Creek Valley range from 6 to 20 inches in diameter, but in the barrens of Nittany Valley they are not numerous, although huge rounded boulders, probably weighing from 2 to 10 tons each, are fairly common.

Practically all of this soil is covered by scrub oaks and a few pitch pines. Its future economic value is questionable. Nevertheless the land provides a safe retreat for wild game of all kinds, and in the near future the entire area will probably be used for propagation of wildlife. The supply of water, however, may limit the use of such areas for game preserves.

Morrison loamy fine sand.—This soil is not very extensive. It occupies almost flat areas that are comparatively free of stone. The surface soil is deep loamy fine sand. Except for Morrison stony loamy sand, it is about the poorest and most nearly worthless member of the Morrison series. Scrub oak and lowbush blueberries make up the vegetal cover.

Morrison stony loamy sand.—This soil is similar to Morrison loamy fine sand, but it occupies higher areas and has scattered over its surface numerous rounded sandstones and boulders that further depreciate its value. It is truly the most nearly worthless of all the Morrison soils. The vegetation consists largely of scrub oak, pitch pine, and lowbush blueberries.

Included on the map with Morrison stony loamy sand is a Podzol soil that is otherwise like the typical Morrison soil. The 3- or 4-inch light-gray sand surface layer of this inclusion overlies a layer, about half an inch thick, of coffee-brown material, and this in turn rests on a brownish-yellow subsurface layer extending to a depth of about 15 inches. Below this is a transitional layer, and at a depth of 18 or 20 inches the soil changes abruptly to yellowish-red loamy sand containing appreciable quantities of colloidal iron oxides and clays. From a depth of 2 feet downward there is little or no change in either the color or the texture. The vegetation is the same as on typical Morrison stony loamy sand.

Morrison-Frankstown complex.—Soils of the Morrison-Frankstown complex occur in the northwestern part of the county, in the barrens of Nittany Valley. Most of the soils in this locality are members of three series—Dekalb, Morrison, and Frankstown. Between the Morrison and Frankstown, however, there is a belt of soils that is not typical of either of those series, although they have some characteristics of both. These soils are mapped as the Morrison-Frankstown complex. They include loam, silt loam, and sandy loam types of both series.

Descriptions of Frankstown and Morrison soils have already been given. The intermediate soil has the following characteristics: The surface soil in most places is yellowish-gray mellow loam or sandy loam having no well-defined structure. Under a forest cover the surface soil is strongly acid. Most of the surface soil material to a depth of 12 to 20 inches appears to have been derived from fine-grained sandstone materials, and in this respect it resembles the surface soil of the Morrison soils. The subsoil below a depth of 15 to 20 inches in most places is brownish-yellow or light yellowish-brown compact tough plastic silty clay that generally has a puttylike consistence. It is strongly acid in reaction.

In many respects the lower subsoil layer is similar to the subsoils of the Frankstown soils, except there are very few if any large fragments of chert present in the lower part of the subsoil. The color of the subsoil varies from reddish brown to yellow. On top of low ridges, where internal drainage and oxidation are good, the lower part of the subsoil in many places is yellowish red; and in lower areas, where drainage is not so good, it is generally yellow. These variations are too numerous and have too intricate a pattern to be mapped separately on a small scale. The total depth of the Morrison-Frankstown soils ranges from 5 to 10 feet or more. These soils generally overlie the Stonehenge limestone, which is dolomitic, and the massive beds of Mines dolomite, which is very hard and contains appreciable quantities of fine-textured water-rounded quartz sand.

The Morrison-Frankstown soils complex occupies smooth to undulating areas. Surface drainage and subsoil drainage are good. Formerly these soils were covered by a dense forest consisting of white oak, red oak, chestnut, white pine, and pitch pine. Most of these trees were cut for lumber, then the areas were burned over repeatedly, and now the land not cultivated is occupied by scrub oaks.

These soils are more productive than most of the Morrison soils because they have much more clay in the subsoil, which provides for greater storage of soil moisture and plant nutrients.

In Centre County, near Pennsylvania State College, some farmers have been growing potatoes on these soils with considerable success where they applied liberal quantities of commercial fertilizers. One of the limiting factors in the use of this soil complex is its location. It occupies low areas in the interridge sags at the edges of the barrens, where frequently late spring or early fall frosts seriously damage crops.

About one-third of the total area of Morrison-Frankstown loams and silt loams has been cleared for cultivation; the rest is occupied by scrub oak and scattered pitch pine. Corn and wheat are the main crops grown on the cleared areas. Corn yields about 30 bushels an acre, and, when the soil is liberally fertilized, wheat yields from 12 to 15 bushels. Morrison-Frankstown sandy loams, also part of the complex, are not so useful agriculturally, and most of the small areas remain under a cover of scrub oak. Potatoes have been grown with some success, however, on this part of the complex near State College in Centre County, when heavy applications of fertilizer were made. These soils respond quickly to fertilization, and their agricultural value and usefulness are determined largely by the moisture-holding capacity.

A few areas of the Morrison-Frankstown complex contain fragments of weathered and rounded sandstone gravel or cobblestone. These areas are designated on the soil map by gravel and stone symbols, as in the area south of Huntingdon Furnace.

On the more rolling areas or steeper slopes where areas of sandy loams have been cleared and cultivated, erosion has been active in removing the surface soil. As the thickness of the sandy loam surface soil was reduced by erosion, plowing and cultivation brought up clays from the subsoil and mixed them with the sandy surface soil, giving rise to a sandy clay loam soil. The total area of this variation is small, and it is comparatively unimportant so far as agricultural usefulness is concerned.

ROUGH BROKEN AND ROUGH STONY LANDS

Rough broken and rough stony lands, as the names indicate, include those areas that are too steep and broken or too rough and stony to be suitable for cultivation. Most of the areas of these land types are in the mountainous parts of the county, but a few of them, aggregating a fairly large total area, are in the shale and limestone hills.

Rough broken land (Gilpin soil material).—This land type comprises the very steep and rough areas of Gilpin soils where the slope exceeds 30 percent. It includes almost vertical stream banks where raw shale is exposed. In many places there is no vegetative cover, but on some of the higher areas a stunted growth of oak and Virginia pine occurs. At the foot of the slopes where soil moisture conditions are more favorable there are some hemlock, maple, and yellow poplar trees.

The largest area is on Stone Creek Ridge.

Rough broken land (Calvin soil material).—This land type comprises areas of very steep slopes and almost vertical stream banks where the slopes are all greater than 40 percent. A number of the areas are located in the valleys of the Raystown Branch Juniata River and Sideling Hill Creek. The total accumulation of Calvin soil material in few places is more than a foot thick, and more than 70 percent of the soil mass consists of angular fragments of red or red and gray shale. The vegetative cover consists mainly of stunted Virginia pine, poverty grass, beggarweed and dewberry brambles. The land has no agricultural value and very little value for forest.

Rough stony land (Dekalb soil material).—This land type includes the rugged mountain crests and very steep slopes, practically all of which are covered by huge irregular-shaped sandstone blocks ranging in thickness from 2 to 10 feet (pl. 10, *B*). There is sufficient Dekalb soil material between and under the rocks of these areas to support a growth of trees, but on the whole the trees are not so thrifty as they are on the less stony areas. It is not feasible to clear away the large rocks and cultivate the soil, and, even if the forest trees were cut, the land would make exceedingly poor pasture. The best use of this land is for game preserves and hunting grounds.

Rough stony land (Leetonia soil material).—This land type includes rugged rocky mountain crests where nearly all of the land surface is covered by great blocks of sandstone or quartzite. In spite of the large number of rocks, there is sufficient soil material between them to support a forest cover, and profiles observed between the rocks are the same as those of typical Leetonia soils. The principal trees are chestnut oak, scarlet oak, scrub oak, and pitch pine. The land has little value for commercial forestry, but it is suitable for wildlife sanctuaries.

Rough stony land (Lehew soil material).—This land type includes areas of steep mountainous land that are covered almost completely by large and small blocks of red sandstone and shale. There is sufficient soil between the rocks to support a somewhat scrubby forest of scarlet oak, chestnut oak, and pitch pine, but the trees have little commercial value.

Rough stony land (limestone material).—This land type comprises very steep limestone bluffs and escarpments in the Little Juniata River gorge between Spruce Creek and Nealmont. There is so little soil material except in a few cracks and pockets in the limestone that the only vegetation is brush and a little grass. The land has practically no value for forestry, agriculture, or grazing.

MISCELLANEOUS LAND TYPE

Riverwash.—Riverwash includes low flood plain areas that are frequently inundated by floodwaters. It is a heterogeneous mixture of silt, sand, stone, and gravel that is sifted frequently by floods. Most of it is occupied by either weeds or trees, mostly willow, elm, and maple, and it has little or no agricultural value.

The largest body of this material borders Great Trough Creek.

PRODUCTIVITY RATINGS

In table 8 the soils of Huntingdon County are listed alphabetically and estimated average acre yields of the principal crops are given for each soil.

TABLE 8.—*Estimated range in acre yields of the principal crops on each soil in Huntingdon County, Pa., under prevailing practices of good management* [1]

Soils [2]	Corn	Wheat	Oats	Barley	Mixed clover and timothy hay	Alfalfa	Potatoes	Principal crops or land use
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Bushels*	
Amberson cobbly sandy loam	15–20				0 75–1. 25			Pasture, forest.
Amberson gravelly loam	15–25	10–15	12–18	15–25	75–1 25			Small grains, hay.
Amberson shale loam		5–10	10–15	10–15	.5 – 75			Hay, forest.
Amberson shaly silt loam	15–25	10–15	12–20	12–15	.75–1 25			Small grains, hay, forest.
Atkins silty clay loam								Forest, some pasture
Atkins clay								Do.
Atkins clay, high-bottom phase								Do.
Berks shale loam					5 – .75			Forest, pasture, hay.
Berks silt loam	25–35	15–20	25–35	20–40	1 5 –2 5	1 5 –2 5	100–150	Corn, small grains, hay.
Berks silt loam, heavy-subsoil phase	20–35	10–15	15–25	15–25	.75–1 5	.5 –1 25		Pasture, hay, forest.
Berks silt loam, rolling phase	15–25	10–15	15–25	15–30	.75–1 5	.75–1 5		Hay, forest.
Berks silt loam, shallow phase					.5 –1	.5 –1		Hay, pasture, forest
Buchanan cobbly loam					.25– 75			Forest, pasture, hay
Buchanan silt loam	25–35		15–25	15–30	1 5 –2			Corn, hay, small grains, forest.
Buchanan silt loam, shallow phase	20–30				.75–1			Hay, pasture, forest
Calvin cobbly silt loam	20–30	12–20	20–30	20–35	1 –1 75	1 –2		Corn, hay, small grains
Calvin gravelly silt loam	30–50	15–25	20–35	25–50	1 5 –2 5	1 –3	150–200	Corn, hay, small grains, potatoes.
Calvin gravelly silt loam, colluvial phase	40–60	20–30	25–35	35–50	1 5 –3		150–200	Corn, hay, pasture.
Calvin loam	30–50	15–25	20–40	25–50	1 5 –2 5	1 5 –2 5	150–200	Corn, hay, small grain
Calvin shale loam					5 – .75			Forest, pasture, hay.
Calvin shaly silt loam	15–30	12–20	20–30	20–35	1 –1 75	1 –1 5		Small grains, hay.
Calvin silt loam	30–50	15–25	20–40	25–40	1 5 –2. 5	1 –3	150–200	Corn, hay, small grains, potatoes.
Calvin-Edom gravelly silt loams	20–30	10–15	15–20	15–25	75–1 5	75–1		Small grains, hay, pasture.
Calvin-Edom shaly clay loams					5 – .75			Pasture, forest.
Calvin-Edom silt loams	20–30	12–18	20–25	15–25	.75–1 5			Small grains, hay, pasture.
Calvin-Edom silty clay loams					5 – .75	5 – .75		Pasture, hay.
Cassville silt loam	20–35	15–25	25–35	25–35	.75–1 5	1 5 –3	175–225	Corn, small grains, hay.
Clymer cobbly loam	20–35	12–18	18–35	15–30	.75–1		75–125	Forest, hay, corn, small grains.
Clymer gravelly loam	20–35	12–18	20–35	15–30	.75–1		75–125	Forest, corn, small grains, potatoes.
Clymer sandy loam								Pasture, forest.
Dekalb cobbly sandy loam								Forest.
Dekalb gravelly loam	15–30	10–15	20–35	20–30	75–1		75–125	Forest, some corn, potatoes, buckwheat.
Dekalb loamy sand	15–30			15–20				Forest, some corn, and small grains.
Dekalb shale loam								Forest.
Dekalb stony loam								Do.
Dekalb stony loamy sand								Do.

Dekalb stony sandy loam								Do.
Duffield sandy loam, rolling phase	25-35	15-25	20-30	25-35	1.25-2	1.75-2.75		Corn, hay, small grains, pasture.
Duffield silt loam	40-60	17-25	35-45	35-45	1.75-2	2.5 -3.5	150-200	Corn, small grains, mixed hay, alfalfa.
Duffield silt loam, rolling phase	20-35	12-20	20-30	25-35	1.25-2	2 -3		Do.
Duffield silty clay loam		15-20	20-30	20-30	.75-1.5	1.75-2.25		Hay, small grains, pasture.
Elk gravelly silt loam	40-50	20-35	30-50	25-35	1.75-2.25	1.5 -2.75	150-250	Corn, hay, vegetables, pasture.
Elk silt loam	45-60	20-35	30-50	30-40	1.75-2.5	1.5 -3	150-250	Corn, hay, fruit, vegetables.
Ernest cobbly loam								Pasture, forest.
Ernest gravelly silt loam					.75-1.25			Do.
Ernest silt loam					75-1.25			Pasture, hay, forest.
Ernest stony sandy loam								Forest.
Frankstown cherty silt loam	40-70	15-25	30-45	30-45	1.75-2.25	2.5 -3.5	100-175	Corn, small grains, hay, fruit.
Frankstown cherty silty clay loam	15-25	8-20	15-20		1 -1.5	1.5 -2 25		Corn, small grains, hay, pasture.
Frankstown cobbly silt loam	30-50	12-20	20-35	20-30				Corn, small grains, pasture, forest.
Gilpin cobbly silt loam	15-25	7-12	10-20	10-20	.75-1			Forest, hay.
Gilpin gravelly silt loam	25-40	12-20	15-25	20-35	.75-1.25		100-125	Corn, hay, small grains, buckwheat.
Gilpin shale loam		5-10	7-12	10-20	.5 - .75			Hay, forest.
Gilpin shaly silt loam	15-30	8-15	10-20	15-25	.5 -1			Corn, small grains, hay, forest.
Hagerstown clay loam					.75-1.5	1 -1.75		Pasture, hay.
Hagerstown silt loam	40-70	20-30	35-50	35-50	1.75-2.25	3 -4	150-200	Corn, wheat, clover, timothy, alfalfa.
Hagerstown silty clay loam	25-40	15-25	30-40	30-40	1 -2	1.5 -2.5		Corn, hay, small grains, pasture.
Hagerstown stony clay loam								Pasture.
Holston gravelly sandy loam	25-40	12-20	15-30	20-30	1 -1.5	2 -3	75-125	Small grains, hay, corn, potatoes.
Holston silt loam	35-50	15-30	30-40	35-50	1.5 -2	1.75-2.5	175-250	Corn, small grains, potatoes, vegetables.
Holston silt loam, high-terrace phase	20-40	12-20	20-30	20-35	.5 -1.25		125-200	Small grains, corn, hay.
Huntington fine sandy loam	30-50		25-35	30-40	1.5 -2	2 -3	150-200	Corn, pasture, hay, vegetables.
Huntington fine sandy loam, high-bottom phase	25-50	20-25	20-35	30-40	1 25-1.75	2 -3	200-300	Corn, alfalfa, vegetables, small grains.
Huntington silt loam	50-80	15-25	30-60	30-50	1.5 -2.25	3 -4	150-200	Corn, pasture, hay, vegetables
Huntington silt loam, colluvial phase	50-80				1.5 -3	2.5 -3		Corn, hay, vegetables, pasture
Huntington silt loam, high-bottom phase	50-70	25-35	40-60	30-50	1.5 -2.25	3 -3 5	200-300	Corn, pasture, hay, vegetables.
Laidig cobbly loam	15-20	8-20	15-20	15-30	.5 - .75			Hay, pasture, forest, idle.
Laidig gravelly loam	25-35	12-25	20-35	25-40	1.5 -2.5	1 -1.5	150-200	Corn, hay.
Laidig gravelly loam, shallow phase	15-30	12-18	15-25	15-25	1 -1.5		150-200	Small grains, hay.
Laidig loamy sand								Forest.
Laidig silt loam	30-35	15-25	25-35	30-40	1.5 -2.5	1 -1.5	150-250	Corn, hay, potatoes.
Laidig stony sandy loam								Forest.
Laidig stony loam								Do.
Leetonia stony fine sand								Do.
Leetonia stony sandy loam								Do.
Lehew shale loam								Do.
Lehew stony loam								Do.
Lehew-Dekalb stony loams								Do.
Lickdale stony sandy loam								Do.
Lickdale stony silt loam								Do.
Lindside silt loam	50-80				2 -3			Pasture, corn, hay, vegetables.
Lindside silty clay loam								Pasture, woodland.
Monongahela silt loam	20-40	12-20	20-25	20-35	1.25-1.75			Hay, small grains, corn.
Monongahela silty clay loam	20-40	10-15	15-20	18-30	.75-1.5			Hay, pasture.
Morrison loamy fine sand								Forest.

See footnotes at end of table.

TABLE 8.—*Estimated range in acre yields of the principal crops on each soil in Huntingdon County, Pa., under prevailing practices good management* [1]—Continued

Soils [2]	Corn	Wheat	Oats	Barley	Mixed clover and timothy hay	Alfalfa	Potatoes	Principal crops or land use
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Bushels*	
Morrison sandy loam								Forest.
Morrison silt loam	15–20	8–12	10–15	10–25	0.5–1		100–150	Corn, hay, forest
Morrison stony loamy sand								Forest.
Morrison stony sandy loam								Do
Morrison-Frankstown complex	20–35	10–15	15–25	15–25	.5–1		75–150	Forest, hay, small grains, corn, potatoes.
Moshannon sandy loam	35–50	10–20	20–30	25–35	1.25–2	1.5–2.5	150–200	Corn, pasture, hay
Moshannon silt loam	50–70	15–25	30–50	25–40	1.5–2	1.75–2.75	150–200	Corn, hay, small grains.
Moshannon silt loam, high-bottom phase	35–60	20–35	35–45	30–50	1.75–2.25	1.75–2.75	150–200	Corn, hay, small grains, potatoes, pasture
Murrill cobbly loam	45–70	15–30	25–40	35–50	1.75–2.5	2.75–3.5	150–225	Corn, hay, small grains, fruit
Murrill cobbly sandy loam, deep phase	40–65	18–25	20–35	25–40	2–2.5	2.75–3.5	150–225	Corn, hay, pasture
Murrill gravelly sandy loam, deep phase	40–65	15–25	20–35	25–40	2–2.5	2.75–3.5	150–225	Corn, hay, small grains, fruit
Murrill gravelly silt loam	50–70	20–30	30–40	35–50	2–2.5	2.75–3.5	150–250	Corn, clover, alfalfa, fruit.
Philo sandy loam	25–40				1–1.25			Hay, pasture.
Philo silt loam	30–50				1–1.75			Do
Philo silt loam, high-bottom phase	30–40	15–20	20–30	20–30	.75–1.25			Hay, pasture, corn, small grains.
Philo silty clay loam					.75–1			Pasture, hay, forest.
Pope sandy loam	30–50				1–1.5		150–200	Corn, hay, pasture.
Pope silt loam	40–60	15–30	35–50	35–50	1.75–2.5	1.75–2.75	150–200	Corn, pasture, hay, vegetables.
Pope silt loam, colluvial phase	30–50				1.5–2.5			Corn, hay, pasture.
Pope silt loam, high-bottom phase	40–60	15–30	35–60	30–50	1.5–2.5	1.75–2.5	150–225	Corn, small grains, hay, vegetables
Rayne cobbly silt loam	20–25	10–15	20–25	20–30	1–1.25		75–100	Corn, hay, forest.
Rayne gravelly silt loam	20–30	12–15	20–30	20–35	1–1.5		75–125	Corn, small grains, hay.
Rayne silt loam	25–35	15–20	20–35	25–40	1–2		100–200	Do.
Riverwash								Forest, pasture.
Rough broken land (Calvin soil material)								Forest
Rough broken land (Gilpin soil material)								Do.
Rough stony land (Dekalb soil material)								Do.
Rough stony land (Leetonia soil material)								Do.
Rough stony land (Lehew soil material)								Do.
Rough stony land (limestone material)								Pasture, forest.
Senecaville silty clay loam								Pasture.
Warners silt loam						[3] 2–3		Pasture, alfalfa, and vegetables (where drained).

[1] A four-year rotation of corn, oats, wheat, and hay is common. Lime is applied prior to the sowing of legumes. Corn and wheat commonly are fertilized with 200 to 300 pounds of 0-12-5, 2-12-4, or 16-percent superphosphate. Manure is commonly applied once in the rotation.
[2] Listed alphabetically. Where no yields are given, the crop is not commonly grown.
[3] This soil is suitable for alfalfa only if it is artificially drained.

The estimates in table 8 are based primarily on observations and interviews with farmers, the county agricultural agent, members of the staff of the Pennsylvania Agricultural Experiment Station, members of the staff of the College of Agriculture, and others who have had experience in the agriculture of the county. Because of a lack of specific data by soil types, the yields are presented only as estimates. It is also realized that the estimates may not apply directly to specific tracts of land for any particular year, since the soils, as shown on the map, vary slightly from place to place, management practices differ somewhat from those indicated, and climatic conditions fluctuate from year to year. The estimates apply to the yields obtained under the prevailing practices of management.

In order to compare directly the yields obtained in Huntingdon County with those obtained in other parts of the country, yields have been converted in table 9 to indexes based on standard yields. Two columns of indexes, A and B, are shown. The indexes in column A refer to yields obtained without the use of fertilizers; those in column B refer to the estimated yields obtained under the prevailing practices of good management, reported in table 8. (See footnote 1, table 8, and footnote 2, table 9.) The soils are listed in the approximate order of their general productivity for the crops commonly grown under the prevailing farming practices.

TABLE 9.—*Productivity ratings of the soils of Huntingdon County, Pa.*

Soil [1]	Crop productivity index [2] for— Corn (100=50 bu.) A	Corn B	Wheat (100=25 bu.) A	Wheat B	Oats (100=50 bu.) A	Oats B	Barley (100=40 bu.) A	Barley B	Mixed clover and timothy hay (100=2 tons) A	Mixed clover and timothy hay B	Alfalfa (100=4 tons) A	Alfalfa B	Potatoes (100=200 bu.) A	Potatoes B	Vegetables [3] A	Vegetables B	Apples (100=200 bu.) A	Apples B	Pasture (100=100 cow-acre-days [4]) A	Pasture B	General productivity grade [5] B	General statement
Huntington silt loam, high-bottom phase	100	120	95	105	90	95	90	100	95	100	80	85	90	120	90	100	90	100	90	95	1+	Very high productivity (excellent cropland). The weighted averages of the indexes in column B for corn, wheat, oats, mixed clover and timothy hay, alfalfa, potatoes, and pasture range from 90 to 106. All these soils are highly desirable for farming, as they are productive, easily worked, and not subject to serious erosion. Hazards of overflow and lodging of small grains are the principal limitations of the soils of the bottoms.
Huntington silt loam	100	130	85	90	85	90	85	90	95	100	80	90	80	90	90	100	----	----	100	110	1+	
Murrill gravelly silt loam	75	100	75	100	60	75	70	100	90	110	45	80	45	100	40	85	70	100	60	80	1	
Hagerstown silt loam	70	100	80	100	60	80	70	100	80	100	45	80	35	95	30	80	60	80	75	90	1	
Moshannon silt loam	100	110	90	95	85	90	70	85	85	95	40	60	70	95	70	90	----	----	70	90	1	
Duffield silt loam	70	100	75	95	60	80	70	100	85	100	45	80	45	100	40	80	60	80	70	85	1	
Elk silt loam	90	100	70	90	75	80	75	85	90	100	40	65	70	100	70	90	90	100	80	90	1	
Elk gravelly silt loam	85	95	70	90	70	75	70	80	90	100	40	65	70	100	70	90	90	100	80	90	1	
Moshannon silt loam, high-bottom phase	80	100	80	90	70	80	80	90	90	100	20	60	50	90	30	60	40	50	60	80	1	
Huntington fine sandy loam, high-bottom phase.	80	95	70	90	45	60	85	95	65	80	60	70	85	125	65	80	60	90	90	95	2	High productivity (good cropland). The weighted averages of the indexes in column B for the crops listed range from 70 to 90. These soils are also desirable for general farming, although certain limitations, such as imperfect drainage, chertiness, and hazard of overflow, are more pronounced.
Murrill cobbly sandy loam, deep phase	70	100	40	80	30	60	35	70	65	95	----	70	50	100	20	50	70	110	30	60	2	
Murrill cobbly loam	70	100	60	80	40	70	60	95	70	95	40	70	50	80	20	50	50	80	50	70	2	
Pope silt loam	80	90	60	80	60	80	70	90	90	100	30	60	50	80	60	80	----	----	80	90	2	
Frankstown cherty silt loam	65	85	65	85	55	75	70	90	90	100	45	75	40	70	30	50	65	85	60	75	2	
Murrill gravelly sandy loam, deep phase	70	100	30	70	20	60	40	70	65	95	----	70	60	100	----	50	70	110	20	50	2	
Pope silt loam, high-bottom phase	75	90	75	85	65	80	70	80	70	90	20	60	50	80	50	80	----	----	60	80	2	
Holston silt loam	70	90	70	80	60	70	65	90	70	90	10	60	50	95	50	80	70	90	60	80	2	
Calvin gravelly silt loam, colluvial phase	60	90	60	90	40	60	80	100	70	90	----	----	45	80	----	----	----	----	40	70	3	
Huntington fine sandy loam	80	95	----	----	50	60	70	80	80	90	70	80	60	80	75	90	----	----	95	100	3	
Lindside silt loam	100	130	----	----	----	----	----	----	100	110	----	----	----	----	70	80	----	----	100	120	3	
Huntington silt loam, colluvial phase	100	130	----	----	----	----	----	----	90	100	60	70	----	----	70	80	----	----	80	90	3	
Moshannon sandy loam	70	90	40	60	40	50	65	75	65	80	30	50	60	85	30	60	----	----	60	70	3	
Hagerstown silty clay loam	50	70	60	80	50	70	65	85	70	90	35	60	----	----	20	40	50	60	60	80	3	

Cassville silt loam	35	65	50	70	40	60	40	70	50	70	30	60	40	100	20	50	30	50	50	60	4	Moderate productivity (fair cropland). The weighted averages of the indexes range from 50 to 70. These soils, as a group, are less productive and less easily tilled than the soils listed above.
Calvin silt loam	40	65	40	70	30	65	40	70	50	80	10	50	35	80	20	30	----	30	25	50	4	
Calvin gravelly silt loam	40	65	40	70	30	60	40	70	50	80	10	40	35	80	20	30	----	30	25	50	4	
Calvin loam	40	65	35	65	25	60	45	65	50	80	----	45	35	80	----	20	----	30	20	40	4	
Laidig silt loam	35	65	40	65	30	55	60	80	65	90	----	30	50	85	20	50	30	40	15	30	4	
Berks silt loam	40	60	50	70	30	60	30	60	50	80	----	50	30	60	----	----	----	----	20	35	4	
Duffield silt loam, rolling phase	40	60	50	70	40	50	50	75	70	85	40	60	----	----	----	----	----	----	60	65	4	
Laidig gravelly loam	30	60	40	60	25	50	50	70	60	85	----	30	45	80	10	40	30	40	15	30	4	
Duffield sandy loam, rolling phase	40	60	40	70	40	55	55	65	65	75	35	60	----	----	----	----	----	----	50	60	4	
Holston gravelly sandy loam	50	65	50	60	40	50	40	60	50	60	10	55	30	50	30	60	40	50	60	70	5	
Monongahela silt loam	40	70	40	60	35	45	40	60	50	70	----	----	----	----	----	----	----	----	50	70	5	
Rayne silt loam	40	55	40	65	30	50	40	65	40	60	----	----	30	60	----	----	----	----	25	40	5	
Holston silt loam, high-terrace phase	40	60	40	60	30	50	40	60	30	50	----	----	30	70	----	----	20	50	40	50	5	
Philo silt loam	60	90	----	----	----	----	----	----	70	80	----	----	----	----	----	----	----	----	80	90	5	
Calvin-Edom silt loams	40	55	40	60	30	45	35	50	50	60	----	----	----	----	----	----	----	----	25	40	5	
Pope silt loam, colluvial phase	70	80	----	----	----	----	----	----	80	90	----	----	----	----	----	40	----	----	70	80	5	
Gilpin gravelly silt loam	35	60	30	60	20	35	30	55	40	55	----	----	15	70	----	----	----	----	20	30	5	
Philo silt loam, high-bottom phase	50	70	50	65	30	45	45	55	40	50	----	----	----	----	----	----	----	----	30	50	5	
Duffield silty clay loam	----	----	50	70	30	50	40	60	40	50	30	50	----	----	----	----	----	----	30	35	5	
Pope sandy loam	60	70	----	----	----	----	----	----	50	65	----	----	40	80	30	60	----	----	50	70	5	
Rayne gravelly silt loam	40	50	30	55	25	45	40	60	40	60	----	----	25	50	----	----	----	----	25	40	6	Moderate to low productivity (fair to poor cropland). The weighted averages of the indexes range from 30 to 50. Unfavorable soil characteristics lower productivity and increase the costs of production and conservation. The number of adapted crops is less than for the groups above.
Calvin cobbly silt loam	35	50	35	60	25	50	40	55	40	65	----	30	----	----	----	----	----	----	15	30	6	
Monongahela silty clay loam	30	60	30	45	30	40	30	50	50	65	----	----	----	----	----	----	----	----	40	60	6	
Calvin shaly silt loam	30	45	30	60	25	50	40	55	40	60	10	30	----	----	----	----	----	----	15	25	6	
Laidig gravelly loam, shallow phase	25	35	30	55	20	35	30	40	30	55	----	----	45	80	----	----	----	----	15	25	6	
Rayne cobbly silt loam	35	45	25	50	25	45	40	60	35	55	----	----	25	45	----	----	----	----	25	40	6	
Berks silt loam, heavy-subsoil phase	25	50	30	50	25	45	20	40	35	60	----	25	----	----	----	----	----	----	20	30	6	
Clymer gravelly loam	20	50	30	55	20	45	20	45	20	40	----	----	----	50	----	40	40	60	10	40	6	
Clymer cobbly loam	20	50	30	55	20	45	20	45	20	40	----	----	----	50	----	40	40	60	10	40	6	
Calvin-Edom gravelly silt loams	35	50	40	50	20	35	35	45	50	60	5	20	----	----	----	----	----	----	20	40	6	
Frankstown cobbly silt loam	50	70	40	55	35	50	30	55	----	----	----	----	----	----	----	----	30	40	40	50	6	
Berks silt loam, rolling phase	20	40	30	50	20	40	20	45	35	60	----	30	----	----	----	----	----	----	20	25	6	
Dekalb gravelly loam	20	40	30	50	30	50	40	55	30	40	----	----	20	50	----	----	----	----	----	30	6	
Morrison-Frankstown complex	20	50	25	45	20	40	30	45	20	40	----	----	20	50	----	30	----	----	----	15	6	
Buchanan silt loam	30	55	----	----	30	50	35	70	50	80	----	----	----	----	----	----	----	----	30	50	6	
Frankstown cherty silty clay loam	20	35	30	45	20	35	----	----	45	60	10	40	----	----	----	----	----	----	30	35	6	
Gilpin shaly silt loam	30	50	30	50	20	35	25	50	30	40	----	----	----	----	----	----	----	----	20	30	7	
Philo sandy loam	40	60	----	----	----	----	----	----	40	55	----	----	----	----	----	----	----	----	40	50	7	
Amberson gravelly loam	20	35	25	45	20	30	25	45	35	45	----	----	----	----	----	----	----	----	10	30	7	
Hagerstown clay loam	----	----	----	----	----	----	----	----	50	70	30	40	----	----	----	----	----	----	60	80	7	
Amberson shaly silt loam	20	40	30	45	20	35	20	35	35	45	----	----	----	----	----	----	----	----	10	30	7	
Morrison silt loam	15	35	10	35	10	25	25	40	10	35	----	----	20	60	----	----	----	----	----	25	7	
Laidig cobbly loam	20	35	25	40	20	35	25	40	20	35	----	----	----	----	----	----	----	----	10	20	7	
Gilpin cobbly silt loam	20	35	20	35	15	25	20	30	25	40	----	----	----	----	----	----	----	----	20	25	7	
Buchanan silt loam, shallow phase	25	45	----	----	----	----	----	----	30	40	----	----	----	----	----	----	----	----	10	15	7	

See footnotes at end of table.

TABLE 9.—*Productivity ratings of the soils of Huntingdon County, Pa.*—Continued

Soil [1]	Crop productivity index [2] for—																				General productivity grade [5]	General statement
	Corn (100=50 bu.)		Wheat (100=25 bu.)		Oats (100=50 bu.)		Barley (100=40 bu.)		Mixed clover and timothy hay (100=2 tons)		Alfalfa (100=4 tons)		Potatoes (100=200 bu.)		Vegetables [3]		Apples (100=200 bu.)		Pasture (100=100 cow-acre-days [4])			
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	B	
Ernest silt loam									30	50									40	60	8	Low productivity (poor cropland; generally better suited for pasture). Weighted averages of the indexes range from 10 to 30. Shallowness, gravel content, droughtiness, stoniness, steepness of slope, and imperfect drainage are some of the undesirable characteristics.
Philo silty clay loam									40	45									60	70	8	
Amberson cobbly sandy loam	20	35							20	40									10	15	8	
Ernest gravelly silt loam									25	45									35	40	8	
Amberson shale loam			15	25	15	25	15	30	20	35									10	20	8	
Berks silt loam, shallow phase									30	40		20							20	25	8	
Dekalb loamy sand		35						40													8	
Calvin-Edom silty clay loams									20	30		15							20	40	8	
Gilpin shale loam			10	25	15	20	20	30	15	30									5	10	8	
Hagerstown stony clay loam																			30	40	8	
Warners silt loam																			80	90	8	
Senecaville silty clay loam																			60	70	8	
Berks shale loam										30									15	20	8	
Calvin-Edom shaly clay loams									15	30									10	20	8	
Calvin shale loam										30									5	10	8	
Buchanan cobbly loam									20	25									20	25	8	
Lindside silty clay loam																			100	110	8	
Rough stony land (limestone material)																			20	25	9	

Clymer sandy loam																			10	15	10	Very low productivity for crop plants. Weighted averages of the indexes range from 0 to 10. These soils are best suited to the production of timber.
Laidig stony loam																					10	
Laidig stony sandy loam																					10	
Laidig loamy sand																					10	
Riverwash																					10	
Lehew-Dekalb stony loams																					10	
Morrison sandy loam																					10	
Ernest cobbly loam																					10	
Lehew stony loam																					10	
Dekalb stony sandy loam																					10	
Morrison stony sandy loam																					10	
Atkins silty clay loam																					10	
Lehew shale loam																					10	
Lickdale stony silt loam																					10	
Ernest stony sandy loam																					10	
Dekalb stony loam																					10	
Dekalb cobbly sandy loam																					10	
Dekalb shale loam																					10	
Lickdale stony sandy loam																					10	
Dekalb stony loamy sand																					10	
Morrison loamy fine sand																					10	
Atkins clay, high-bottom phase																					10	
Atkins clay																					10	
Morrison stony loamy sand																					10	
Rough stony land (Dekalb soil material)																					10	
Leetonia stony sandy loam																					10	
Rough stony land (Lehew soil material)																					10	
Leetonia stony fine sand																						
Rough broken land (Calvin soil material)																					10	
Rough broken land (Gilpin soil material)																					10	
Rough stony land (Leetonia soil material)																					10	

[1] Soil types, phases, complexes, and land types are arranged in the descending order of their general productivity for the common crops under prevailing practices of good management. Where no index is shown, the crop is not commonly grown.

[2] The soils are given indexes that indicate the estimated average production of each crop on each soil as a percentage of the standard. the standard has an index of 100 and represents the approximate average yield obtained without the use of amendments on the more extensive and better soil types of the regions of the United States in which the crop is most widely grown. The indexes in column A refer to estimated yields under management practices that do not include the use of commercial fertilizers or lime, and only sufficient manure to maintain soil productivity at a level comparable to that of the soil soon after it was first farmed. The indexes in column B refer to estimated yields under current good management practices that include the use of legumes in the rotation, commercial fertilizers, manure, lime, and some measures of erosion control, if needed.

[3] These indexes refer to vegetables in general, and 100 applies only to the most productive soil for vegetables in Huntingdon County.

[4] "Cow-acre-days" is a term used to express the carrying capacity or grazing value of pasture land. It represents the number of days per year that 1 acre will support 1 animal unit without injury to the pasture, or the product of the number of animal units to the acre multiplied by the number of days of grazing. The animal unit is a means of measuring the feed requirements of livestock. It is the equivalent of a mature cow, steer, or horse, or 5 hogs, or 7 sheep or goats. For example, a soil that would provide grazing for 1 cow or 1 animal unit per acre for 100 days of the year, or 2 cows or 2 animal units for 50 days, would rate 100; another soil that would provide grazing for 1 cow or 1 animal unit to 4 acres for 100 days of the year would rate 25. Data on the carrying capacity of soil types are lacking, and these indexes are only estimates

[5] The grade number indicates the general productivity of the soils and is determined by a weighted average of the productivity indexes for various crops as follows Corn, 25; wheat, 20; oats, 10; mixed clover and timothy hay, 20; alfalfa, 10; potatoes, 10, and pasture, 5. In certain instances where no index appears in the table for a given soil, an index of 20 was assumed in the calculations in order to obtain a more reasonable result When the weighted average is above 100, a grade of 1+ is assigned; when the weighted average is between 90 and 100, a grade of 1 is given; when it is between 80 and 90. a grade of 2 is given, and so on.

The rating compares the productivity of each of the soils for each crop to a standard of 100. This standard represents the approximate average yield obtained without the use of fertilizer and other amendments on the more extensive and better soils of the regions of the United States where the crop is most widely grown. An index of 50 indicates that the soil is about half as productive for the specified crop as is the soil with the standard index. The standard yield for each crop, except vegetables, shown in table 9 is given at the head of each respective column. Soils given amendments, such as commercial fertilizers and lime, or special practices, such as irrigation, and unusually productive soils may have productivity indexes of more than 100 for some crops.

Factors influencing the productivity of the land are mainly climate, soil (including drainage and relief), and management. No one of these factors operates separately from the others, although some one may dominate. Yields of crops over a long period of years furnish the best available summation of these factors contributing to productivity, and they are used whenever available. Productivity tables cannot present the relative roles that separate soil areas play in the agriculture of the county, because of the variable associations in which they occur. The tables give a characterization to the productivity of individual soil types and phases. They cannot picture the total quantitative production of crops by soil areas without the additional knowledge of the acreage of the individual soil types used for each of the specified crops. Economic considerations play no part in determining the productivity ratings; therefore the ratings cannot be interpreted directly into land values, except in a very general way. Distance to market, relative prices of farm products, and other factors influence the value of land.

General productivity grade numbers are assigned in the column "General productivity grade." This grade is based on a weighted average of the indexes for the various crops, as indicated in footnote 5, table 9, the weighting depending on the relative acreage and value of the crops. Since it is difficult to measure mathematically either the exact significance of a crop in the agriculture of an area or the importance or suitability of certain soils for particular crops, perhaps too much significance may be given to the order in which the soils are listed.

It is important to realize that productivity, as measured by yields, is not the only consideration that determines the relative worth of a soil for growing crops. The ease or difficulty of tillage and the ease or difficulty with which productivity is maintained are examples of considerations other than productivity that influence the general desirability of a soil for agricultural use. In turn, steepness of slope, absence or presence of stone, resistance to tillage offered by the soil because of its consistence or structure, and size and shape of areas are characteristics of soils that influence the relative ease with which they can be tilled. Likewise, inherent fertility and susceptibility to erosion are characteristics that affect the ease of maintaining soil productivity at a given level. Productivity, as measured by yields, is influenced to some degree by all these and other factors, such as moisture-holding capacity of the soil and its permeability to roots and water. These factors, therefore, should not be considered entirely separately from productivity. On the other hand, methods of land evaluation or classification to designate the relative suitability of land for agricultural use must give some recognition to such factors. In the right-hand column of table 9 a few summary statements are given regarding the relative productivity and desirability for use of the soils of Huntingdon County.

LAND USES AND SOIL MANAGEMENT

LAND USES

The suitability of land for the growing of cultivated crops is determined largely by its productivity, workability, and conservability; and these, in turn, depend largely on (1) steepness of slope; (2) thickness of soil over rock, gravel, sand, impervious clay, or other unfavorable substratum; (3) soil texture and content of stone, gravel, chert, shale, etc.; (4) drainage and moisture-holding capacity of the soil; (5) soil fertility; (6) structure, consistence, and permeability of the soil; (7) climate; and (8) the response of the soil to management practices. Economic conditions, however, may overshadow the significance of these physical characteristics of the land, and in many places the location and pattern or distribution of soils are determining factors in land use.

More than 60 percent of the area of Huntingdon County is steep, rugged, and stony mountainous land, which, because of steepness of slope and quantity of stone throughout the soil, does not lend itself to clearing and cultivation. In general, the line between forested land and cultivated land, as it now exists throughout the county, marks the boundary between steep, stony land and land that can be cultivated; that is, the clearing of land stopped where the soils were too steep or too stony for cultivation.

From a study of soils now under forest and others in cleared areas, it appears evident that the average depth of the soils over bedrock was considerably greater before the land was cleared—probably 30 inches or more in most places. When the land was first cleared the depth of most soils was sufficient to allow plowing and cultivation and to provide sufficient storage of soil moisture for crops. In general, the soils of the limestone valleys and alluvial flood plains were deepest, the soils of the mountains were next in order of depth, and the soils of the shale hills were the shallowest. The lands and forests of Huntingdon County have now been subjected to the white man's extravagant use and wastefulness for the brief period of less than 100 years. The stony lands of the forested areas retain most of their original soil, but most of the cultivated lands have undergone the ravages of soil erosion. The soils of the shale hills have been injured the most. So-called ghost farms and fields of scrub pine are evidence of the white man's extravagant use of the soil. In general, land is not abandoned unless the soil is so shallow or so stony that plowing is very difficult or productivity so low that it does not return the cost of growing crops. The actual depth of soil in many of the abandoned areas is now less than 8 inches.

In the past, steepness of slope did not always discourage cultivation, and much of the steeper land of the shale hills that should have

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remained under the protection of a forest or grass cover was placed under cultivation. Erosion has reduced many of the steeper cultivated areas to land that has little or no value for the production of cultivated crops, pasture plants, or forest trees.

Throughout Huntingdon County natural drainage of most soils is excessive rather than insufficient. Where runoff from cultivated lands is excessive it induces destructive soil erosion. Practically all of the soils of the uplands have either good or excessive soil drainage, and drainage in itself is rarely a limiting factor in the use of the uplands. In the valleys many of the soils of the alluvial flood plains are either imperfectly or poorly drained, and on these soils drainage does affect land use. Some of the soils of the flood plains would be more valuable if they had better subsoil drainage, and the drainage of these soils in many places can be improved by use of open ditches or tile drains. The water-holding capacity of many of the shallower, stonier, and sandier soils is so low that it limits the growth of vegetation on them.

The fertility level of a large proportion of the soils of the uplands is below the demands of most of the crops that are now grown on these soils. Naturally, the soil fertility problem is ever before the farmers of the area, and the better farmers apply lime and fertilizer liberally to most soils for most crops. The soils of the limestone valleys are by far the most fertile soils of the uplands, and it is on them that farmers are most prosperous. The farming operations are centered mainly around dairying. The soils of the shale hills are very low in fertility and are shallow and erodible, and agriculture on most of them is not prosperous. The well-drained soils of the alluvial flood plains are the most fertile and most productive soils in the county. These soils are used mainly for the production of corn or as pasture land. Where overflow or flooding is frequent, the land is generally used for pasture, which produces ample and good grazing for livestock. Apparently few if any of the areas of alluvial soil can be economically protected from overflows or flooding. The flood of 1936 inundated large areas of bottom lands, and protection of alluvial soils against such floods would be practically impossible.

Climatic conditions in Huntingdon County are not always favorable for crops that require a long growing season. In addition, perennial crops must be hardy if they are to survive the cold winters and frosts. Early-maturing varieties of corn, hardy varieties of alfalfa, clover; and barley, and rust- and smut-resistant varieties of small grains should be selected if maximum production of crops is to be expected. Peaches escape winter-killing of buds only about 1 year out of 3.

Geographic and economic conditions, including distance from city markets, have also affected land use in Huntingdon County. In the early history of the area agricultural production was centered around the marketing of small grains, livestock, and livestock products. Now agricultural production is centered around the production of fluid milk, which, because of modern refrigeration and rapid transportation, can be marketed daily in the large eastern city markets. What the future trend in land use will be no one knows, but it seems probable that interest in forestry will increase in the near future.

There are thousands of acres of abandoned land that are not suitable for any use except forestry or the propagation of wildlife. The development of hydroelectric power and the manufacture of forest products may also become important in this region. Along with these developments will probably come increased numbers of recreational farms and summer outing camps and cottages, as there are great possibilities for this type of land use and development.

In brief, there are few land areas, irrespective of roughness or ruggedness, that have no economic use. In fact, valuable mineral materials, mainly stone for silica brick, sand for glassmaking, and coal, are obtained from the most rugged mountains in the county. Forest products can be produced in the mountains, and agricultural crops may be produced on the more level and more fertile valley lands. Both coal and water for power development are cheap and abundant. An intelligent and well-planned use of the county's land resources will go far toward the preservation and maintenance of a stable and prosperous type of agriculture within its boundaries.

The present use of cleared land in Huntingdon County is the result of a long period of trial-and-error experimentation by farmers in an attempt to find the most profitable use for the many different kinds of soils. In general the soils and the climate of Huntingdon County will not allow the production of a great variety of crops; but the soils will produce the major food and feed crops needed by man and animals. These crops are mainly corn, wheat, oats, rye, barley, buckwheat, potatoes, fruits, vegetables, clover, timothy, bluegrass and other pasture grasses, and, to less extent, alfalfa, sweetclover, and miscellaneous crops that require more specific soil conditions. Soil conditions alone do not determine land use and type of farming. Other factors, such as markets, transportation facilities, climate, length of growing season, or presence of plant diseases, insects, and parasites, may control the number or kinds of crops that may be grown in a given area. In this county transportation and markets have had a very important influence in determining farming types and kinds of crops grown. The kind of soil has also had a very important influence on the economic production of the major crops, and in general the most profitable production of crops is on the more level soils of the limestone valleys and alluvial flood plains.

TYPES OF FARMING

The more important types of farming or farm occupations may be classified as follows: (1) Dairying, (2) livestock farming, (3) general farming, (4) subsistence farming, (5) fruit growing, (6) market gardening, (7) poultry farming, and (8) recreational or part-time farming.

Approximately 80 percent of the farmers are dairy farmers. They are engaged mainly in the production of fluid milk that is marketed daily in eastern cities. Their farms may be classed as dairy farms, because the entire farm enterprise is set up and organized for the production of dairy products, mainly fluid milk.

The dairy cow requires large quantities of feed, both in winter and in summer, and the farmer grows those crops and pasture grasses that will give the most and best balanced feed for the dairy cow. If his soils are not naturally adapted to the production of certain necessary feed crops, he either buys these feeds or amends his soils by adding the lime and fertilizers needed for the production of such crops. The soils of the uplands and many of the alluvial soils are naturally deficient in lime, phosphorus, and organic matter; and dairy farming fits into the soil-improvement schemes that must be followed if the crop-producing powers of the soils are to be retained at fertility levels that allow the most economical production of crops. Approximately 80 percent of the dairy farms are located on the soils of the limestone valleys, where maximum crop production may be obtained at the lowest cost per unit of product.

Few of the farms may be classed as livestock farms. There are a few farmers, however, who are engaged primarily in the production of cattle and sheep. Most of the livestock farms are in upper Stone Creek Valley, where the production of sheep is profitable if sheep-killing dogs are controlled.

General farming with the production of both crops and livestock for sale is of minor importance. Most of the farms that would come under this class are in Aughwick Valley and in the vicinity of Alexandria and Petersburg, where a greater proportion of the farm unit is used for the production of corn or grain crops.

Probably 10 percent or more of the farms might be called subsistence farms. They are operated by families who seek to cut the cost of living by staying in rural sections where they are occupying some of the poorer farms. The women and children are usually engaged in the production of poultry products and vegetable crops, while the men are employed temporarily or for part time in brick plants, coal mines, shops, factories, and mills or on highway construction.

There are not more than 8 or 10 fruit growers or market gardeners in the entire county. The main fruit crop is apples, which are grown mainly on the higher levels of Warrior Ridge west of Huntingdon. The growing of vegetables is limited to the better watered and very fertile soils of the stream valleys, mainly near Ardenheim and Warriors Mark.

There are very few strictly poultry farms in Huntingdon County. Most of these farms are in the central part of the county, and the products can be readily marketed in the larger towns or shipped to eastern cities.

A type of farm operator, now becoming more numerous in Huntingdon County, might be called a recreational part-time farmer or city-country farmer. Improved highways, together with the short-week labor law, are encouraging an increasing number of city people to drive to the country for 2 or 3 days of each week during the growing season. Huntingdon County is only 1 to 3 hours distant from several large cities. A number of people from large cities have purchased tracts of land in this county to which they may retreat in summer for outdoor recreation, and at the same time some of them grow vegetables, fruits, flowers, evergreens, ornamental shrubbery, and trees and propagate fish and wildlife. The range in size of these recreational farms is great—from 2 to as much as 3,000 acres—depending on location, value of land, and type of land cover. Many of them border either the mountainous areas or the water fronts of the larger streams.

CROP ROTATION

The systems of crop rotation followed by the farmers in this county reflect the need for food crops, the ever-present need for feed crops for dairy cattle, and the need for improved soil fertility. The more important crop rotations are (1) the standard Pennsylvania 4-year rotation (corn, oats, wheat, hay); (2) a 3-year rotation (corn, barley, hay); (3) a 2-year rotation (potatoes, legumes); and (4) a 6-year rotation (corn, barley, alfalfa), in which alfalfa occupies the land 4 years. The choice of a system of rotation is usually determined either by the needs of the farmer or by the kind of soil that predominates on any given farm unit. In general the Pennsylvania standard 4-year rotation is by far the most popular. On some of the better farms of the limestone valleys and the alluvial flood plains, however, the introduction of alfalfa has lengthened the rotation to 6 years. Where the dairy farmer needs more silage corn and less small grain the 3-year rotation is becoming more popular, and the 2-year rotation is employed where the farmer is interested in the production of special crops like potatoes or vegetables.

The standard Pennsylvania 4-year rotation represents a long-time adjustment of the production of crops to the soil and market conditions. Normally this is a corn, oats, wheat, hay rotation, but there are slight variations, depending on seasons, soil condition, and personal preferences of farmers, as follows: (1) Corn, wheat, wheat, clover and timothy hay; (2) corn, oats, wheat, clover and timothy hay; and (3) corn, barley, wheat, clover and timothy hay.

If the corn is cut for silage, wheat may be sown immediately after the corn is removed; if the corn matures late and is cut late, then corn may be followed by oats or barley the next spring. Recently barley has become more popular. Barley may be planted in either fall or spring, and it yields as much as or more than oats.

In this rotation corn is planted on hay sod that has been plowed either in late fall or early spring. Where manure is available, it is often spread on the sod before it is plowed. The seedbed for corn is usually prepared by thoroughly pulverizing and loosening the soil with either a spring-tooth harrow or a rotary disk harrow. The corn is usually surface planted, and it may or may not be checkrowed. It is cultivated three or four times. Many farmers formerly cultivated their corn too deep. Now the better farmers are using cultivators equipped with six or more shovels and are cultivating shallower, thereby causing less injury to the corn roots. Experiments have shown that the main value of cultivation is for control of weeds, but the breaking up of a hard surface soil crust, which sometimes forms after heavy rains, may also be desirable (*29*).

If wheat or winter barley follows corn, the corn must be cut as early as possible in the fall. The seedbed for wheat or barley is prepared by either thoroughly disking or plowing and harrowing the corn-stubble ground; then the wheat is planted about the first of October. The hessian fly is present in the region, and wheat planting dates are usually deferred until after this insect is supposed to have gone into winter hibernation. Much of the wheat in this county is sown in late September or during the first week of October.

After the wheat is harvested the following summer, the wheat-stubble land is plowed and prepared for the second year of small grain, usually wheat. If lime is to be applied, it is commonly spread on the soil during August or September before the second crop of wheat is sowed. The application of lime at this time allows it to work into the soil before the seedings of clover and timothy. Rather heavy applications (200 to 300 pounds) of commercial fertilizer (superphosphate or 2–12–4) are usually applied with the second planting of wheat.

Timothy is sown soon after or at the time the second crop of wheat is sown, at the rate of 4 to 6 quarts of seed to the acre. The timothy seeds germinate in early fall, and the young plants start growth along with the wheat during the fall and winter. During the late winter or early spring, red or alsike clover seed or a mixture of both is sown by hand or by a seeder over the wheat and timothy at the rate of about 6 pounds to the acre. It is generally recognized that alsike clover is better adapted than red clover to the soils of the shale hills, mainly because alsike clover is more tolerant of the lower fertility and of the wetter conditions that may exist in these shallower soils in the winter and early spring.

After the second crop of wheat is harvested, the timothy and clover grow more rapidly, and if soil moisture is sufficient they provide a thick cover by early August. If there is much growth of weeds the stubble land is clipped with a mower in early August, after which the clover and timothy provide appreciable quantities of pasturage for livestock during late August, September, and October.

The following year the clover and timothy are cut for hay. The second growth of clover may be cut for hay, may be allowed to produce seed, or may be used for pasture. Late that fall or the following spring the hay sod land is plowed and the land is prepared for the planting of corn, thus completing the 4-year rotation.

The 3-year crop rotation might be called the dairyman's rotation, as 1 year of small grain is dropped from the standard 4-year rotation, and by so doing the production of corn and hay is increased. The rotation is essentially corn, wheat, and hay, but it may be corn, barley, and hay or corn, oats, and hay. In this rotation lime and fertilizers are applied liberally to the soil previous to the planting of the small-grain crop, which may be either wheat, oats, or barley. The hay crop, which is mainly clover and timothy, is sown with the small grain. The timothy is sown in the fall and the clover in late winter or early spring. In this rotation the manure is usually applied to the sod land just before the land is plowed and prepared for the planting of corn.

The 2-year rotation is used primarily by those who grow potatoes or vegetables. In this rotation a rotation of small grain and red clover or small grain and sweetclover or some other legume is practiced for the purpose of adding organic matter and nitrogen to the soil. Other mixed plantings of soil-improvement crops may also be used. These mixtures may be (1) clover, timothy, and wheat or rye; (2) rye and vetch; (3) soybeans; (4) soybeans and millet; or (5) cowpeas and millet. Where erosion is a problem some potato growers are changing to a 3-year rotation of potatoes, grain, and hay. By lengthening the rotation, the period of clean cultivation occurs less frequently and the soil is protected longer by noncultivated crops.

The 6-year rotation is essentially one of corn, small grain, and alfalfa, in which alfalfa occupies the land 4 years. The acreage of alfalfa in Huntingdon County has been increasing, and the present trend is toward a continued increase. This is a valuable legume that not only is an important soil-improvement crop but also produces valuable hay, which is in great demand as feed for livestock, especially dairy cows.

Many of the soils are too acid or too low in natural fertility or have too low moisture-holding capacity for profitable production of alfalfa, and up to the present time alfalfa production is limited to the limestone valleys and the well-drained alluvial soils along the major streams. Heavy applications of both lime and phosphate fertilizer are essential if maximum production of alfalfa is to be obtained, even on the better soils.

In the 6-year rotation, the lime and phosphate fertilizer are applied to the soil before or at the time the small grain is sown. If wheat or winter barley is used in the rotation, the lime and fertilizer are applied before the fall seeding of this crop. The alfalfa is then sown in the wheat or barley in early spring. If oats or spring barley is used in the rotation, the alfalfa is generally sown with the grain in early spring. The lime is usually applied in the fall or winter, and the fertilizer is applied when the small grain and alfalfa are planted in the spring. Where alfalfa is to follow the small-grain crop, from one-third to one-half of the normal quantity of seed is sown. The reduction of the stand of small grain gives the alfalfa seedlings more sunlight and a better chance for growth in the spring.

After the small grain is harvested, alfalfa comes on and becomes well established by early fall. The small-grain stubble provides winter protection for the alfalfa the first winter, and this is an important item in getting alfalfa established in an area where winter-killing by frost and soil heaving is common.

In this rotation the alfalfa is started the second year of the rotation and is in production the third, fourth, fifth, and sixth years. After this the land is plowed and prepared for corn, and the 6-year rotation is completed. Manure is often applied to the sod land before it is plowed for corn.

CROPS, VARIETIES, AND CULTURE

The more important crops grown in Huntingdon County are those that are well adapted to the soils and climate and that supply either the feed requirements of livestock, mainly dairy cattle, or the food requirements of man. The more important field crops are corn, wheat, oats, rye, barley, buckwheat, potatoes, alfalfa, clover, sweetclover, timothy, soybeans, and millet. The more important pasture grasses are Kentucky bluegrass, Canada bluegrass, white clover, redtop, orchard grass, meadow fescue, and ryegrass, and there are small amounts of alsike clover, Sudan grass, and some other grasses. Soil-improvement crops have recently received more consideration than in the past. Fruits, potatoes, and vegetables are minor crops.

Corn is one of the major cereal crops that is grown in nearly all crop rotations. Production is limited, however, largely to those soils that are comparatively deep and occupy reasonably level areas, because corn is a long-season crop and requires greater quantities of water than can be supplied by shallow soils during prolonged dry periods. The production of corn should be limited to soils that are at least 2 feet deep. On the more sloping areas the growing of corn introduces serious losses from soil erosion. Corn rows should, wherever possible, be across rather than up and down the slope. Contour cultivation reduces runoff, increases the moisture-storage capacity, and reduces soil erosion.

Corn is usually grown on plowed sod land, and barnyard manure is often applied to the sod before it is plowed. A well-prepared seedbed is always important. The soil should be well disked, thoroughly pulverized, and freed from clods before the crop is planted. This will eliminate additional or deep cultivation after the corn starts growth. Commercial fertilizer (2–12–4) or superphosphate is usually applied at the rate of 150 to 200 pounds to the acre in the hill or row at the time the corn is planted.

Cultivation of corn should not be more frequent than is necessary to control weeds or break up soil crusts formed after heavy rains (*29*). Cultivation should be shallow rather than deep. Deep cultivation usually does more harm than good, because it tears off too many corn roots, thereby reducing production. This is especially true with regard to the shallower soils.

The more important varieties of corn grown in this region may be classed under two headings, (1) grain-producing varieties and (2) forage or silage varieties. The most productive grain-producing varieties are Early Clarage, Improved Pennsylvania Leaming, and Smith White Cap or College White Cap. All these varieties mature in 95 to 100 days, and each is the product of selections that have been made from longer season types of similar names that are grown at lower elevations and in warmer areas to the east of Huntingdon County.

The more important forage or silage varieties are Lancaster Sure Crop, 100-Day Bristol, and College White Cap (*31*).

The yield of corn varies greatly with different soil types, the depth of soil, and the fertility level of the soil. In general, yields of 60 to 70 bushels an acre are obtained on comparatively level areas of the deep Huntington, Frankstown, Murrill, Elk, Pope, Moshannon, and Hagerstown soils. The lowest yields are obtained on shallow soils over shale, which dry out quickly in midsummer and do not supply sufficient moisture for the corn crop during July and August.

Yields of corn on the better soils of the limestone valleys commonly range from 35 to 70 bushels an acre; whereas on the soils of the shale hills they range from 10 to 40 bushels, probably averaging between 20 and 25 bushels on those soils that are 2 feet deep or more. The production of corn in the shale hills where the soil is less than 2 feet deep should be discouraged, because the yields are very low and cultivation of such shallow soils merely accelerates erosion and brings about ultimate ruin and abandonment of shallow soil areas.

Like corn, wheat is one of the major crops in the more common rotations. Wheat matures early in the growing season, before soil moisture becomes deficient, and this is one of the principal reasons it is grown on practically all of the cultivated soils. Wheat usually follows either a small grain (wheat, oats, or barley) or corn in the crop rotations. Where wheat follows corn, the seedbed for wheat is prepared by either disking or plowing, depending on soil conditions. Where there is a heavy growth of weeds, plowing may be necessary to cover the weeds; otherwise deep disking is an excellent method and is commonly used for preparing a seedbed for wheat on land previously in corn.

Where wheat follows wheat, oats, or barley, the stubble ground is always plowed as soon as possible after the crop is removed. Manure may or may not be spread on the stubble ground before plowing. Commercial fertilizers are almost universally applied with the wheat at the time of planting at rates that range from 150 to 300 pounds an acre. Superphosphate and 0–12–5 or 2–12–4 commercial fertilizers are most popular.

Wheat is usually seeded at or immediately after the time that the hessian fly goes into winter hibernation. The fly-free sowing date in Huntingdon County varies, but usually it is in late September or early October. For the fly-free date wheat growers should always consult the local county agricultural agent or the Pennsylvania State College extension specialists who make a special study of the habits of the hessian fly.

Yields of wheat either with or without fertilizer are always higher on soils of the limestone valleys, mainly on Hagerstown, Frankstown, and Duffield soils, than elsewhere. On these soils, yields commonly range from 15 to 25 bushels an acre and maximum yields with fertilizer on the best soils sometimes approach 40 bushels. On the soils of the shale hills, yields commonly range from 5 to 15 bushels an acre and rarely exceed 20 bushels on the best soils. The average for the entire county in 1939 was about 17 bushels because of the low yields on many acres of shallow soils of the shale hills.

All the wheat grown in this county may be classed as soft winter wheat. Very little if any spring wheat is grown. The outstanding and most productive varieties are Pennsylvania 44 and Fulcaster, the soft-bearded varieties, and Leap (Leap Prolific) and Forward, the soft beardless or smooth varieties. Pennsylvania 44 is probably the best wheat for the area, as it produces maximum yields of high-quality wheat.

A rather large proportion of the wheat is sold to local mills, where it is ground into flour and other wheat products.

The total production of oats in Huntingdon County is gradually decreasing, mainly because of comparatively low yields of poor-quality oats. In many instances low yields can be traced to the use of poor-quality or diseased (smutty) seed. Many farmers go to the local markets and buy western oats for feed. When oat-planting time arrives they too often plant these same oats, which are not well adapted to either the soils or the climate of Pennsylvania. The farmers of Huntingdon County could easily increase both the yields and the quality of oats by using a good quality of seed of the Patterson, Keystone, or Cornellian varieties. Pennsylvania State College is also in a position to supply one or two new varieties of oats that are smut-resistant.

At present oats are grown partly as a nurse crop for alfalfa or clover, and for this reason the farmers are not always concerned about yields of oats. When oats are used as a nurse crop the rate of seeding is reduced from one-third to one-half of the quantity that is normally sown for the production of grain. Practically all of the grain produced is used for feed on the farm where it is grown, and little, if any, enters the grain markets. Many farmers buy oats from outside of the county for feed.

Rye is an important crop on the poorer lands, mainly on the shallow soils of the shale hills. Rye has given both better growth and greater yields of grain than wheat on the shallower and less fertile soils.

Rye is frequently sown on disked cornland in the fall after the corn is cut. The seeding dates are usually earlier than those for wheat, because the hessian fly does little damage to rye. Rye may be sown any time after the first of September and usually covers the soil before cold weather sets in. Clover and timothy are not often sown with rye but more commonly with wheat, oats, or barley. There are no leading varieties of rye. In general the farmers grow what they call "common rye." Where the farmer is interested in planting a good variety, he usually obtains Rosen.

The total acreage of barley has been increasing in recent years, mainly because yields of barley are a little higher than those of oats. Barley also ripens earlier than oats, and therefore it is a better nurse crop for the grasses or hay crops that follow. Recently winter barley is replacing wheat in a few places. It can be sown earlier in the fall because the hessian fly does little or no damage to barley, it matures earlier, it returns higher yields than wheat, and the grain makes as good or better feed for most livestock than either wheat or oats. The best yielding winter barleys are Tennessee Winter and Kentucky No. 1, both of which are six-row barleys. York Hooded (Dummer's Beardless), a six-row winter barley, is receiving some attention because of its lack of beards, and it is also a good yielding variety. The spring barleys are mainly Wisconsin Pedigree 38 and Comfort, both of which are smooth-awn varieties. The smut diseases attack barley, and all barley seed should be treated for smut before it is planted.

In general, buckwheat is a poor-land crop. It is usually grown on the shallow Gilpin, Amberson, Calvin, and Dekalb soils. It matures quickly and commonly serves as a catch crop that can be used where other crops fail. It is usually planted in late June or during the first part of July and matures in September. Buckwheat yields from 8 to 20 bushels an acre and probably averages about 13 bushels. Most of the buckwheat is cut with grain binders and shocked in the field. Later it is threshed and the grain is either used for livestock feed or sold to local mills where it is ground into buckwheat flour.

Soybeans (*13*) can be grown on medium-acid soils and therefore on practically all of the cultivated soils of the county. However, they are grown mostly on the soils of the limestone valleys, where they are less affected by a deficiency of moisture in midsummer. They sometimes take the place of oats in the 4-year rotation where the soil is too wet for sowing oats in early spring. Wheat may follow soybeans in the fall. Most of the soybeans are cut for hay rather than allowed to mature and be harvested for seed. Soybeans, like many legumes, should be inoculated with nitrogen-fixing legume bacteria before or at the time of planting if maximum yields are to be obtained. Soybeans also respond to phosphate fertilizers where phosphorus is deficient in the soil. Lime is not essential for the production of soybeans but does increase yields on the more acid soils.

Alfalfa (*15*, *16*) is becoming more popular each year. Yields of alfalfa, however, are nearly everywhere restricted by soil conditions. Normally this crop demands a deep well-drained soil that is not distinctly acid and is well supplied with calcium, magnesium, phosphorus, and sulfur. Nearly every soil in Huntingdon County is deficient in these nutritional elements. The Huntington soils come the nearest to having the necessary qualifications, but, unfortunately, the total area of Huntington soils is very small. The soils of the limestone valleys are next nearest to being ideal soils for alfalfa, but they are generally deficient in calcium and phosphorus and commonly are too acid unless they have been limed. They are generally fairly deep and well drained, and if plenty of lime and phosphorus is applied alfalfa can be grown on them with considerable success.

In growing alfalfa it is very important to obtain hardy varieties from States where the winters are as cold as or colder than those of Pennsylvania. Northwestern-grown and Grimm varieties have proved most reliable for soil conditions in central Pennsylvania. Seed of these varieties should be obtained from States north of Kansas but not from irrigated districts. The seed should be inoculated before planting. Inoculation materials can be obtained from the Bacteriology Department, Pennsylvania State College, or from reliable commercial concerns.

Alfalfa may be sown either in early spring or in early fall. The time of seeding, however, is not nearly so important as the condition of the soil and favorable weather conditions following seeding. Any field that is to be sown to alfalfa should of course be free from weeds or weed seeds and free from the more troublesome wild grasses. Alfalfa differs from clover in that, when planted, it must be covered with one-eighth to one-fourth of an inch of soil and the seedbed must be well prepared and very firm. It is also more sensitive than clover to freezes; therefore it cannot be sown as early in the spring as red clover.

Fall seedings may be made on land where wheat, oats, early potatoes, canning peas, or barley have been harvested in early summer. Preparation of the seedbed should start a month or 6 weeks before the date of seeding, which is near the middle of August and rarely later than the third week of August. Lime and phosphate fertilizer should be applied very liberally 3 or more weeks before seeding. There should be plenty of moisture in the soil at the time of seeding. From 12 to 15 pounds of seed to the acre are used. Recently some clover and timothy seed is being added with the alfalfa seed for the purpose of establishing a plant cover on wet spots or eroded slopes. Timothy aids in controlling erosion on steep slopes.

Seedings may be made in spring in fields of wheat, rye, barley, or oats with good success if plenty of lime and phosphate fertilizer has been applied for the small-grain crops in the early fall. Additional phosphate or a complete fertilizer, such as 2–12–4, may also be applied in the spring if necessary. The spring seedings are becoming more and more popular because alfalfa follows the small grain just as clover does in the 4-year rotation. Where alfalfa is to be sown with small grain, the seeding rate for the small grain should be reduced from one-third to one-half. From 4 to 6 pounds of clover and timothy seed may be added if the field contains spots where fertility is low or wet areas where alfalfa may be winter-killed. In this way the clover and timothy provide cover for areas where alfalfa might not become established.

Sweetclover is taking its place among other legumes as a soil-improvement crop. Like alfalfa, it must have a deep soil that is about neutral or at least not distinctly acid, if it is to make maximum growth. Sweetclover is hardy and produces a heavy growth the second year. If there is plenty of lime and phosphorus in the soil, it produces a good growth on very shallow soils. As a soil-improvement crop it has no superior, and it is also a valuable pasture crop. Experiments have shown that sweetclover on an acre of deep soil will produce as much or more forage for cattle as other clovers or pasture grass mixtures when placed under similar soil and grazing conditions. The best soils in this county for sweetclover are the Huntington, Lindside, Hagerstown, Duffield, Murrill, and Frankstown soils, but the crop can be grown on the Gilpin, Rayne, Amberson, Calvin, and Dekalb soils if they are given heavy applications of lime and phosphate fertilizer.

There are two kinds of sweetclover, the white and the yellow. The white varieties give the greatest growth of roots and tops. The yellow varieties are frequently preferred if sweetclover is grown for hay, because the stems are finer and give a better quality of hay. Sweetclover, like alfalfa, should be inoculated with legume bacteria when sown on land on which neither alfalfa nor sweetclover has been grown before.

Sweetclover may be sown either in early spring or late summer. If it is sown in the spring, it is often sown in fields of small grain. After the small grain is cut, the young sweetclover plants take over the grain-stubble land and continue growth until fall. In the following spring sweetclover makes a very vigorous growth that can be used for pasture or hay or can be plowed under for soil improvement. It may be sown in late summer in the cornfields at the last cultivation or on land from which early potatoes have been dug.

Sweetclover is used as a cover crop in orchards, where it is clipped with a mower when it becomes too tall. It is also used in crop rotations with potatoes because it adds both nitrogen and organic matter to the soil. It is plowed under in early spring before the potatoes are planted.

Red and alsike clovers have long been included in the crop rotations of Pennsylvania. As legume-hay crops they have occupied first place for many years. They are grown on nearly all of the cultivated soils, as they are more tolerant of wet or acid soils than is alfalfa. Nevertheless, they respond well to treatments with lime and fertilizer. The best yields of these clovers are obtained on the deeper soils of the limestone valley and on soils of the alluvial bottom lands where there is an abundance of soil moisture throughout the growing season. Red clover is the most popular legume grown in Huntingdon County. This is because it fits into a greater variety of crop rotations and yields well under less favorable soil conditions than alfalfa. Alsike clover is frequently sown with red clover and will provide a stand on areas where the soils are too acid or too wet for red clover. Alsike clover, however, does not produce so large a yield as red clover on the less acid and better drained soils. This is especially true if there is a scarcity of soil moisture. Alsike clover produces only one main crop, whereas red clover produces two crops, the second of which can be used for hay, seed, or pasture. Like alsike clover, mammoth clover produces only one main crop but has been used with considerable success instead of red clover on soils of low fertility. On fertile soils mammoth clover often produces a very heavy growth of coarse hay that has a lower feed value than red clover. Because of its coarse stems, it is difficult to cure in damp weather.

Farmers in this county are advised to use locally grown clover seed if possible. If local seed cannot be obtained, hardy varieties and strains of clover should be obtained from the Northern States where the winters are as cold as or colder than those of central Pennsylvania. Certified seed from Ohio and Michigan has proved reliable and satisfactory for soil and climatic conditions in Huntingdon County.

Clover is generally sown with small grain in late winter and early spring at the rate of 10 to 14 pounds to the acre. The seed lies on the surface of the soil and gradually works into the soil as a result of freezing and thawing. The seed germinates in April or early May, and by the time the small grain is harvested the young clover plants are large enough to provide cover for the grain stubble land. The clover grows through the late summer and produces two crops of hay the following summer.

Like red clover, timothy is easily and cheaply established on a wide variety of soils, and it is a very important hay plant. It is widely used in both hay and pasture mixtures. If it is to be included with clover in a hay mixture, timothy is generally sown with or in the small grain (wheat, rye, or barley) in the fall at the rate of 4 to 6 quarts of timothy seed to the acre. The seed germinates in early fall, and the young timothy plants become established before cold weather arrives in November. In the following spring they are held down by the small grain until it is harvested. As soon as the small grain is removed, however, the timothy, together with the young clover, which is usually seeded in the spring, rapidly covers the ground with a rather dense growth.

Where timothy is placed in pasture-grass mixtures it is generally sown with the mixture for the purpose of acting as a nurse grass until the more permanent bluegrass and white clover have an opportunity to become well established.

Even though Huntingdon County needs more areas of good pasture, there are several reasons for the absence of good pasture grasses on many of these abandoned areas, as the following: (1) Sufficient soil moisture-holding capacity is lacking wherever the soils are either steep or shallow, and in some places they are both steep and shallow; (2) many of the soils are too strongly acid to allow the growth of the more valuable pasture grasses, such as bluegrass and white clover; and (3) many of the soils have a very low fertility level; that is, they are very deficient in plant nutrients, including nitrogen, phosphorus, potassium, calcium, and organic matter.

It is evident that the establishment of pasture grasses on many areas would be not only difficult but expensive in time and money. First, grasses and legumes must be selected that will tolerate soils of low fertility; and second, lime and fertilizer must be applied in large quantities if a good pasture is to be established. Poverty grass grows quite well on abandoned land, but it has little or no feed value for livestock.

The soils of the alluvial flood plains, together with the better soils of the limestone valleys, are the only soils that will normally produce good pastures in which bluegrass and white clover are dominant. The establishment of good pastures on the Gilpin, Amberson, or Dekalb soils in Huntingdon County would be difficult, and would be practically impossible without the use of lime and phosphate. These soils are very acid and do not have the capacity to absorb and to store the moisture that pasture grasses must have throughout the summer. At best only very acid-tolerant grasses and legumes can be grown on the more acid soils of the uplands unless lime and phosphate are applied. Where the soils are not strongly acid or where the subsoils contain appreciable quantities of available calcium, it is possible to establish pasture grasses that will give fair returns for the investments involved.

Comparatively little land in this county has ever been seeded specifically for pasture. What pasture grasses there are on many areas have come in naturally, as the clover and timothy sod sown for hay disappeared. Only rarely do farmers give much attention to soil improvement for pastures, although there is great need for such improvement. However, there are large areas of steep shallow soils that are so low in fertility and in moisture-holding capacity that it would not be profitable to improve them for pastures. They should be allowed to return to forest.

With the increase in the importance of dairying, pasture becomes more important. Better pastures for higher production of milk become of vital importance, and greater emphasis should be placed on production of pasture grasses.

If a soil, when tested, shows a lime requirement of a ton or more of lime per acre to neutralize the acidity, the first step in pasture improvement would be a top dressing of lime to neutralize the acidity. The next step would be to add manure and to apply phosphate fertilizer at the rate of 400 to 500 pounds of 16-percent superphosphate to the acre. This treatment should be repeated every 4 or 5 years.

When soil conditions are made favorable for pasture grasses they will come in rather rapidly even though they are not seeded. If desirable grasses or legumes are scarce, however, it may be necessary to reseed with the more desirable pasture plants. In the establishment of a new pasture, Kentucky bluegrass and white clover are often sown with clover and timothy. Then after several mowings for one or two seasons the timothy and red clover gradually decrease and the stand of bluegrass and white clover increases.

In certain instances or places a mixture of pasture grasses may be desirable. This is especially true where soils vary in their acidity or fertility levels. Under such circumstances a mixture of grasses that includes Kentucky bluegrass, Canada bluegrass, redtop, orchard grass, ryegrass, meadow fescue, alsike clover, and white clover is recommended.

The following pasture-grass seeding mixtures may be used in Huntingdon County (*11*): (1) For soils of the limestone valleys and alluvial flood plains, red clover 5 pounds, alsike clover 2 pounds, timothy 6 pounds, Kentucky bluegrass 8 pounds, redtop 2 pounds, and white clover 1 pound; totaling 24 pounds to the acre. (2) For soils of the shale hills and gravelly foot slopes and terraces, red clover 2 pounds, alsike clover 2 pounds, timothy 5 pounds, Kentucky bluegrass 5 pounds, Canada bluegrass 5 pounds, white clover 1 pound, orchard grass 2 pounds, and redtop 2 pounds; totaling 24 pounds to the acre.

The successful production of potatoes (*10*, *14*) in Huntingdon County depends largely on soil conditions and air temperatures. Soils that are most suitable for the growing of potatoes are deep, well drained, and have loam, sandy loam, and silt loam surface soils. Potato scab, a disease, prevalent in the region, causes most damage to potatoes that are grown on neutral or only slightly acid soils, but it may not cause so much damage where potatoes are grown in medium acid or strongly acid soils. Where the pH value is 5.5 or less the activity of this disease is usually much less than where the pH value is 6.0 or higher.

The soils best adapted to potatoes in this county are the sandy loam, loam, and silt loam types of the Pope, Moshannon, Cassville, Holston, Elk, Murrill, Duffield, Hagerstown, Laidig, and Calvin soils and selected areas of the high-bottom Huntington soils. In all these soils, however, plenty of organic matter and fertilizer is essential if good yields of potatoes are to be obtained. Where the soils are well fertilized (700 to 1,000 pounds of a 4–8–7 or 4–10–10 commercial fertilizer), potatoes yield from 200 to 375 bushels an acre, depending much on summer temperatures and the distribution of rainfall.

The important early varieties of potatoes are Irish Cobbler and Early Rose; the late varieties are Russet Rural, White Rural, and Green Mountain. In general, the late varieties produce considerably higher yields, partly because they are more resistant to both tuber and vine diseases. Both early and late potatoes should be sprayed a number of times during the growing season.

The production of fruits and vegetables is limited largely to home orchards and gardens. A few farmers have specialized in the production of fruit on Warrior Ridge west of Huntingdon and near Shirleysburg. Apples are the major fruit produced in these areas. Vegetables are grown commercially near Ardenheim, Huntingdon, and Warriors Mark.

There are both suitable soils and suitable locations for orchards in the county. Soils for orchards should be deep, medium-textured, and permeable. The Murrill, Elk, Holston and Laidig soils, together with the deeper parts of the Hagerstown, Frankstown, and Duffield soils, are the best soils in the county for orchards. The soils used should be on elevated benches or terraces where air drainage is good. In late spring and early fall low areas collect cold air at night, and blossoms and fruit are likely to be frosted. Cold air, like water, nearly always flows down the narrow mountain valleys and empties out into the main valleys, and the air temperatures where the narrow mountain valleys join with the main or wider valleys is nearly always lower than the air temperatures farther out in the wider valleys. The planting of orchards at these valley junctions is risky and should not be done unless careful studies of air temperatures indicate that the proposed site is a safe one.

The most promising varieties of fall and winter apples for Huntingdon County are Stayman, Winesap, McIntosh, Rome Beauty, Delicious, Golden Delicious, and Starking. For summer varieties, Yellow Transparent and Summer Rambo are best.

There are few sites where peaches can be grown successfully. Cold temperatures in winter and late spring frosts allow a crop only about 1 year out of 3. A few farmers have been able to harvest peaches 1 year out of 2 where their trees are planted in sheltered places or on favorable sites. The most promising varieties for this county are Elberta, Golden Jubilee, South Haven, and Belle (Belle of Georgia).

The more promising varieties of plums are Bradshaw, Italian Prune, Stanley, and Shiro.

Cherries can be grown successfully in nearly all parts of the county, provided the soils are deep and fertile. The leading varieties of sweet cherries are Black Tartarian, Napoleon, Ida Schmidt, Lambert, and Bing. The sour cherries are Montmorency and Early Richmond.

For both quality and production the soils in orchards must be well supplied with organic matter and fertilizers.

Strawberries, raspberries, blackberries, and grapes are the more important small fruits. They are grown mainly for home use, but a few farmers have gone into commercial production on a small scale. The leading varieties of strawberries are Aberdeen, Howard (Premier 17), Dorsett, and Fairfax. The production of strawberries should be attempted only on silt loam, loam, and sandy loam soils that are deep, well drained, and well supplied with organic matter. Strawberries are often winter-killed by heaving in places where the soils are not well drained. In addition to selecting the better drained soils, a 2-inch straw mulch in winter is also needed for protection of strawberries against injury.

Success in growing raspberries depends much on soil conditions and on the resistance of the plants to mosaic and fungus diseases. A fertile well-drained soil is essential to the best production of raspberries. Good air drainage is also essential. The promising older varieties of red raspberries are Newburgh, Latham, Cuthbert, and Chief. Among the newer red varieties, the Indian Summer and Taylor are worthy of trial. For black varieties the Cumberland, Plum Farmer, and New Logan are most popular. The new Morrison black is very promising.

Varieties of blackberries are mainly Eldorado, Snyder, Blowers, and Alfred. Eldorado and Blowers are the outstanding varieties.

The production of grapes is not of commercial importance, but for home vineyards the leading varieties are Concord, Moore Early, Worden, and Fredonia for the blue grapes and Niagara and Portland for the white grapes.

For small fruits, well-drained deep fertile silt loam, loam, or sandy loam soils are essential for good growth and production. The best soils for small fruits are the deeper soils of the Laidig, Murrill, Frankstown, Hagerstown, and Duffield series. The Elk, Holston, Moshannon, and Huntington soils are also very good for small fruits where air drainage is good. Plenty of commercial fertilizer and organic matter must be applied to all soils on which small fruits are to be produced. For additional information the reader is referred to the Department of Horticulture, Pennsylvania State College.

In this publication the discussion of vegetable growing will be confined mainly to its relation to soils. Discussion of varieties and cultural practices will be omitted. Vegetables can be and are grown on practically every soil in the county, but success or failure depends much on the texture, fertility, drainage, content of organic matter, depth, and total water-storage capacity of a given soil. The best and most desirable soil textures are silt loam, loam, and sandy loam.

Soils for vegetable growing must be very fertile, or, if they are not, large quantities of fertilizers must be added to the soil. Wet soils are cold, and well-drained soils usually warm quicker in the spring. Soils for vegetable growing must be well drained and should contain a large amount of organic matter (humus), which provides for greater absorption and storage of soil moisture. Humus also makes the soil more porous and permeable and easier to till, prevents baking or crusting of the soils, and stimulates action of soil bacteria and a more rapid production of the soil nitrates that vegetable plants need in large quantities.

Vegetables require a large amount of water, and if the soil does not supply the needed moisture then irrigation may be necessary during the hot part of the summer.

The best soils for vegetable growing are the silt loam, loam, and sandy loam of the Huntington, Pope, Moshannon, Holston, and Elk series, all of which are on the alluvial flood plains or terraces. Certain areas of deep soils of the Hagerstown, Frankstown, and Duffield series, where they are well supplied with fertilizers and organic matter, may be used for the production of vegetables and produce well if there is a uniform and normal distribution of rainfall throughout the summer. For best success vegetables demand at least 1 inch of rainfall each week throughout the growing season.

CONTROL OF WEEDS

The control of weeds is essential in any agricultural region. It is estimated that the average annual losses in Pennsylvania due to weeds is approximately $2 an acre on all cultivated lands.

The most troublesome weeds in Huntingdon County are Canada thistle, quackgrass, ragweed, chicory, garlic, corncockle, horsenettle, whitetop, dodder, dandelion, buckhorn plantain, sowthistle, wild carrot (Queen-Annes-lace), and a great number of annual weeds.

Many of these weeds may be controlled by cultivation and crop rotation, but some require special control measures. Detailed information on weed control can be obtained from General Bulletin 558 (*20*) of the Pennsylvania Department of Agriculture, from the Department of Agricultural Extension, State College, Pa., or from the local county agricultural agent.

SOIL FERTILITY AND SOIL MANAGEMENT

When the soils of Huntingdon County were first placed under cultivation they were comparatively well supplied with organic matter and plant nutrients that had accumulated through the annual deposition and decay of forest leaves for thousands of years. After the forests were removed and these soils were plowed, great changes in the fertility of the soil began to take place. The organic matter decayed, no more forest leaves fell on the ground, soil leaching proceeded, and heavy rains washed large quantities of fertile soil material from the steeper slopes. The soils, most of which were originally acid, became even more so. The problem now is how to preserve the soil that is left and

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maintain its fertility, in order that crops and pastures may be produced on these soils now and in the future.

SOIL ACIDITY AND LIMING

The first step essential to the improvement of most soils of Huntingdon County is to reduce soil acidity by the addition of lime in some form (*12*, *37*, *38*). The Lindside and Huntington soils are normally the only soils in the county that do not need liming. The more acid soils, such as the Rayne, Gilpin, and Dekalb, need as much as 3 or 4 tons of ground limestone to the acre. The complete neutralization of an acid soil is not always necessary, because some crops will do just as well, if not better, in an acid soil than they do in a neutral soil. Potatoes do well and usually have fewer diseases if grown in acid soils. Corn, oats, wheat, rye, barley, timothy, and soybeans tolerate medium-acid soils, but alfalfa and sweetclover must have soils that are nearly neutral. In general, the kind of crop that is to be grown determines to a large extent the quantity of lime needed; and applications of lime should be based on both the acidity of the soil and the tolerance of the crop. In general the farmer should test his soil or have it tested by his county agent or State experiment station and from these results determine the quantity of lime that is needed to produce a given crop on a specific field or soil.

Huntingdon County is fortunate in that it contains large deposits of limestone, which may be obtained and spread on fields that contain acid soils.

Several forms of lime can be used for liming soils. They are burned lime (CaO), slaked lime ($Ca(OH)_2$), ground limestone ($CaCO_3$), and furnace slag ($CaSiO_3$). The amount of calcium, as well as the cost, varies for each kind of material.

In general 2,000 pounds of limestone ($CaCO_3$) when burned will lose 880 pounds of carbon dioxide (CO_2), leaving approximately 1,120 pounds of burned lime (CaO). If water is added to burned lime to bring about slaking (or hydration, as the chemist calls it), 1,480 pounds of hydrated or slaked lime results, containing the same amount of calcium as 1.120 pounds of burned lime or 2,000 pounds of raw limestone. In addition to these forms of lime, blast furnace slag ($CaSiO_3$), a byproduct from the manufacture of pig iron, may be used. Experiments have shown that 1 ton of slag equals in value for liming 1 ton of ground limestone if both materials are pulverized to the same degree of fineness, that is, to a size that will pass through a 20-mesh screen.

Systematic chemical studies of the lime requirements of the soils of Huntingdon County have never been made, and the liming recommendations that follow are based on studies of similar soils at Pennsvlvania State College or on the outlying experimental fields. In general, lime is being leached from cultivated soils of central Pennsylvania at rates ranging from 150 to 500 pounds an acre annually, depending to considerable extent on the total amount of lime presént in the soil. From this it may be concluded that the cultivated soils should receive from ½ to 1 ton of lime every 4 years to replenish the losses as a result of leaching. In addition the calcium needs of the crops must be provided for. Legume crops (alfalfa, sweetclover, and peas) require large quantities of calcium, and larger applications of lime must be made where these crops are to be grown.

In general, soils developed from shale materials or gravelly deposits give more rapid response to liming than do the heavier soils developed from limestone materials, and very noticeable increases in crop yields are obtained where only one-half of the recommended quantities of lime are applied to these soils. Light applications of lime usually give very generous returns on the money invested.

Table 10 gives the approximate quantities of lime that should be applied to soils of a number of important groups in Huntingdon County in order that maximum production of certain crops may be obtained.

TABLE 10.—*Lime requirements for important crops when grown on soils of the major groups in Huntingdon County, Pa.*

[In tons per acre of finely ground (20 mesh or finer) limestone applied every 4 years in major crop rotations]

Crops	Soils of the limestone valleys [1]	Soils of the shale hills [2]	Soils of high terraces and colluvial fans [3]	Soils of the mountains [4]	Soils of the alluvial flood plains and terraces	
					Soils from limestone materials [5]	Soils from shale and sandstone materials [6]
	Tons	*Tons*	*Tons*	*Tons*	*Tons*	*Tons*
Alfalfa Sweetclover Peas	1½-3	2-3½	2-3½	2½-4	0-½	1-2½
Red clover Alsike clover Mammoth clover Soybeans Cowpeas	¾-2	1½-3	2-3	2½-3	0	½-1½
Corn Wheat Oats Rye Barley	0-1½	1-2	1-2	1½-2½	0	0-1
Bluegrass White clover	1-2	2-3	2-3	3-4	0	1-2
Redtop Timothy Orchard grass	0	½-1	½-1	1-2	0	0-1

[1] Hagerstown, Frankstown, Duffield, and Murrill soils.
[2] Gilpin, Rayne, Berks, Amberson, and Calvin soils.
[3] Laidig, and deep phases of the Murrill soils.
[4] Dekalb, Clymer, Morrison, Leetonia, and Lehew soils.
[5] Mainly Huntington, Lindside, and Warners soils.
[6] Pope, Moshannon, Philo, and Atkins soils of the first bottoms; and Holston and Monongahela soils of the terraces, which are generally more acid than the soils of the bottoms.

The main benefits of lime are not limited to the correction of soil acidity alone, because lime also furnishes calcium that is needed by growing plants. In addition lime is essential for soil bacteria that are engaged in the decomposition of organic matter and in the production of soluble nitrates that most plants must have for normal growth. Lime also tends to granulate the soil, making it easier to cultivate and less likely to pack, crust, or bake after hard rains.

SOIL FERTILITY PROBLEMS AND FERTILIZER PRACTICES

The two outstanding requirements for fertile or productive soils are (1) an abundance of soil organic matter, especially soil humus, and (2) an abundance of readily soluble plant nutrients, mainly nitrogen in form of nitrates (NO_3), phosphorus in form of phosphates

(PO_4), potassium, and calcium. In addition other minor elements are now becoming more important in plant nutrition as the soils are becoming impoverished by continued removal of crops, soil leaching, and erosion.

In general, the total supply of soil organic matter is a rough indicator of the amount of nitrates that a crop plant may obtain from a soil. A scarcity of organic matter or humus usually indicates a deficiency of nitrate. Therefore the maintenance of a large amount of organic humus in a soil cannot be emphasized too strongly, and the preservation of humus is of vital importance in the production of crops in this county.

The rate of decay of organic matter greatly affects the concentration of available nitrogen and the solubility of phosphorus, potassium, and calcium in the soil. A slow rate of decay may indirectly restrict the growth of plants through deficiencies of nitrogen, phosphorus, potassium, and calcium. The problem of conserving or increasing the supply of humus in the soil is ever present in Pennsylvania, and the farmer should make every effort to return as much organic material to the soil as possible in the form of manures, straw, spoiled hay, cornstalks, etc. In some places green cover crops should be plowed under for the purpose of adding organic matter to the soil. Erosion should be controlled, in order to prevent removal of valuable organic materials or fertilizers from the fields.

Nitrogen stimulates and promotes top growth of plants. Plants well supplied with nitrogen usually have a rich deep-green color, and greenish-yellow plant leaves indicate a deficiency of nitrogen in the soil. Nitrogen is essential in the formation of plant proteins, which are important in feed for livestock.

The nitrogen supply of the soil comes mainly from (1) the decay of organic materials, (2) the biological fixation of atmospheric nitrogen in the soil by nitrogen-fixing soil bacteria, and (3) electrical storms and rainfall, which bring down 3 to 5 pounds an acre of nitrogen annually. If soil conditions are favorable, the nitrogen-fixing bacteria fix comparatively large quantities of nitrogen in the soil. There are two groups of nitrogen-fixing bacteria, namely, (1) free-living, those that do not require a host plant to be able to fix atmospheric nitrogen, and (2) the legume bacteria (*Rhizobium*), many of which are specific for certain legume plants. Unfortunately, most of the nitrogen-fixing organisms will not tolerate strongly acid soils, and the population of these organisms is thought to be very low in the more acid soils of the county. Research has shown that soils must be less acid than pH 6.0 if the nitrogen-fixing organisms are to be depended on for nitrogen fixation. A neutral soil (pH 6.8 to 7.2) favors the most rapid fixation of nitrogen in the soil. Where the soils are not acid the legume bacteria (*Rhizobium*) may fix a nitrogen equivalent of 30 to 150 pounds of sodium nitrate fertilizer to the acre annually, depending on the kind of host plant. In general alfalfa and clover bacteria fix the larger amounts of nitrogen.

Nitrate nitrogen (NO_3) is very soluble and is readily leached from soils. Therefore the farmer must not only conserve and apply organic matter to his soils, but he must also keep his soils in a condition that favors the fixation of atmospheric nitrogen by the soil bacteria. This requires intelligent study and management of any or all soils that are used for the production of farm crops.

Whenever legumes are to be established in any field the farmer should inoculate the seed he plants with the proper legume organisms. The Pennsylvania State College or the local county agricultural agent will gladly supply detailed information relative to methods of inoculating either soils or legume seed with the proper nitrogen-fixing bacteria. It is also very important, however, that the soil in which the bacteria are to live be properly prepared and well supplied with lime and phosphorus, because these organisms in general will not live or function efficiently in acid soils that are deficient in phosphorus.

In many instances nitrogen fertilizers must be applied to soils if maximum crop yields are to be obtained. Nitrogen fertilizer is usually purchased in the form of sodium nitrate ($NaNO_3$) or ammonium sulfate ($(NH_4)_2\ SO_4$), or it may be a part of a commercial mixed nitrogen, phosphorus, potassium (N-P-K) fertilizer, which is often referred to as a complete fertilizer. Nitrogenous fertilizers are most important for vegetable, fruit, and cereal crops. If properly inoculated legumes are grown on nonacid soils, they will get their nitrogen from the nitrogen-fixing organisms.

Phosphorus is a mineral element that comes originally from the rocks. That which is present in organic matter becomes available to plants as the organic matter decays. All the soils of south-central Pennsylvania, including Huntingdon County, are deficient in phosphorus, which is essential for the best growth and maturity of both plants and animals. Phosphorus is vitally important in the formation of seeds, fruits, and grains. It is also important in the production of root crops and luxuriant pasture grasses.

Phosphorus cannot be fixed in the soil by bacteria; therefore, where it is deficient in soils, it can be increased only by the addition of organic matter or phosphate fertilizers. The more important commercial phosphate fertilizers used in Huntingdon County are superphosphate, rock phosphate, basic slag, and bonemeal. Superphosphate (acid phosphate) is by far the most popular with the farmers. It is used in largest quantities where alfalfa and wheat are to be grown. Phosphate fertilizers, however, should be applied liberally to all pastures, because both the pasture grasses and the soil will be greatly benefited by more available phosphorus.

Some of the soils of Huntingdon County are deficient in the element potassium and some are not. In general the soils of the limestone valleys contain the largest reserves of potassium, and the sandy soils of the mountains contain the least amount. The amount of potassium in a soil gives indication as to the amount that is available to plants. In general most of the potassium in soils is not readily available to plants, but its availability can be increased by having an abundance of organic matter decaying in the soil.

Potassium aids in the formation of sugars, starches, and oils in plants; therefore it is important in the production of good-quality hays, grasses, grains, fruits, and vegetables.

In this county most of the potash fertilizer is applied in commercial fertilizer mixtures that contain nitrogen, phosphate, and potassium. The commercial fertilizer that contains potassium is generally applied to soils where small grains, fruits, vegetables, potatoes, and legumes or grasses are to be grown. The most popular fertilizer is a complete one, 2–12–5, which is generally applied at a rate of 150 to 250 pounds to the acre on wheat. For potatoes the rates range from 700 to 1,000 pounds to the acre. Recently experiment stations are recommending that smaller quantities of higher analysis fertilizers be used. These are more economical because less freight is paid for filler.

In general, fertilizer practices differ greatly from farm to farm and from one locality to another, irrespective of the kind or type of soil. Apparently the rates of fertilizer application are largely a result of custom rather than of specific needs of certain crops on certain soils, and in most places the farmers underfertilize rather than overfertilize. This is especially true where hay and pasture grasses are grown. There is a lack of definite information concerning the best application rates for different crops when grown on soils other than those belonging to the Hagerstown and Dekalb series. For detailed fertilizer requirements for soils of these two series the reader may obtain a number of publications from the Pennsylvania Agricultural Experiment Station, State College, Pa.

Table 11 contains generalized recommendations for application of fertilizers for the more important crops on soils of the major groups. The fertilizer mixtures and quantities given are not necessarily the best that can be used, but they have given good results in this part of Pennsylvania under common field practices. More concentrated fertilizers would be more economical.

TABLE 11.—*Recommended fertilizer treatments for the more important crops on soils of the major groups in Huntingdon County, Pa.*

Crop and type of fertilizer	Quantities of fertilizer used per acre [1] on—	
	Soils of the limestone valleys and alluvial flood plains	Soils of the shale hills, old terraces, and colluvial slopes
Alfalfa or sweetclover (seeded with nurse crop—wheat, oats, or barley).		
Using manure 3 to 10 months before seeding and commercial fertilizer as top dressing in fall on small grain.	8 to 10 loads of manure [2] and 200 to 300 pounds of 16-percent superphosphate or 0-12-5.	10 to 15 loads of manure and 300 to 400 pounds of 16-percent superphosphate.
Using complete fertilizer as top dressing in fall on small grain.	250 to 300 pounds of 3-12-6 or 2-12-6.	300 to 400 pounds of 3-12-6 or 2-12-6.
Alfalfa or sweetclover (not seeded with nurse crop)		
Using manure 1 to 10 months before seeding and superphosphate applied on surface and harrowed in several days before seeding.	6 to 10 loads of manure and 250 to 350 pounds of 16-percent superphosphate.	8 to 12 loads of manure and 300 to 400 pounds of 16-percent superphosphate.
Using complete fertilizer applied on surface and harrowed in several days before seeding.	300 to 400 pounds of 0-12-5, 2-12-6, or 3-12-6.	300 to 400 pounds of 0-12-5, 2-12-6, or 3-12-6.
Red clover or alsike clover and timothy:		
Using superphosphate or complete fertilizer applied with wheat or barley in fall before this crop is sown in spring.	200 to 300 pounds of 16-percent superphosphate, 175 to 250 pounds of 0-12-5, 2-12-6, or 3-12-6, or 150 to 200 pounds of 4-16-4.	300 to 350 pounds of 16-percent superphosphate, 200 to 300 pounds of 2-12-6 or 3-12-6; or 150 to 200 pounds of 4-16-4.
Corn		
Using manure spread on alfalfa or clover sod before plowing and superphosphate at planting time.	8 to 15 loads of manure and 150 to 200 pounds of 16-percent superphosphate.	10 to 18 loads of manure and 175 to 250 pounds of 16-percent superphosphate.
Using complete fertilizer at planting time.	200 to 275 pounds of 2-12-5 or 3-12-6 or 175 to 250 pounds of 4-16-4.	225 to 275 pounds of 2-12-5 or 3-12-6 or 200 to 275 pounds of 4-16-4.
Wheat, oats, and barley:		
Using manure in rotation and commercial fertilizer applied with grain drill at seeding time.	200 to 250 pounds of 16-percent superphosphate or 0-12-5.	250 to 300 pounds of 16-percent superphosphate or 0-12-5.
Using no manure in rotation but commercial fertilizer alone applied with grain drill at seeding time.	250 to 300 pounds of 0-12-5 or 2-12-5 or 225 to 275 pounds of 3-12-6 or 4-16-4.	275 to 325 pounds of 0-12-5 or 2-12-5 or 250 to 300 pounds of 3-12-6 or 4-16-4.

TABLE 11.—*Recommended fertilizer treatments for the more important crops on soils of the major groups in Huntingdon County, Pa.*—Continued

Crop and type of fertilizer	Quantities of fertilizer used per acre [1] on—	
	Soils of the limestone valleys and alluvial flood plains	Soils of the shale hills, old terraces, and colluvial slopes
Rye:		
Using commercial fertilizer applied with grain drill at seeding time.	200 to 250 pounds of 16-percent superphosphate or 175 to 225 pounds of 2-12-5 or 3-12-6.	250 to 275 pounds of 16-percent superphosphate or 200 to 225 pounds of 2-12-5 or 3-12-6.
Potatoes:		
Using manure on alfalfa, sweetclover, or red clover sod before plowing and applying superphosphate with potato seed at planting time.	12 to 18 loads of manure and 600 to 800 pounds of 16-percent superphosphate.	14 to 20 loads of manure and 600 to 800 pounds of 16-percent superphosphate.
Using no manure but plowing under clover or alfalfa and applying commercial fertilizer with potato seed at planting time.	700 to 1,000 pounds of 0-12-5 or 3-12-6.	700 to 1,000 pounds of 0-12-5 or 3-12-6.
Using commercial fertilizer alone with potato seed at planting time (no manure and no sod plowed under).	1,200 to 1,500 pounds of 4-8-7 or 4-8-8 (early crop) and 1,000 to 1,200 pounds of 4-8-7 or 4-8-8 (late crop).	1,200 to 1,500 pounds of 4-8-7 or 4-8-8 (early crop) and 1,000 to 1,200 pounds of 4-8-7 or 4-8-8 (late crop).
Buckwheat or soybeans	200 to 300 pounds of 0-14-6 or 200 to 250 pounds of 0-20-0.	250 to 350 pounds of 0-14-6 or 200 to 250 pounds of 0-20-0.
Garden and truck crops:		
Using manure plowed under and commercial fertilizer.	10 to 20 loads of manure and 800 to 1,200 pounds of 2-12-4, 600 to 800 pounds of 4-16-4, or 500 to 700 pounds of 4-8-8.	15 to 20 loads of manure and 1,000 to 1,200 pounds of 2-12-4, 700 to 900 pounds of 4-16-4, or 600 to 800 pounds of 4-8-8.
Using commercial fertilizer alone	1,200 to 1,500 pounds of 2-12-4, 1,000 to 1,200 pounds of 4-16-4, or 800 to 1,000 pounds of 4-8-8 or 5-8-7.	1,500 to 2,000 pounds of 2-12-4, 1,200 to 1,500 pounds of 4-16-4, or 1,000 to 1,200 pounds of 4-8-8 or 5-8-7.
Pasture grasses (bluegrass; red, white, and alsike clover; timothy; redtop; and orchard grass):		
Using manure and superphosphate as top dressing before fall seeding and every 2 or 3 years thereafter.	8 to 12 loads of manure and 400 to 500 pounds of 16-percent superphosphate or 350 to 400 pounds of 20-percent superphosphate.	10 to 20 loads of manure and 500 to 600 pounds of 16-percent superphosphate and 450 to 550 pounds of 20-percent superphosphate.
Using commercial fertilizer alone as top dressing every 2 or 3 years.	400 to 500 pounds of 4-16-4	450 to 550 pounds of 4-16-4.

[1] The quantities of fertilizer applied to the various soils do not differ greatly, but the returns from each dollar invested on the different soils differ markedly.
[2] Manure-spreader loads of 50 to 75 bushels.

CONTROL OF RUNOFF AND EROSION

Huntingdon County is a land of strong relief. The narrow valleys are separated by steep hills and mountains. The present topographic features are the product of millions of years of rock weathering, slow geological erosion, and denudation. Accelerated soil erosion is the result of the activities of civilized man.

As long as the land was under the cover of virgin forests, accelerated erosion was not serious, for the annual deposit of leaf litter provided a humus mat that covered and protected the soil from beating rain drops and running water. In fact, a delicate balance existed between the rates of soil formation and soil removal on any given site or slope throughout the region. Apparently, before the land was cleared the depth of soil in few places was less than 2 feet and in most places exceeded 3 feet, and a well-developed layer of surface soil was present nearly everywhere.

Clearing and cultivating of the land introduced a new and more rapid rate of runoff and erosion, and apparently soil is being removed from steep cultivated slope lands faster than new soil is formed from the parent rocks. Every hard rain produces a heavy runoff that carries a load of silt and sediment from unprotected slopes and leaves behind a slope scarred with rills and gullies. Cultivation may hide these erosion scars temporarily, but gradually the soil becomes shallower. As the depth of soil decreases in such areas, runoff increases, and erosion becomes even more active. The ultimate outcome is serious deterioration or virtual destruction of the soil and abandonment of the land. Then nature slowly covers the impoverished soil with poverty grass, ragweed, scrub pine, and brambles.

There are now several thousand acres of abandoned land in the county. Much of the soil is too shallow to store more than 2 inches of rainfall at any given time, and plant growth on these areas is restricted because of deficiencies in soil moisture during the summer.

Measures for the control of runoff and erosion are vitally important and very largely determine the future success or survival of agriculture on more than 75 percent of the cultivated lands. The first and most important measure for the control of erosion is a vigorous plant cover. Where lime and fertilizer are needed they must be supplied. A few control measures that seem to hold considerable promise are (1) proper land use; that is, using only the less steep and less erodible areas for cultivated crops; (2) crop rotation; (3) strip cropping; and (4) maintenance of a vegetative cover.

Plowing and cultivation loosen the soil so that it may be more readily washed away. Corn, tobacco, potatoes, and vegetable crops must be cultivated if weeds are to be controlled. These crops afford little protection to the soil in either summer or winter and favor erosion wherever the slope allows runoff of rainfall.

A well-designed crop rotation that includes small-grain and hay crops reduces the frequency of plowing and cultivation and provides a protective vegetative cover much of the time. In a corn, wheat, hay rotation the land is plowed only once in 3 years, whereas, if the same area were continuously used for corn, it would be plowed three times in 3 years. Small-grain and hay crops are not cultivated in the above rotation, and corn is the only crop that is cultivated. Losses from erosion are reduced by less frequent plowing and cultivation and by the close cover afforded by the wheat and hay crops. When the hay sod is plowed the grass roots tend to hold the soil until they decay. The presence of these decaying roots in the soil during the corn-cultivation season reduces erosion losses below what they would be if there were no grass roots in the soil. Well-designed crop rotations not only reduce losses from erosion but also reduce the costs of cultivation and help to maintain or increase the fertility of the soil.

Strip cropping consists of the planting of a number of crops in the same field in long narrow parallel strips across the slope. Each crop strip generally occupies a given contour level throughout its length, although this is not entirely essential. The width of each crop strip is usually determined by the steepness of slope, the fertility of the soil, the number or kind of crops to be grown, and the crop needs of each individual farmer. Each strip-cropping system should provide for a small-grain or hay strip above and below each cultivated crop strip.

Strip cropping is not a perfect or complete method for the control of runoff and soil erosion. It has advantages and disadvantages, but a well-designed strip-cropping system definitely reduces the total loss of water and soil from sloping lands that are used for growing farm crops. Small gullies may start in the cultivated strips, but they usually terminate in the upper edge of the grass or hay sod strip that lies immediately below the cultivated strip.

Strip cropping also provides for contour cultivation; that is, cultivation across or around the slope and not up and down the slope. Experiments at Pennsylvania State College on Hagerstown soils have shown that contour cultivation is very effective in reducing runoff and soil erosion losses (*7*, *17*).

The use of vegetative cover for erosion control is nothing more than the reversion to nature's own way of reducing or controlling soil erosion. However, the use of a permanent vegetative cover removes the land from the production of some of the more important crops. The depth and the fertility of the soil frequently determine the success or failure of a given cover crop. In general the farmers of Huntingdon County do not resort to cover crops (hay or pasture grasses) for control of erosion unless the soil is too shallow for the production of corn or small grains. It is then and only then that they allow the soil to return to a cover crop, generally clover and timothy, which gradually reverts to pasture.

It is very difficult to establish and hold either desirable hay crops or grasses on shallow soils that have a very low moisture-storage capacity. Soil moisture rather than plant nutrients may limit the production of a vegetative cover on many areas of shallow soils in Huntingdon County. It is also very difficult to prevent the loss of lime and fertilizer from shallow soils that occupy steep erodible slopes. Thus, as soils become shallower the possibilities of restoring or establishing a desirable vegetative cover becomes more and more difficult.

In Huntingdon County the kind of soil largely determines the kind or choice of vegetative cover that can be established most successfully on many areas of shallow soils. If the soil has been developed from limestone or calcareous shale materials, then good hay or a pasture-grass cover can be established economically on the land. The major shallow soils that comprise this group are those of the Hagerstown, Duffield, and Frankstown series and the Calvin-Edom complex. The fertility level of these soils allows the establishment of alfalfa, clover, and bluegrass, but depth of the soil and the distribution of rainfall during the growing season generally control the yields.

For the shallow soils that have been developed from acid shales and sandstones there is but one logical kind of plant cover—forest (*2*, *30*). Present economic conditions do not warrant the time and the expense required to bring these shallow acid soils up to a fertility level that would allow the growth of desirable grasses and legumes for hay or pasture. The best future use for the shallow and steep areas of the Gilpin, Amberson, Berks, Calvin, and Dekalb soils is forestry. Forest-tree plantings on these soils should include a large proportion of tree species that have very low moisture requirements, because the total water-holding capacity of many of these soils is well below 4 inches of water. Pines are probably the most suitable for advance plantings on most of these acid soils, and they will probably make a thicker cover and more rapid growth than hardwoods on the steeper and shallower soils.

FOREST PLANTINGS ON OLD FIELDS OF HUNTINGDON COUNTY AND ADJACENT COUNTIES OF PENNSYLVANIA[8]

Huntingdon County and adjacent counties of Pennsylvania have an urgent problem in their idle cleared land. Areas that have never been cleared but merely cut over or burned off and pastured for some years after the timber was removed soon show a regrowth of young trees of fairly acceptable species. Repeated burning on mountain slopes and plateaus may result in a scrub oak barren on which there are some scattered pitch pine and sparse clumps of sprouts of the more aggressive oaks. The area of such mountain land, however, is very small and is exceeded many times over by fields dropped out of cultivation and too low in value for grazing to pay for the cost of fencing.

Owners and real-estate agents usually list such uncultivated fields under the designation wild pasture or grazing land. In practice, however, successful use of these lands for grazing is infrequent if it occurs at all. The natural grasses on these impoverished sites grow sparsely, are not palatable to livestock, and apparently are low in nutritive value. Hence, it is highly improbable that these areas can compete, under conditions at hand, with the range lands of the West or with farm land in the Central States where livestock raising is a specialty.[9] Moreover, if pasture is grazed nearly to capacity, certain parts of these rolling hills and steep slopes suffer a steady loss from sheet erosion and gullying. Erosion is not so rapid or so obvious as that which occurs on land under cultivation, but it is an item that should not be overlooked by one who wishes to have the land accumulate and rebuild a store of fertility.

The alternative use for such land is forestry, but even for this purpose there are obstacles to surmount and pitfalls to avoid. Some abandoned fields lie for years without any indication of a forest cover coming on, as in many places suitable seed trees are absent in the locality. Many trees require shade in the first few years of life and find this in the forest, but when their seed is dispersed over open fields they fail to survive the first month. Some tree seeds require moss for a satisfactory germination bed, and many cannot tolerate competition by grass and weeds. Heavy seeds are rarely carried out over open fields, as they are disseminated mainly by animals and birds that prefer woodland areas.

Scrub or Virginia pine is the tree best suite for survival on such sites, as it has small winged seeds and prefers sunlight. The scrub pine field has therefore become typical of Huntingdon County and neighboring counties. If the trees stand close and no insect or climatic calamities intervene, scrub pine will grow to pulp-wood size in about 30 years. Where trees are sparse or soil especially adverse, the trees are low-crowned and knotty or so defective as to be of very little commercial value. Nevertheless, under the thin shade and by virtue of the slow soil improvement that occurs, an understory of better trees always develops when the pine canopy begins to thin with age.

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[8] This section was written by George S. Perry, senior research forester, Pennsylvania Department of Forests and Waters, Forest Research Institute, Mont Alto, Pa.

[9] AUTEN, J. T. EFFECT OF FOREST BURNING AND PASTURING IN THE OZARKS ON THE WATER ABSORPTION OF FOREST SOILS. U. S. Dept. Agr. Cent. States Forest. Expt. Sta. Note 16, 5 pp., illus. Columbus. 1934. [Processed.]

At best fields of scrub pine yield a low return; at worst they are an encumbrance, their limiting influence on erosion being the one redeeming feature. Progressive landowners are therefore turning to forestry for some means to make this land produce a full crop of valuable trees without delay and disappointment.

Adjacent to many of these fields are natural woods where shellbark and other hickories, red oak, white oak, walnut, tuliptree (tulip poplar), ash, and sugar maple thrive in company with hemlock and white pine. As the best land was presumably cleared for farming and pasture, at first thought it appears easy to get a young forest of the most valuable trees started on fields now idle. Extensive changes brought about under destructive cultivation, however, must be taken into account. With the single exception of plantations of white pine, no successful planting of these more valuable trees on an old exhausted field was observed in Pennsylvania between 1930 and 1933.

In Switzerland (*8, p. 359*) and in the Middle West of the United States (*5*) some careful studies show that cultivation and pasturage affect the porosity of the soil and the rate at which water penetrates the soil. Many soils of the woodland absorb water from 10 to 25 times faster than the same soil of an adjacent pasture. Loss of fertility by erosion is doubtless also a factor. Exacting trees grow well near some old houses where garden soil, ash dumps, or manure heaps occur, whereas these trees have failed elsewhere.

The proper choice of trees for planting on these old fields is very important. White pine is a good selection, but this tree should not constitute more than 40 percent of the stand, since it has some serious enemies and the wood it tends to produce on such sites is knotty and inferior. As a matter of fact, no kind of tree will grow best if planted by itself. A mixed planting is safer and more thrifty. Red pine, shortleaf pine, or pitch pine, and possibly up to 30 percent of Scotch pine, Norway spruce, and larch, are suitable for mixture with white pine or with each other. Plantings of Austrian pine, Banks pine, white spruce, red oak, common or black locust, and Douglas-fir in mixture may succeed, but their chances of success on adverse sites are small.

Soils of the shale hills more frequently offer serious problems in reforestation than do those derived in whole or in part from sandstone materials. Experience shows that mattock or bar planting of sturdy seedling trees with a spacing of 4 to 6 feet apart will succeed best. White pine and spruce require rather close spacing, whereas light-demanding trees can be spaced wider. Cultivation of the soil to aid in the re-establishment of trees has not proved profitable. Cutting of brush, briers, and rank weeds or grass on spots where these prevail is often helpful.

A good forest plantation will stop all erosion on most areas and is an excellent investment for many abandoned fields. Within 15 years some posts and fuel can be taken out, and thereafter at 5-year intervals the landowner should take out the trees that are crowding better associates. The final harvest of saw timber will be realized 50 to 80 years after planting, depending on site, kind of tree, and character of treatment.

MORPHOLOGY AND GENESIS OF SOILS

Soils, like plants and animals, differ greatly in their mode of genesis and in their morphological characteristics. Physical and chemical characteristics of soils are partly inherited from the parent rocks and are partly acquired through the interaction of soil-forming processes.

Soil is the product of the forces of weathering and soil development acting on the parent soil materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point depend on (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life in and on the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of development have acted on the material. External climate, although important in its effects on soil development, is less so than internal soil climate, which depends not only on temperature, rainfall, and humidity, but also on the physical characteristics of the soil or soil material and on the relief, which, in turn, strongly influences drainage, aeration, runoff, erosion, and exposure to sun and wind.

The mineral part of a soil is inherited almost entirely from the parent rock, but the inherited mineral materials are altered by chemical changes and become quite different from the minerals of the parent rock. The extent of alteration depends on the intensity of weathering and on the length of time of exposure. The mineral components of soils of the Hagerstown and Duffield series, as well as of many other soils, are partly inherited from the parent rock, which underlies the soil, but they have been modified sufficiently by processes of weathering to change their character considerably. Some colors of the parent rocks persist in the soil after a very long period of weathering and soil formation, whereas others are rapidly changed by soil-forming processes. Acquired soil colors are generally the result of the effects of temperature, rainfall, vegetation, and natural drainage on a soil. Other acquired soil characteristics are acidity or alkalinity, structure, and the number and thickness of soil horizons.

After making detailed studies of the soils of the United States over a period of many years, Marbut (*28*) pointed out that many well-drained soils of the medium to gently sloping uplands within certain broad regions have one or more characteristics in common. On the basis of his observations he classified these well-drained upland soils in two great groups: (1) Pedocals, soils in which calcium accumulates somewhere within the profile, and (2) Pedalfers, soils in which iron or aluminum oxides or both accumulate in upper soil horizons, and carbonates of magnesium and lime and other bases are leached from the upper horizons and in many places are carried away almost completely from the upper part of the parent material. The Pedocals occupy the semiarid and arid regions of the western half of the United States where the effective annual precipitation is generally low or very low. The Pedalfers occupy the eastern half of the United States and humid parts of the western half where the effective annual precipitation is medium to high.

These two great groups of soils are sufficient for the classification of the well-drained soils of the moderately to gently sloping uplands, but they are not satisfactory if all soils are to be taken into consideration. For this reason a revised classification was prepared in 1937 and 1938, in which it is possible to place not only the well-drained soils of moderately to gently sloping uplands but also the imperfectly and poorly drained ones, those that are very shallow and lie on steep slopes and those that consist of freshly deposited materials (*5*). In this classification both the Pedocals and the Pedalfers belong to the order of zonal soils; the imperfectly and poorly drained soils belong to the order of intrazonal soils; and the shallow soils of steep slopes and the recently deposited alluvial soils belong to the order of azonal soils.

The deeper, more strongly developed soils of Huntingdon County are Pedalfers, according to Marbut (*28*), or, according to the more recent classification, to the suborder of light-colored podzolized soils of timbered regions, which is a suborder of the zonal soils. Within this suborder two great soil groups are represented in Huntingdon County: (1) The Gray-Brown Podzolic soils, including Hagerstown, Duffield, Frankstown, Murrill, Rayne, Laidig, Elk, Holston, Cassville, Clymer, and Morrison soils; and (2) Podzols, which include only the Leetonia soils. The intrazonal order of soils in Huntingdon County is represented by the suborder of hydromorphic soils and the following great soil groups: (1) Planosols, including the Buchanan (half-Planosols), Monongahela, and Ernest soils; (2) Half Bóg soils—Warners silt loam, included in areas of Philo silty clay loam; and (3) Bog soils—muck. The azonal order of soils is represented by: (1) Lithosols, including members of the Berks, Gilpin, Calvin, Amberson, Lehew, and Dekalb series; and (2) Alluvial soils of the Huntington, Lindside, Moshannon, Senecaville, Pope, Philo, and Atkins series. It should be noted that some of the alluvial soils are well drained, some are imperfectly drained, and some are poorly drained. The imperfectly and poorly drained ones approach the intrazonal hydromorphic soils in characteristics.

All the soils of the county were developed under a humid, temperate climate where the precipitation ranges from approximately 40 to 45 inches a year and under a cover of hardwood forests, mainly of chestnut and oak. The forest provided an abundance of leaves, from which was developed a mat of partly decayed organic material and granular black humus over most of the soils. In the limestone valleys the partly decayed mat of leaves was not so thick as elsewhere and the dark humus was largely incorporated in the upper 3 or 4 inches of soil. Organic acids from the leaves have been carried into the mineral soil by percolating water, and they have leached this part of the profile of the greater part of its soluble minerals, including lime and other bases and part of the iron and aluminum. Some of these materials have been removed completely from the soil and the upper part of the parent material, and some of them, especially the compounds of iron and aluminum, have been deposited in the subsoil.

Most of the Gray-Brown Podzolic soils of Huntingdon County have been developed in the lower parts of the county and on heavier textured materials than the Podzols. The following are the characteristics of Gray-Brown Podzolic soils as found in Huntingdon County:

A_0. Forest litter, mainly of partly decomposed leaves and twigs over an acid humus spongelike layer resting on the mineral soil. The lower part generally blends with the mineral soil.

A_1. Dark-gray mineral soil containing much incorporated humus. The medium- and heavy-textured soils have a crumblike structure, and the individual aggregates are soft and porous and easily crushed in the fingers. In the soils developed from limestones this horizon is generally only slightly acid in reaction, but in soils developed from acid rocks it is medium to strongly acid. The thickness in few places exceeds 2 inches.

A_2. A brownish-gray to yellowish-gray eluviated horizon that is considerably lighter textured than the horizon below. The structure is not well defined, although in places the soil breaks into ill-defined thin plates. This is the most strongly acid horizon in the profile ranging from medium or strongly acid in the soils of the limestone valleys to very strongly acid in the soils developed from acid shales and sandstones. The horizon contains little organic matter. It ranges from 3 to 20 inches in thickness and averages approximately 12 inches.

B. Brown or yellowish-brown material that is heavier in texture than the horizon above, ranging from sandy clay loam to silty clay loam or silty clay, depending on the character of the parent material. In the heavier textured soils this horizon generally breaks into subangular and rounded nutlike aggregates. These aggregates range from ¼ to ¾ inch in diameter, and the average size of the aggregates increases with depth. In some places in the lower part of the horizon the aggregates are more sharply angular and might be more accurately described as blocky. The larger aggregates in soils developed from limestones break down into small hard sharp-angled grains ranging from less than 1/16 to about ¼ inch in diameter. In lighter textured soils the structure is not well defined. Where the soils are developed from red shales and sandstones the red color of the rock may be partly preserved in this horizon. The reaction is medium to strongly acid. The thickness of this horizon is from about 1 foot to about 18 inches.

C. This is the physically and chemically weathered parent material the color of which depends largely on the color of the parent rock. Where the rocks are red this material is generally of a red hue, but where the rocks are gray the parent material is likely to be yellow or grayish yellow.

D. The parent rock of limestone, shale, sandstone, or colluvial or alluvial materials.

The Podzol soils of Huntingdon County are developed mainly on the high humid and cool mountains. They are especially well developed in materials that are the product of the weathering of sandstones, and not many extensive areas have been developed from shales or red fine-grained sandstones. Apparently climatic conditions are such in Huntingdon County that only the materials high in quartz develop into Podzols. In northern Minnesota and other areas farther north, Podzols are developed from much heavier parent materials and even from parent materials that contain a large proportion of limestone fragments. Evidently Huntingdon County is on the margin of the tension zone between the Podzols of cool moist climates and the Gray-Brown Podzolic soils of temperate humid regions, and Podzols can form only in the cooler parts on highly siliceous materials. Leetonia stony sandy loam and stony fine sand are the only representatives in Huntingdon County of the great group of Podzols. The following is a description of Leetonia stony sandy loam:

A_0. Undecomposed forest litter, mainly leaves and twigs, over a very strongly acid raw humus mat, which rests directly on the mineral soil. This layer is held together by the fine feeder roots of trees and shrubs and it can be lifted from the mineral soil much as a rug is lifted from a floor.

There is no layer of well-decomposed humus at the line of contact. The thickness ranges from a mere film to 3 inches.

A_1. A very thin layer of a very dark gray mixture of sand and black humus. In many places this horizon is lacking entirely.

A_2. Very light gray stony sandy loam without well-defined structure. In some places there is a slight lavender tint to this material. The thickness of the layer varies considerably within very short distances, and the maximum thickness is about 14 inches in Huntingdon County. The reaction is very strongly acid.

B. Coffee-brown or rusty-brown stony sandy loam, slightly indurated in some places. The color becomes lighter with depth, and the lower part of the horizon is dark yellow or brownish yellow. The total thickness may be as much as 10 or 12 inches, but it is generally much less. In most places the darkest part of the horizon is not more than 2 inches thick. The reaction is strongly acid.

C. Weathered fragments of sandstone and hard shale. The material between the fragments is yellow fine sandy loam that is strongly acid in reaction. The thickness ranges from 1 to 4 feet.

D. Unweathered or partly weathered rock, largely of quartzite sandstone containing a few layers of hard shales.

All the intrazonal soils of Huntingdon County belong to the suborder of hydromorphic soils. They are all either gray or mottled in the deep horizons, and the more poorly drained members are mottled in the subsoils and the surface soils as well. The Buchanan soils, developed on old high terraces and colluvial fans in association with the Laidig soils, have compact subsoils and mottled lower subsoil layers. The compaction is hardly sufficient to class these soils as Planosols, but they might be considered as intermediate between the Gray-Brown Podzolic soils without hardpans and the true Planosols with hardpans or claypans. The imperfect drainage of the Buchanan soils is due to impervious strata immediately beneath the parent material.

The Monongahela soils have well-developed claypans above the heavy parent material, and they can be classified as true Planosols. The profiles are podzolic in character, and the A_2 horizon is more strongly leached and lighter colored than the A_2 horizon of the normal Gray-Brown Podzolic soils.

The Ernest soils have developed on seepy slopes where the parent material has accumulated through local wash and through the effects of gravity. Most of these soils have fairly well developed hardpans, which would place them in the great group of Planosols. The Lickdale soils occupy wet swales of the uplands and can be classified as Half Bog soils, although, as mapped, there is some overlap between them and the Planosols. They include a few very small areas where there is an accumulation of muck a few inches thick over the surface.

The soils of steep slopes may nearly all be included in the Lithosols—a great group of soils in which the outstanding characteristics are the shallowness of the soils and the lack of any strong profile development. Partly weathered fragments of the parent rock are scattered through the soil and in many places lie on the surface. Where the rocks are soft the Lithosols show somewhat more evidence of profile development than where the rocks are hard; and there is no sharp line of demarcation between the Lithosols and the neighboring Gray-Brown Podzolic soils and Podzols.

Some of the Berks soils, especially Berks silt loam, heavy-subsoil phase, have some definite profile development. Furthermore, in many imperfectly drained spots the soils grade toward the suborder of hydromorphic soils. Berks silt loam in many places has the beginnings of a true B horizon, but it is nowhere well developed. Berks shale loam consists largely of fragments of shale mixed with some silty soil material and has no suggestion of a B horizon. The Gilpin soils are developed from acid shales and fine-grained sandstones and typically have no B horizons. The Calvin soils, developed from red acid shales, typically have no well-defined B horizons. Although the Amberson soils are somewhat similar to the Calvin in color, the parent materials are less acid, and as a result the soils are better from an agricultural point of view.

The Calvin-Edom soils are a complex of narrow strips of Calvin soils interwoven with narrow strips of Edom soils, which are developed from slightly calcareous grayish-yellow shales. In much of the area the two kinds of parent materials have been mixed by the slow downhill creep of weathered materials.

Developed from red acid sandstones and shales of the mountains, the Lehew soils are comparatively shallow but are deeper than the Calvin and Amberson soils. They are so stony that most of them cannot be used for crops.

The Dekalb soils are formed from weathered sandstone and hard shales that are strongly acid in reaction. These soils have no well-defined B horizons, but the shattered and weathered parent rock extends to a depth of several feet in places, so that there is room for the expansion of tree roots. The Dekalb soils are mostly rather stony and unsuitable for cultivation.

The Leetonia, Dekalb, and Morrison soils are the most acid and grayest of the well-drained soils in the county. The extremely acid reaction of these soils favors the removal of iron from the surface soils, and as a consequence the soils are very light colored.

The alluvial soils of the river bottoms include the slightly acid to neutral well-drained Huntington soils and the imperfectly drained Lindside soils. The Moshannon soils are well drained and consist of reddish-brown materials washed from areas of Amberson and Calvin soils. They are medium acid in reaction. The Pope, Philo, and Atkins soils are, respectively, the well-drained, imperfectly drained, and poorly drained acid alluvial deposits washed from the shale and sandstone uplands.

The chemical composition of the mineral part of the parent soil and rock materials has greatly influenced the rate of podzolization in any given soil. Where the parent materials are rich in basic elements, podzolization has been reduced to a minimum; but, where the parent materials are low in bases and high in silica, the podzolic leaching has been rapid.

Practically all of the soils of south-central Pennsylvania have been subjected to rapid geologic erosion for a very long period of time. The total area where the soil material has been allowed to accumulate and to develop a mature profile is considerably smaller than the area of immature soils. This accounts for the fact that such a large proportion of the soils belong to the Lithosol group of azonal soils.

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