

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE PENNSYLVANIA STATE COLLEGE, SCHOOL
OF AGRICULTURE AND EXPERIMENT STATION,
R. L. WATTS, DEAN AND DIRECTOR.

SOIL SURVEY OF BLAIR COUNTY,
PENNSYLVANIA.

BY

J. O. VEATCH, OF THE U. S. DEPARTMENT OF AGRICULTURE, IN
CHARGE, AND HARRY P. YOUNG AND H. P. COOPER,
OF THE PENNSYLVANIA STATE COLLEGE.

HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1915.]



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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., September 6, 1916.

SIR: In the extension of the soil survey in the State of Pennsylvania during the field season of 1915 a survey was undertaken in Blair County. This work was done in cooperation with the State of Pennsylvania, and the selection of the area was made after conference with State officials.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1915, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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MAP.

Soil map, Blair County sheet, Pennsylvania.

SOIL SURVEY OF BLAIR COUNTY, PENNSYLVANIA.

By J. O. VEATCH, of the U. S. Department of Agriculture, In Charge, and HARRY P. YOUNG and H. P. COOPER, of the Pennsylvania State College.—Area Inspected by HUGH H. BENNETT.

DESCRIPTION OF THE AREA.

Blair County is situated in the south-central part of Pennsylvania. It is bounded on the north and east by Center and Huntingdon Counties, on the south by Bedford County, and on the west by Cambria and Clearfield Counties. It has an area of 534 square miles, or 341,760 acres.

The topography in general is mountainous and hilly. Some of the valley areas are rolling or only moderately hilly, but most of the land throughout the county is characterized by rather steep slopes. The major topographic features have a general northeast-southwest trend and consist of a high, mountainous plateau belt on the west and two broad parallel valleys, separated and inclosed by high, narrow mountain ridges, in the central and eastern parts of the county. The elevation above sea level ranges from a little less than 900 feet to slightly more than 3,000 feet.

The county lies partly within two of the major physiographic provinces of the eastern United States—the Allegheny Plateau and the Appalachian Valley.

The two divisions are separated by a bold, eastward-facing escarpment, 400 to 800 feet high, which is a part of the Allegheny Front. The western part of the county is embraced in the Allegheny Plateau division and consists of a high, rolling to nearly level plateau dissected by deep, eastward-flowing creeks and ravines. The general elevation of the plateau surface ranges from about 2,300 to 3,000 feet above sea level. The trend of the Allegheny Front is northeast-southwest and the width of the plateau belt in this county increases from about 1 mile in the extreme southern part to about 7 miles in the northern part of the county.

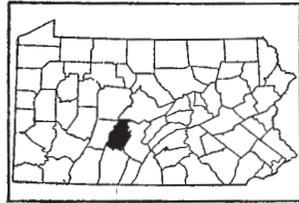


FIG. 1.—Sketch map showing location of the Blair County area, Pennsylvania.

A high plateaulike area also occurs in the southwestern part of the county, near Blue Knob, and in this area there are a few high knobs detached by erosion from the Allegheny Plateau to the west.

To the eastward of the Allegheny Front there is a valley belt, ranging from about 3 to 8 miles in width. The elevation of this belt at the base of the Allegheny Front is 1,600 to 2,300 feet above sea level. From here there is a slope to the east, marked by two or three steps or poorly defined escarpments, to elevations of 1,000 to 1,200 feet. The topography is broken and rugged on the west, being characterized by steep slopes, but gradually becomes more subdued toward the east, giving way to the smoother, more rounded slopes of the minor valleys known as Bald Eagle and Logan Valleys and the narrow, longitudinal valley occupied by the Frankstown Branch of the Juniata River.

This broad central valley belt is terminated on the east by a mountain barrier which is continuous across the county except for small stream gaps. It includes Bald Eagle, Brush, Canoe, Lock, Loop, Short, and Dunning Mountains. These mountains range in elevation from about 1,800 to 2,500 feet above sea level. They are characterized by very narrow crests, which appear to be nearly even and level when viewed from a distance, and by steep, precipitous, wall-like slopes or escarpments at the top. The lower slopes on both sides are generally flaring, with a more gradual decrease in elevation. Near Frankstown there is a sinuous flexure to the east in what is nearly a continuous linear ridge, and a long, canoe-shaped valley, extending about one-half the length of the county, is inclosed by the loops of the mountain crests. This lowland is a part of the broader valley belts to the west, with which it is connected by a constriction or neck traversed by the Juniata River. This division of the central valley belt of the county is characterized by hilly topography and includes several subordinate narrow, longitudinal valleys, as Turkey Valley and Scotch Valley.

Inclosed by the series of high mountain ridges described above and the high, linear mountain ridge (Tussey Mountain) which forms the eastern boundary of the county, there is a broad northeast-southwest limestone valley, which forms one of the principal topographic features of the county. This valley is known as Morrisons Cove. The valley at the south has a width of 7 or 8 miles, but narrows to about 3 miles near Williamsburg, where it is known as Canoe Valley, while within a short distance to the north it again expands and merges into the Nittany Valley of Huntingdon and Center Counties. Sinking Valley, a small, wedge-shaped area in the northern part of the county inclosed by a fold in Brush Mountain, is a part of the major Nittany-Morrisons Cove Valley. These limestone

valleys have a rolling to moderately hilly topography, and the general elevation of the valley plain is about 1,100 to 1,400 feet above sea level, while the crests of the inclosing mountains are 700 to 1,000 feet higher. Most of the valley hills have nearly uniform altitudes, and the surface appears to have been a nearly level or graded plain before the present cycle of stream erosion began. In a few places there are low, broad sandstone ridges included in the valley. These are prominent topographic features, although in general they rise only 50 to 300 feet above the level of the surrounding valley plain.

High, narrow benches or erosion terraces, lying 100 to 400 feet lower than the narrow crests of the Appalachian Valley Mountains, are conspicuous features of the topography. The benches are parallel to the crests and are continuous with the mountains, except where they have been dissected by transversely flowing streams. They vary from 100 yards to three-fourths mile in width and range in topography from nearly level to rolling.

The drainage of the county as a whole is quite irregular. The general direction of stream flow, however, is northward and eastward, the county being drained by the upper tributaries of the Juniata River, which flows into the Susquehanna. The streams issuing from the Allegheny Plateau flow eastward and join the north and south flowing tributaries of the Juniata at nearly right angles near the western bases of Bald Eagle, Brush, and Dunning Mountains. In the Appalachian Valley division each subordinate valley has to some extent its own peculiar drainage system. The direction of the streams has in general been determined by geologic structure and existing topographic features, although the courses of the larger streams are in places quite independent of both these influences, and occasionally they have cut deep, narrow gaps directly through mountain barriers. There are no very large streams in the county, but all parts of it are reached by small branches or ravines, so that no extensive level or poorly drained tracts remain. The stream currents are rapid, and the channels are being cut to lower levels, with but little aggradation.

The population of Blair County, according to the census of 1910, is 108,858, of which 37.2 per cent is classed as rural. The density of rural population is about 75 persons per square mile.

The first settlement in the region which embraces Blair County is supposed to have been made in 1756, and other settlements are known with certainty to have been made shortly after this date in Morrisons Cove and Scotch and Turkey Valleys. The early settlers were mainly Scotch-Irish and German. The farming population is now almost entirely of native birth, the foreign element being mainly employed in the mines and quarries and by the railroads. The population is centered in the valleys, where the lands are most productive

and accessible. In places there are large tracts of mountain land entirely uninhabited. While agriculture is a very important industry in the county, the greater part of the population is employed in or directly dependent upon factories, railroad shops, quarries, mines, and lumbering.

The main line of the Pennsylvania Railroad between Philadelphia and Pittsburgh crosses the county and branches of this system traverse all the valley areas, affording good transportation facilities for farm products. The main public highways are macadamized, have easy grades, and are kept in excellent repair by the State and county. All parts of the county, except the rougher and more mountainous sections, are easily accessible.

Most of the farm products are marketed locally, Altoona, a city of 52,127 inhabitants, being the chief center of trade. Tyrone, Hollidaysburg, Williamsburg, and other smaller places where manufacturing or quarrying are important afford good markets for farm produce.

CLIMATE.

There are no complete weather records available for Blair County. The records of the Weather Bureau station at Huntingdon, a few miles to the east, are, however, probably in the main representative of local conditions, and various data of importance in relation to agriculture, compiled from the records of the Huntingdon station, are presented in the table below.

The mean annual temperature at Huntingdon is 50.4° F., the mean for the winter season being 29.5°, and that for the summer, 70.3°. The highest recorded temperature is 104° and the lowest -23°. Frosts not infrequently occur late in May, and light frosts have been known to occur in August. Wheat is subject to injury from freezing unless protected by snow. The growing season, however, is generally long enough to produce the staple farm crops—corn, wheat, and oats—except in the highest parts of the county, where corn frequently fails to mature. Pasturage for stock is available for about six months in the year. The records of the Weather Bureau station at State College, 20 miles northeast of the northeast corner of Blair County, show the average date of the last killing frost in the spring as May 9 and that of the first in the fall as October 2; the latest killing frost recorded here occurred May 29 and the earliest in the fall on September 16.

The mean annual precipitation amounts to 42.37 inches. The rainfall is well distributed throughout the year, being slightly greater in the spring and summer than in the fall and winter. Droughts of short duration occur during the summer months, but dry weather

seldom causes crop failures or even serious reductions in yields. The county lies in a region having about 40 inches of snowfall.

There are slight variations in temperature and precipitation in different parts of the county, attributable to differences in altitude. Crops generally mature about two weeks earlier in the valleys of the southeastern part of the county than on the mountain lands of the western and northwestern parts. Fruit and truck crops also seem less likely to be injured on the mountains and on the higher hills, where there is good air circulation, than in the lower valleys.

The following table gives the normal monthly, seasonal, and annual temperature and precipitation as recorded at Huntingdon:

Normal monthly, seasonal, and annual temperature and precipitation at Huntingdon, Huntingdon County.

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1895).	Total amount for the wettest year (1890).
	°F.	°F.	°F.	Inches.	Inches.	Inches.
December.....	32.1	68	- 9	3.19	2.99	3.35
January.....	28.6	72	-19	3.22	5.16	3.00
February.....	27.9	68	-23	2.88	0.46	5.18
Winter.....	29.5	72	-23	9.29	8.61	11.53
March.....	38.3	85	- 7	3.94	1.42	3.61
April.....	49.1	93	16	2.98	1.97	4.91
May.....	60.4	98	22	4.91	3.01	6.36
Spring.....	49.3	98	- 7	11.83	6.40	14.88
June.....	68.4	99	36	4.40	4.78	4.18
July.....	72.0	104	33	4.07	3.15	4.56
August.....	70.5	102	38	4.01	1.46	4.40
Summer.....	70.3	104	33	12.48	9.39	13.14
September.....	64.5	99	28	3.28	1.26	3.55
October.....	51.9	78	17	3.01	1.09	5.04
November.....	41.4	68	0	2.48	1.07	1.38
Fall.....	52.6	99	0	8.77	3.42	9.97
Year.....	50.4	104	-23	42.37	27.82	49.52

AGRICULTURE.

The early settlers in this region from necessity followed a mixed system of farming, growing mainly subsistence crops and raising most of the various products required for domestic use. Corn was the principal crop. Rye was more important than wheat until about

1850. With the development of other industries and of better transportation facilities and with increase in population gradual changes have been brought about in the agriculture. Rye has become a minor crop; wheat, although remaining a staple money crop, has lately decreased in relative importance compared with corn and hay, and cattle raising has almost ceased to be carried on, largely because of the closing of free pasture lands. In those sections of the county most suitable for general farming dairying has been developed and greater attention has been given to producing fruit and truck crops to supply the demands of growing local markets. At the present time the prevailing system of agriculture is general farming. Dairying, fruit growing, and trucking, carried on in connection with general farming, vary in importance in different sections of the county according to a number of factors, including soil conditions, topography, and location with reference to markets. The following table gives the acreage, production, and value of the principal crops as reported by the census of 1910:

Acreage and production of principal crops, census year 1910.

Crop.	Acreage.		Production.		Average yield per acre.	Average for State.	Value of crops.
	Acres.	Tons.	Tons.	Bushels.	Tons.	Bushels.	Dollars.
Hay.....	22,776	26,085	1.14		1.38		1 383,441
Corn.....	14,996	405,207	27.02	41			} 2 698,118
Wheat.....	13,861	225,646	16.3	17.8			
Oats.....	11,605	267,602	23	35.2			
Rye.....	2,439	26,905	11	17			
Buckwheat.....	1,753	20,422	11.6	19.5			
Barley.....	482	11,341	23.5	26.5			
Potatoes.....	2,350	182,278	77.5	88			
Vegetables.....							3 256,964
Fruits and nuts.....							162,522

¹ Value of all hay and forage.

² Value of all cereals.

³ Including value of potatoes.

Soft winter wheat is the staple income crop and is grown on practically all the soils of the county. All the grain is sold, with the exception of such quantities as are required by farmers for making flour for home use. The average yield of wheat for the county in 1909, according to the census, was 16.3 bushels per acre. Yields range from 20 to 25 bushels per acre on the limestone-valley soils and from 12 to 15 bushels per acre on certain thin shale soils and rough mountain land not so well adapted to the crop.

The acreage of corn is slightly greater than that of wheat. Corn is grown on practically every farm except a few that are devoted to truck and fruit and a few farms lying at high altitudes. The average

yield for the county is about 27 bushels per acre. On thin shale and mountain soils poorly suited to this crop the yields range from 12 to 15 bushels per acre, while on the better limestone and bottom-land soils as much as 50 bushels¹ per acre is obtained. All the corn is consumed on the farms, principally by the work stock and hogs. On farms on which dairying is carried on it is the chief silage crop. Dent corn is grown almost exclusively, the most common varieties apparently being strains of Reids Yellow Dent, Whitecap, and Silver King, the latter a white variety.

The acreage of oats is slightly less than that of corn or wheat. This crop is grown on all the farms where general farming is carried on, following corn in the rotation. The average yield per acre is about 27 bushels. Medium-late varieties of white oats are sown. The crop is largely consumed on the farm in feeding work stock, but on the more productive lands there is commonly a small surplus for sale.

The hay crops occupy a larger acreage and have a greater value than any of the cereals. The principal hay crop is a mixture of timothy and red clover, of which the average yield is about 1½ tons per acre. A considerable quantity of timothy and alsike mixed is produced on some of the bottom lands and the more poorly drained soils. Timothy alone was grown on 8,319 acres in 1909. Wild carrot is the most serious weed pest in the hay fields. Generally much the greater part of the hay crop is consumed on the farms, most of that sold coming from farms on which dairying is not carried on.

Rye has ceased to be an important grain crop, the acreage in 1909 being only about one-fifth that of wheat or oats. Rye is grown mainly in the western part of the county and to a large extent on thin shale soils or rough mountainous land. Yields range from 10 to 20 bushels per acre, the average for the county being low, owing principally to the fact that little attention is given to manuring and fertilizing the land. Most of the crop is fed, but small quantities of both grain and straw are sold.

Vegetable production on the market-garden plan is an important industry in the county because of the excellent local markets. There are a large number of small farms devoted entirely to the production of truck crops and small fruits, and in addition a very large percentage of the farms which carry on general farming derive a considerable part of their income from small truck patches, particularly in the western part of the county. The common garden vegetables, including cabbage, sweet corn, rhubarb, celery, and tomatoes, are most generally grown. The light-textured bottom-land soils near

¹ Locally most farmers estimate yields by measured bushels in ear. The figures given in this report are bushels by weight.

Altoona and other places in the western part of the county and the well-drained shale soils and certain stony loams favorably situated but unsuitable for general farming are successfully used for trucking. Very little truck is shipped from the county.

Fruit is grown on practically every farm for home use, as well as for sale in the local markets, and a considerable part of the farm income is derived from this source. There is a large acreage of cheap land in the county well suited to fruit growing, although as yet only a few large commercial orchards have been established. The farm orchards range in size from 2 to 8 acres. Apples, the principal fruit grown, do well on practically all the soils. It is only in years of unusually bountiful crops that any considerable quantity of apples is shipped from the county, except from the few large commercial orchards. Peach trees grow well and produce a fair quality of fruit on several soil types, although on the whole the crop has been found less certain and less profitable than apples. Cherries and plums are successfully grown on most farms, and pears do fairly well on a number of soil types in the Appalachian Valley division.

Small fruits, consisting mainly of raspberries, strawberries, and currants, are the principal source of income on many small farms. There is a large acreage of stony land in the county, favorably situated with reference to markets but unsuited to general farming, that could profitably be cleared and used for the production of small fruits. There are a few small vineyards on shale loam soils in hillside situations in the central part of the county.

Irish potatoes are the most valuable of the minor crops. Potato growing has not, however, become a specialized industry, being for the most part an adjunct to general farming. The crop usually is grown in patches ranging in size from one-half acre to 4 acres. In favorable years yields of about 100 to 125 bushels per acre are obtained. Most of the shale loam and sandy loam soils are suited to potatoes, and their production might be profitably extended if more attention were given to cultivation and fertilization. Potatoes mature about August 15 to September 1, the time varying according to the elevation and the nature of the soil on which the crop is grown.

Buckwheat is grown in patches, principally upon the stony loam and shale loam soils in the western part of the county. The fields are commonly 1 to 4 acres in extent and rarely as large as 8 or 10 acres. Yields range from 10 to 20 bushels per acre. Most of the buckwheat is consumed on the farms, a part of it being ground into flour and a part fed to poultry and stock. A small quantity is sold to local mills.

Alfalfa has been grown successfully in a small way, but has not yet become an important crop. Most of the successful attempts to grow this crop have been made on the Hagerstown silt loam and

clay loam, but fairly good yields have been obtained on the Duffield clay, the Murrill gravelly loam, and at one place on the Huntington loam. The more extensive growing of this legume would probably prove remunerative, especially on the farms where dairying is carried on throughout the year.

There is a very small acreage of barley, the grain being utilized on the farms for feed. Soy beans are grown in a small way for forage and for the purpose of soil improvement. The acreage might profitably be increased, especially on thin shale soils and the sandy types most deficient in organic matter. Millet occasionally is grown as a catch crop.

As a general rule the farms produce sufficient meat, vegetables, and fruit to supply the home and sufficient grain to provide the bread required by the family.

Dairying is an important industry in the limestone valleys and is also carried on to some extent on the more easily cultivated slate-hill lands. Dairying is carried on throughout the year, the herds being pastured in the summer months and fed in the barns in the winter. The value of corn silage as a winter feed is generally recognized and the number of silos is increasing yearly. Corn is the principal grain fed and timothy and clover and oat and wheat straw constitute the principal forage. Farmers conveniently situated with respect to railroads and the Altoona market ship milk, while those in localities less favorably situated sell cream and butter.

The cattle are mostly of the dairy type, grades of Holstein and Jersey predominating. Probably not a dozen farmers in the county make a business of feeding cattle for beef. Nearly every farmer keeps enough hogs to supply the home with meat and to provide a small surplus for the local markets.

Sheep raising is not so important as in former years, although a considerable number of farmers in Sinking Valley and other parts of the county maintain small flocks and find them profitable. There is a large acreage of steep hillside land in the county, poorly suited for cultivated field crops, which might be very profitably maintained in permanent pastures for sheep.

There are some notable and striking differences in farm practice and crops in different parts of the county, due to variations in the character of the soils and in the topography and altitude. The broader limestone valleys, such as Morrisons Cove, Canoe Valley, and Sinking Valley, are rolling or only moderately hilly, permitting the use of modern farm implements in tilling the soil and harvesting crops, while the texture and structure of the soils are well suited to the production of grain and hay. Therefore, general farming, with dairying as an adjunct, can be profitably carried on.

On the other hand, the steep topography and stony character of the soils in the western part of the county and on the slopes of the Appalachian Valley ridges preclude general farming on an extensive scale, for only a small proportion of the land in individual farms is easily cultivated and the cost of clearing the stony land is excessive. Owing both to the more favorable topographic situation and to the character of the soils, the rougher parts of the county seem to be better suited to fruit growing than the valley lands. Fewer animals are kept on the farms here, while, on account of the greater cost, smaller quantities of lime and commercial fertilizer are used for the general farm crops, and the farm income is derived mainly from the sale of fruits, vegetables, and minor products, rather than from general farm crops or from industries directly dependent upon them.

The topography of the land and the absence of stones has also greatly influenced the size of the farms or more especially the acreage of improved land per farm. There are many farms on the stonier and rougher lands that have only 10 to 30 acres under cultivation, while in the valleys the farms range in size from 100 to 200 acres, with 90 per cent or more of the area improved.

There has been in general a recognition of special adaptation of certain soils to certain crops and industries. Light-textured soils have in many instances been intentionally chosen for growing truck, but in many instances nearness to markets or good roads rather than the character of the soil has been the determining factor.

Modern farm implements are in use in the limestone-valley areas. Manure spreaders are seen on all the more prosperous farms, and the economy of lime spreaders as compared with the old methods of distributing lime by hand from wagons or from heaps in the field is recognized. Corn binders are coming into more common use, although by far the greater part of the crop is still cut by hand. Much of the land in grain is too steep for the use of binders, and on such fields the crop is still cut with cradles or, in a few places, with the old self-rake reapers.

Crop rotation is practiced on all farms where general farming is carried on, the most common plan being a 4-year or 5-year course consisting of corn, oats, wheat, and grass (timothy and clover). The hay or grass land is plowed in the spring for corn and generally harrowed and sometimes rolled. Oats follow corn, the common practice being to plow the land in the spring and drill in, rather than broadcast, the seed. For wheat, the oat stubble is plowed in the late summer or early fall, the land usually being harrowed and rolled and the seed sown with a drill. Sowing is done in September and October. Wheat generally is grown only one year, but on some of the more productive fields two crops in succession are seeded. Timothy is sown with the wheat in the fall and clover the following

spring. Hay commonly is cut for one or two seasons and the land pastured. The second year the timothy to some extent crowds out the clover. Much of the hay land throughout the county is excessively weedy, wild carrot being particularly abundant, greatly lowering the quality of the hay, especially the second crop.

Lime is in general use for all soils where the cost is not prohibitive. The general rule is to make applications once in every rotation period, but where lime can be cheaply obtained many farmers still follow the practice of spreading a large quantity of burned or slaked lime at intervals of 10 or 15 years. The quantity varies according to soil texture and other factors, and usually ranges from 50 to 150 bushels per acre, while there are a few instances in which 200 to 300 bushels have been used. It is possible that excessive applications are made in some cases, reasoning from the known effects of lime on soils in oxidizing organic matter and in liberating mineral plant food, although visible injury to plant growth due to caustic action may not be observed.

Barnyard manure generally is considered the most efficient fertilizer, especially where general farming is carried on, and in conjunction with lime is chiefly relied upon to maintain the productivity of the soil. The largest applications of manure are commonly made to corn land.

Commercial fertilizer is used, mainly to supplement barnyard manure, both in general farming and in vegetable growing. Fertilizers have come into common, although not universal, use throughout the county, where the cost of hauling is not prohibitive. They are used especially for wheat and to a less extent on other grain crops. The applications generally are small, ranging from 100 to 200 pounds per acre. A phosphatic fertilizer of an 8-2 or 10-2 grade is in most common use, although various grades, some containing as much as 5 to 10 per cent of potash, are purchased. Some high-grade nitrogenous and potash fertilizers are used on truck farms, although manure is mainly relied upon.

Farm labor is rather scarce and most of the work is done by the farmer and his family. The ordinary wages of farm hands is about \$30 a month and board, employment being usually only for the busier seasons. On most dairy farms labor is hired by the year and is more easily obtainable, the wages in this case ranging from \$20 to \$25 a month.

The census of 1910 reports 51.6 per cent of the land area of the county in farms, of an average size of 94.6 acres, of which 63.1 acres are improved. The total number of farms is reported as 1,865. Owners operate 69.3 per cent of the farms, tenants 27.8 per cent, and managers 2.9 per cent. The share system of leasing is generally followed.

The price of land ranges from \$5 to \$10 an acre for mountain land that is rough or difficult of access to \$150 an acre for the most highly improved farms in the limestone valleys. Valley farms of ordinary productiveness sell for \$60 to \$100 an acre, depending upon location and other factors, while the hilly and less productive farms range in price from \$20 to \$40 an acre.

SOILS.

Residual, alluvial, and colluvial soils, broad soil classes based on manner of formation, are all developed within the area of Blair County. The residual soils are most numerous and most widely distributed. They have been formed by processes of weathering, are in their place of origin or, at most, have not been moved appreciable distances, and have inherited their characteristics mainly from the rock which directly underlies them.

The alluvial soils occupy a relatively small area and are as a class of less agricultural importance in this county than the residual soils. Soils of this class represent original residual material or rock detritus washed from the drainage basins of streams and redeposited in the flood plains throughout their courses.

Colluvial soils represent material which has been slowly moved short distances from higher to lower topographic positions on slopes by the action of gravity and other agencies. Colluvial accumulations, or talus, of variable extent occur at the bases of practically every hill and mountain slope, and in a region of hilly and mountainous topography such as prevails in Blair County the colluvial soils form a large aggregate area. For various reasons much of the colluvial soil has been included with adjoining residual types in the mapping, and the soil map therefore does not fairly indicate the relative extent of this class.

Texturally the loam and silt loam types of soil, modified by presence of large quantities of rock fragments, predominate. The sandy loams and the clay and clay loam types occur to about an equal extent. The stony loams occupy the largest aggregate area, but have a smaller agricultural value than other types. It is estimated that about 17 per cent of the area of the county is excessively stony and rough and of no value for cultivated crops.

Soils bear a close relation to the lithologic character of the rocks from which they are derived, and their distribution, depth, and other features which have a bearing upon the agricultural value are involved with the geologic and physiographic history of the region in which they occur. In Blair County there is a striking contrast between the varied and complex character and peculiar distribution of the soils of the Appalachian Valley division, where

a complex rock structure obtains, and the nearly uniform soils of the Allegheny Plateau, where the underlying rocks have a comparatively simple structure and no great variation in lithologic character.

The rocks of Blair County are all of sedimentary origin and consist mainly of shales, sandstones, and limestones. The rocks of the Appalachian Valley have undergone great structural disturbances, and the beds are generally inclined at high angles or have nearly vertical attitudes. There has been some extensive faulting in places, and the older formations, especially, are minutely jointed. The strike of the rock beds is in general east of north, and the groups of strata or formations, therefore, lie in northeast-southwest belts across the county.

The strata range in age from Lower Ordovician to Carboniferous. The essential facts about the distribution and structure of the rocks in relation to the soils have been obtained mainly from the Pennsylvania Geological Survey¹ and the United States Geological Survey² publications. In the absence of any recent published geologic map, except for the western part of the county, some of the older formation names and divisions of the rocks, which would doubtless be subject to change according to later knowledge of Paleozoic stratigraphy, are used. The lithologic character of the strata, however, is of prime importance in the classification of the soils.

The Ordovician rocks consist of a basal group (Calciferous formation) consisting of white sandstone or quartzite, probably calcareous, and siliceous limestones. Much of the rock appears to be transitional lithologically from nearly pure quartzite to pure limestone and dolomite. The rocks form low sandy ridges in the broad limestone valley of the eastern part of the county and weather into a distinctive soil series—the Morrison.

The limestone formations (Trenton and Chazy) overlying the Calciferous consist of gray and bluish-black, hard limestone, together with some dolomite or magnesian rocks, which contain in places cherty members. The beds are steeply inclined and minutely jointed. These rocks underlie the broader limestone valleys and give rise to the important Hagerstown soil series, which includes most of the soil locally classified as "limestone land."

The Hudson River and Utica shales, lying directly above the limestones, consist of black and olive-green, hard, and very minutely jointed slaty shales which upon weathering disintegrate into small blocks and pegs, producing a loose-structured, gravelly or fine shaly loam. The Hudson River beds dip at high angles and occur as

¹ Second Pa. Geol. Surv., Blair Co., Report I, by Franklin Platt.

² Ebensburg and Barnesboro-Patton Geologic Folios.

narrow bands at the bases of the mountain slopes inclosing Morrisons Cove and Canoe and Sinking Valleys. In most places the formation is obscured by talus from the higher slopes.

Directly above the Hudson River formation and occupying higher and steeper slopes of the mountains are grayish and greenish, thin-bedded, shaly, and massive sandstones which produce yellowish, stony soils. The high erosion benches or terraces of the mountains are underlain principally by red, fine-grained sandstones and dark-red shale, while the crests and the steep upper escarpments are composed of hard, resistant, gray or white sandstone and quartzite. The beds are steeply inclined or nearly vertical. These rocks compose the Medina-Oneida formation (Silurian). The soils vary according to the color and structure of the underlying rocks.

The groups of Silurian strata classified as the Clinton, Niagara, and Salina formations consist of gray, greenish, and red clay shales, with some interbedded thin layers of impure limestone. These rocks occupy moderate slopes on the western side of the mountain ridge which traverses the county from north to south. The complexity of the lithologic character of the strata is reflected in the resultant soils, although they have a uniform structure and are classed in a single series.

The Devonian system of rocks is represented at the base by the comparatively thin Helderberg limestone formation. This formation consists of hard, bluish-gray, nearly pure limestone and in the upper part of black and grayish, thin-bedded or shaly, impure limestone (Water-lime beds) containing some chert. The strata are steeply inclined or vertical and, together with the associated Oriskany formation, form low but rather sharp and steep-sided ridges.

The Oriskany formation is mainly a yellowish or white, heavy-bedded sandstone or grit. It is comparatively thin and therefore forms only narrow bands of sandy soil.

A broad belt of Devonian shales and sandstones lies east of and parallel to the Allegheny Front and underlies the greater part of the central valley area of the county. The lower formations consist of grayish or grayish-green, hard, sandy shales and thin-bedded, flaggy sandstones, with a smaller development of black, more fissile and more argillaceous shales along the eastern edge of the belt. These Devonian shales are the source of the soils locally known as the "gray-slate-hill lands."

The Chemung formation, a part of this group, contains a considerable proportion of chocolate-colored and brownish shale and fine-grained sandstone and produces a separate soil—the Chemung.

The Catskill formation, the youngest formation of the Devonian group, lies just beneath the Allegheny Front, and consists predominantly of dark-red, massive, jointed shale, or mudstone, and lighter

red, fine-grained sandstone, the beds varying from steeply inclined on the north to horizontal or with gentle westward dips on the south. These formations weather into a soil series (Upshur) which closely coincides in boundaries with the geological formation.

The rocks underlying the Allegheny Plateau are of Carboniferous age and include formations of both the Mississippian and Pennsylvanian (Coal Measures) series. The strata are principally gray sandstones and grayish sandy shales, with a small development of conglomerate, all giving rise to soils classed in a single series. A considerable percentage of the beds in the Mauch Chunk formation are reddish, soft shales, which, where not obscured by fragments of the associated grayish rocks and by the yellow soils, produce red soils classed in the Upshur series. The strata on the plateau are nearly horizontal or have only a moderate dip westward and do not have the complex structure which characterizes the strata in the Appalachian Valley.

Pleistocene deposits and recent alluvium, occurring both as remnants of terraces and as narrow strips of overflow bottom land, have been formed along the larger streams. The alluvial deposits are of variable character, and comparatively thin. They are described in connection with the soils to which alluvium gives rise.

The soils, while intimately related in their origin to the rocks, also bear a close relation to local topography and to the physiographic history of the region. The relation to local topography is obvious in the distribution and extent of stony soils and of nonarable land, and to the rather wide distribution of colluvial soils. Various characters of the soils as depth, the development of certain colors (except where inherited directly from the underlying rock), structure, and the general mixture of material from the different rock formations present, bear a relation to the age of the land surface and the various erosion cycles through which the region has passed. The limited development of alluvial soils is due to the fact that the streams have been rejuvenated and are engaged in deepening rather than widening their valleys.

In the classification of the soils for the purposes of mapping they are separated into series on the basis of a common origin and of similar characteristics in color, structure, and topography. The series are subdivided into soil types. The type, the unit of mapping in a detailed soil survey, is based on the texture of the soil material, or the proportions of different-sized mineral particles, as sand, silt, and clay. In Blair County 13 series, embracing 22 types, exclusive of Rough stony land, are differentiated.

The Dekalb series is characterized by yellow and grayish surface soils and yellow subsoils. This is the most widely distributed series in the county, occurring in both the physiographic divisions and oc-

cupying about 29.3 per cent of the total area. The topography is pre-vaillingly rough and hilly to mountainous. The soils are derived from sandstones and shales of a number of geological formations from Ordovician to Carboniferous, and are characterized by an entire or nearly entire freedom from influence by limestone. The material is typically residual, but in this survey some colluvial variations on mountain slopes are included. Five types are mapped in this series—the stony sandy loam, stony loam, stony silt loam, shale loam, and gravelly loam.

The soils of the Berks series are somewhat similar in color and structure to the shale soils of the Dekalb series, but are characterized by a darker color at the surface and appear to be less compact in the subsoil. They are not widely distributed, occurring only in the Appalachian Valley division of the county. The material is derived from the darker colored and more carbonaceous clay shales and slates of the Devonian and from the Hudson River shale formations. Only one type, the shale loam, is mapped in Blair County.

The Hagerstown series is characterized by light-brown to brown surface soils and yellow to dull-red subsoils, which commonly have a moderately stiff, compact structure. The soils of this series are confined to the Appalachian Valley division in the eastern and central parts of the county. The topography is gently rolling to moderately hilly. The soils are residual in origin, being derived principally from the Trenton group of limestones and to a smaller extent from the Helderberg limestone. The Hagerstown soils comprise about 16.6 per cent of the area of the county and are the most valuable soils in the county for general farming. In Blair County the series is represented by three types—the gravelly loam, silt loam, and clay loam.

The Morrison series includes yellowish to brownish surface soils and yellow subsoils. The soils of this series are similar in many respects to those of the Dekalb series, but there seems to be a sufficient limestone influence in this county to warrant their separation from the latter series. The Morrison soils occupy ridges in the valley areas and occur in association with the Hagerstown soils, being derived from the weathering of sandstone and limestone in the Calciferous and Oriskany-Helderberg formations. In Blair County two types are mapped in the Morrison series—the stony loam and sandy loam.

The Upshur series embraces the dark-red shale and sandstone soils of the county and is characterized by reddish or brownish surface soils and decidedly dark red or Indian-red subsoils. The soils of this series are widely distributed. They are residual and are derived from the red strata of the Medina, Catskill, and Mauch Chunk formations. The rocks, although belonging to widely sepa-

rated formations, have very similar lithologic character, and no considerable differences in the soils can be observed by a field examination. In Blair County two Upshur types are mapped, the stony loam and loam.

The types of the Chemung series are chocolate and lighter brown soils residual from the Chemung formation (the upper part of the Devonian group of rocks), which is composed of fine-grained, chocolate-colored mudstone or shale and fine-grained, thin-bedded sandstone interbedded with grayish-green and drab sandstone and shale. In the northern part of the county the proportion of dark-colored rock is smaller and only very thin bands appear. The soils vary accordingly, and since the yellowish and light-brown rocks predominate, the soils from this geological formation have been classified as Dekalb rather than as Chemung. The Chemung series is represented in Blair County by only one type—the stony loam.

The surface soils of the Duffield series are yellowish brown to brown in color and heavy and intractable in structure. The subsoils are yellowish to reddish yellow in color and stiff and plastic in structure. These soils are residual from the variegated shales and interbedded impure limestone of the Clinton, Salina, and Niagara groups of rocks. Only one type of this series, the clay, is mapped in Blair County.

The Frankstown series is characterized by brownish to grayish and yellowish surface soils and yellow subsoils. The soil material is residual from the more impure phases of the Helderberg formation and occupies the crests and steep slopes of low ridges. In Blair County only one type of this series—the gravelly loam—is mapped.

The Murrill series embraces soils mainly of colluvial origin and consisting of mixed material from limestone, sandstone, and shale, generally overlying limestone rock. The soils are somewhat variable, but are prevailingly brownish or yellowish in the surface layer and yellow in the subsoil. A moderately friable structure is most common. The series is represented in Blair County by one type—the gravelly loam.

The Lickdale series embraces grayish and yellowish, poorly drained soils lying at the bases of hills and mountain slopes. The subsoils are characterized by a compact, impervious structure and are generally mottled gray or bluish and yellow. The soil material is colluvial, mainly from slopes occupied by Dekalb soils. In this series the only type mapped in Blair County is the silty clay loam.

The alluvial soils of the county are grouped in three series. The Huntington and Pope soils occur in the first bottoms and the Holston soils on the second bottoms, or terraces. The soils of the Huntington series contain considerable material derived from limestone

or other calcareous strata, while those of the Pope series are derived entirely from materials washed from areas of sandstone and shale. The Huntington series is represented in this county by two types, the loam and silty clay loam, and the Pope series by one type, the loam. The Holston series is the terrace equivalent of the Pope. The Holston gravelly loam is the only type of this series mapped in Blair County. Much of the bottom land along the smaller streams is gravelly or stony.

In the following table the actual and relative extent of the various soil types mapped in Blair County are given:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Rough stony land.....	60,544	17.7	Pope loam.....	6,080	1.8
Dekalb stony loam.....	52,736	15.4	Duffield clay.....	5,760	1.7
Upshur stony loam.....	41,664	12.2	Dekalb gravelly loam.....	5,568	1.6
Hagerstown silt loam.....	29,760	8.7	Chemung stony loam.....	5,312	1.6
Dekalb shale loam.....	22,784	6.7	Morrison stony loam.....	4,608	1.3
Hagerstown clay loam.....	17,984	5.3	Dekalb stony sandy loam.....	4,032	1.2
Dekalb stony silt loam.....	14,912	4.4	Upshur loam.....	3,136	.9
Berks shale loam.....	12,288	3.6	Frankstown gravelly loam.....	3,136	.9
Murrill gravelly loam.....	11,328	3.3	Holston gravelly loam.....	2,368	.7
Huntington loam.....	9,920	2.9	Huntington silty clay loam.....	2,304	.7
Hagerstown gravelly loam.....	9,024	2.6			
Lickdale silty clay loam.....	8,384	2.4			
Morrison sandy loam.....	8,128	2.4			
			Total.....	341,760	

DEKALB STONY SANDY LOAM.

The Dekalb stony sandy loam consists of a grayish to pale-yellow, loose sandy loam, underlain at 8 to 10 inches by a yellow, more clayey and slightly sticky sandy loam, or, in places, by a yellow, friable loam. At a depth of about 3 feet the residual material becomes more sandy and friable and grades into disintegrated sandstone rock. In virgin areas there is a superficial covering, 2 to 4 inches in thickness, of dark-grayish and brown loamy sand, high in organic matter. The land is generally covered with large blocks of gray sandstone, and in places it is so excessively stony as to have only the lowest agricultural value.

The largest area of this type occurs on the Allegheny Plateau, in the northern part of the county, adjoining Cambria, Center, and Clearfield Counties. The topography here is rolling to fairly level, with some steep slopes at the heads of mountain ravines. There are a few smaller areas on the plateau in the southern part of the county, and some unimportant bodies, many of which are not shown separately on the soil map, in association with the Upshur stony loam

on the high benches along the mountains of the Appalachian Valley. The soil material in the latter division is derived from the grayish sandstones of the Oneida formation.

The Dekalb stony sandy loam consists for the most part of cut-over timberland, only two or three small farms on the more stone-free areas having been established. Where the areas on the Allegheny Plateau have been entirely cleared of trees the land has grown up in dense brush, consisting of oak, chestnut, and sassafras, together with ferns, huckleberry, and a variety of heather plants and briers. Fair yields of oats, rye, hay, and Irish potatoes have been obtained, but it is not probable that the soil will prove very durable, except with the most careful treatment. Large quantities of manure and commercial fertilizer probably would be required for the production of profitable yields after a few years of cultivation.

DEKALB STONY LOAM.

The Dekalb stony loam occurs in large areas both in the Allegheny Plateau and on the mountain slopes in the Appalachian Valley division of the county. The soil in the two physiographic divisions has in general similar physical characteristics, topography, and agricultural value, but presents differences of considerable local importance.

In the Allegheny Plateau the Dekalb stony loam consists predominantly of a friable, yellow loam, underlain at a depth of 8 to 10 inches by a rather dark yellow, friable gritty loam or clay loam. The soil material generally becomes more gravelly and porous at about 30 to 40 inches and grades into the disintegrated or hard underlying bedrock at shallow depths. The virgin soil has a covering, 2 to 4 inches deep, of dark-brown, loamy or spongy material, consisting principally of forest mold and gray quartz sand. Large blocks and flattish slabs of sandstone are scattered over the surface in such quantities that their removal is necessary before the land can be cultivated. Smaller stones and gravel also are distributed throughout the soil section.

The type occupies both steep mountain slopes and comparatively level or rolling plateau areas. The steep slopes generally have the roughest surface and carry the largest rock fragments, but in places the nearly level areas also are excessively stony. Most of the land has sufficient slope to insure good drainage, and on the more nearly level areas the rainfall quickly sinks into the earth, owing to the porous structure of the soil.

The soil on the plateau is residual in origin and has been derived entirely from the sandstones, the conglomerate, and, to a less extent, the shales of the various formations composing the Carboniferous group of rocks.

The Dekalb stony loam is the most extensive soil type of the Allegheny Plateau, but only a few small patches of it have been utilized for farming. Most of the type at present consists of cut-over timberland, and where it was completely cleared of large trees it is now covered with a dense brushy growth of oak, chestnut, and sassafras, with an undergrowth of briars, huckleberry, and various other low-growing plants. The timber growth consists mainly of chestnut and chestnut oak, with a considerable percentage of white oak, red oak, maple, scrub pine, and other trees. The land is for the most part held in large tracts by lumber, mining, and water companies.

Most of the type in this division is rather difficult of access from the east, and the cost of clearing the land for farming would be out of proportion to the present agricultural value. It is, however, suitable for forestry and makes fair pasture land.

In the Appalachian Valley division the Dekalb stony loam occupies practically the whole extent of the middle and lower slopes on the western sides of Dunning, Lock, Canoe, Brush, and Bald Eagle Mountains. On these mountain slopes the type consists predominantly of a light-brown or yellow fine loam, underlain at a depth of 6 to 10 inches by a yellow, friable clay loam or gritty sandy clay. The lower subsoil or substratum, at a depth of 2 to 4 feet, is a moderately stiff and slightly plastic clay, for the most part yellow in color, but presenting various shades of yellow, brown, chocolate, and red. The areas with the chocolate-colored subsoil would be mapped in the Chemung series and those with the reddish subsoil in the Hanceville series if they could be separated accurately. The surface is everywhere strewn with large blocks of sandstone, but the clay substratum is generally free from stones and gravel and has a rather impervious and retentive structure. The soil consists of mixed colluvial and residual material, the surface soil being formed in part from sandstone material from the crests of the mountains, while the subsoil or substratum is residual from the variegated clay shales of the Clinton group, which in other situations give rise to the Duffield soils.

The mountain slopes are fairly gentle to quite steep and rough. Most of the land, by virtue of its position on slopes, is well drained, although there are numerous seepage spots on the gently sloping benches which lie just beneath the mountain crest escarpments. Practically all the land remains in forest, supporting a dense growth of fairly large chestnut, white oak, red oak, maple, pine, and other trees. Only a few small, scattered areas, comparatively free from large stones and favorably situated, or at least more accessible, have been cleared. These are utilized chiefly for the production of

small fruits and truck crops for local markets. The cost of clearing the land for general farming is at present entirely out of proportion to the agricultural value and, as in the Allegheny Plateau division, the land probably could be most successfully utilized for forestry.

Still another variation of the Dekalb stony loam occupies the eastern slopes of the above-named mountains and also the extensive western slopes of the Tussey Mountain. In these areas the type has formed on the slopes below the high benches of Upshur stony loam. The soil here is also of mixed colluvial and residual origin, consisting principally of material from grayish sandstones and from shales, together with some talus or colluvium washed from the mountain benches and crests, which are underlain by red and white sandstones and shales of the Medina formation. In places there is simply a mantle of talus or stony colluvial soil resting at a depth of 18 inches to 3 feet upon a substratum of the hard shale rock which normally weathers into the Berks soils.

The soil here is generally very stony, although a number of small areas favorably situated have been cleared. These are utilized partly for the production of fruit and partly for general farming in connection with other types. Fair yields of the staple farm crops are obtained, although the cost of clearing has been for the most part in excess of the valuation of the land.

In the vicinity of Gallitzin, Coupon, and other places near the Cambria County line some small areas of Dekalb silty clay loam are included, consisting of a yellowish to grayish silty clay loam overlying yellow, plastic clay. There are in these areas some spots of poorly drained soil—Lickdale silty clay loam. Soil of this kind has generally proved best for hay crops. Only a little of it has been cleared.

DEKALB STONY SILT LOAM.

The Dekalb stony silt loam consists predominantly of a pale-yellow or grayish floury silt loam, 4 to 6 inches deep, underlain by yellow silty clay loam, which in turn grades into yellow friable silty clay. The soil layer is everywhere thin, the underlying beds of shale rock being encountered at depths of 12 to 30 inches, except on slopes at the bases of the steep hills, where there have been colluvial accumulations 3 or 4 feet deep. In virgin areas much of the immediate surface soil has a brown color and seems to contain a fair percentage of organic matter. The organic content, however, seems to be rapidly exhausted when the land is cultivated, and old fields present a grayish or ashy appearance. The soil has somewhat the character of both a stony silt loam and a shale loam. It is residual from grayish and greenish hard sandy shale or slate and interbedded, very fine grained, hard, flaggy sandstone. Slabs and blocks of the sandstone, from 3 to

15 inches in length, are scattered over the surface in such quantities as to interfere seriously with tillage, and in addition the soil contains a high percentage of small flat shale fragments which impart a loose and friable structure. The content of stones is variable, and there are small tracts comparatively free from large stones, not differing essentially from the Dekalb shale loam. The line of division between this type and the belt of Dekalb shale loam on the east is arbitrarily drawn.

The Dekalb stony silt loam type occurs in a narrow belt in the western part of the county, lying parallel to and between the broad belts of Upshur stony loam and Dekalb shale loam. The belt consists of a series of high hills or knobs and short narrow ridges with steep and in places almost precipitous slopes. The topography is slightly rougher and the elevation higher than that of the Dekalb shale loam belt adjoining on the east.

The greater part of the type is too steep or too stony for profitable farming at the present time and remains in forest. It is estimated that only about 15 per cent of the area is improved land. Corn, oats, wheat, rye, and hay crops are grown, but the yields are often unprofitably low. Most farmers grow buckwheat in small fields, mainly for home consumption, and have small orchards. Raspberries, currants, and other small fruits seem to do well. Few animals are kept on the average farm.

The land is easily tilled after the larger stones have been removed, but special care is necessary to prevent erosion and rapid deterioration of the fields. Much of the type is so steep that binders can not be used and small grain is cut with cradles. Small applications of lime are frequently made and have proved beneficial. Very little commercial fertilizer is used. Manure is most needed, but the average farm can not under the present system of agriculture produce a sufficient quantity to maintain the supply of organic matter so essential in a soil of this character.

Improved farm land of this type sells for \$25 to \$30 an acre.

DEKALB SHALE LOAM.

The Dekalb shale loam consists generally of a gray or grayish-brown silt loam or fine silty loam, forming a thin veneer over a yellow silt loam which grades into friable, yellow silty clay loam at a depth of 6 to 8 inches. There is nearly everywhere a considerable percentage of small, flat shale and sandstone fragments in the soil, producing an open, friable structure. The soil layer is thin, a mass of disintegrated shale or hard, slaty shale bedrock being encountered at a depth of 12 to 30 inches. The soil structure is unfavorable for the

retention of moisture. Where there are few shale fragments in the subsoil the clay is compact.

The Dekalb shale loam occupies a belt lying a short distance west of Altoona and Hollidaysburg and extending in a north-south direction entirely across the county. It is closely associated with parallel belts of Dekalb stony silt loam and Berks shale loam and merges into these two types without any distinct line of demarcation. Two rather small areas occur east of Frankstown in the shale or slate hills lying in the valley inclosed by Lock and Brush Mountains. The land is deeply dissected by creeks and numerous small, intermittent drainage ways, so that the topography is rough and hilly and generally characterized by steep slopes. The tops of hills are generally 200 to 400 feet above the valleys of the larger streams. There are no considerable areas of level land.

The surface is everywhere thoroughly drained, except for occasional spots of wet, "spouty" land at the bases of hills where seepage waters appear. The steeper slopes are subject to destructive erosion when placed under cultivation. There are a number of abandoned fields on this type.

The Dekalb shale loam occupies 35.6 square miles, and because of its large extent and favorable location is of considerable agricultural importance, although of low average productiveness. It is estimated that about 50 per cent of the land is improved.

Corn, oats, wheat or rye, and hay are grown on most of the farms, but the production of apples, small fruit, and truck is probably depended upon to a greater extent than general farming as a source of income. Corn generally is not a successful crop, the average yield for a period of years being hardly more than 15 bushels per acre, although on a few of the best farms 40 bushels or more are obtained in favorable years. Wheat yields ordinarily about 12 to 15 bushels, rye 15 bushels, oats 20 to 25 bushels, and hay crops 1 ton per acre. Buckwheat is grown in fields of one-half acre to 5 acres, the yields ranging from 10 to 20 bushels per acre. Irish potatoes, though grown only in small patches, seem to give good results.

The soil has a loose structure and does not compact or harden, rainfall is rapidly absorbed, and tillage is hindered to a much less extent by rainy weather than on many of the other types of the county. The steepness of the slopes, however, adds materially to the labor and expense of cultivation and of harvesting crops.

Small quantities of commercial fertilizer, for the most part applications of 100 to 200 pounds of 8-2 or 10-2 grades, are used for the general farm crops. High-grade fertilizers and stable manure are purchased where truck patches of considerable size are cultivated. Small applications of lime have generally proved to be beneficial. Easily soluble fertilizers are probably rapidly leached out.

Improved land of this type, of average productiveness, is valued at \$25 to \$30 an acre, and unimproved land in forest, exclusive of valuable timber, at about \$10 an acre.

The maintenance of a large supply of organic matter is most essential for the production of profitable yields on the Dekalb shale loam. A more extensive cultivation of leguminous crops, such as clover, soy beans, and alfalfa, is a means of soil improvement which might be practiced to advantage. Rye makes a good winter cover crop and might also be profitable as a green-manure crop.

DEKALB GRAVELLY LOAM.

The Dekalb gravelly loam is very similar to the stony loam in distribution, origin, and soil character, differing simply in the smaller size of the rock fragments contained and in being, therefore, more arable. It occupies slightly more level areas and smoother slopes.

On the Allegheny Plateau this type is much less extensive than the stony loam. Small fields here are under cultivation, and the soil has proved to be moderately productive, hay, rye, oats, and Irish potatoes being grown. Crops mature about two weeks later on this type in the Allegheny Plateau than in the Appalachian Valley.

In the Appalachian Valley division the Dekalb gravelly loam is very inextensive in comparison with the stony types. One of the more important areas lies on the lower slopes of the southern end of Brush Mountain, north of Hollidaysburg. The soil here is a light-brown and yellowish, mellow silt loam or fine loam, passing into yellow clay loam at 6 to 12 inches and then into yellow, moderately friable clay. The lower subsoil and substratum in many places consist of a stiff clay, which has the characteristics of the Duffield clay. Blocks of sandstone are scattered over the surface, the size varying considerably in different positions on the slopes. It is generally necessary to remove a considerable proportion of the larger stones from the fields in order to make the land arable. A large percentage of the land has been cleared and is in small fruit and truck farms, the products being sold at Altoona, Hollidaysburg, and other local markets.

There are a number of other small areas distributed throughout the county in close association with the stony loam type, but these are on the whole of minor agricultural importance.

A narrow, isolated ridge occupied principally by this soil lies in the limestone valley a few miles southeast of Martinsburg. The type here is derived from slaty shales and thin-bedded sandstones, presumably belonging to the "Hudson River" slate formation. Only a very small percentage of the land is utilized, and it is only moderately productive.

BERKS SHALE LOAM.

The surface soil of the Berks shale loam consists of a brown, mellow loam to silt loam, 6 to 8 inches deep, usually containing a high percentage of fine fragments of black or yellowish shale and slate, which impart a loose structure. The subsoil is a friable, brownish-yellow or yellow silty clay loam, containing shale fragments, and passing into a loose mass of disintegrated shale or resting upon the hard shale bedrock at a depth of 15 to 30 inches. Several small areas of silt loam comparatively free from shale fragments at the surface are included with the dominant shale loam type. The Berks shale loam differs from the Dekalb shale loam mainly in the darker color of the surface soil. The two types merge gradually, and a sharp line of division can not be drawn.

The Berks shale loam occurs principally in a nearly continuous narrow belt of low, rounded hills extending from a point near Tyrone to the Bedford County line. The soil here is derived from the darker colored slates and black fissile clay shales, which lie at the base of the Devonian shale formations. The topography is more subdued and the slopes are gentler than in the Dekalb and Upshur areas to the west. Narrow bands and isolated hills of this type are also developed in the two small wedge-shaped areas of slate hills lying east of Frankstown. A large number of scattered areas occur on the lower slopes of the mountains inclosing Morrisons Cove, Canoe, and Sinking Valleys. The soil in these latter areas is derived from the "Hudson River" shales and slates. The geological formation itself is continuous, but overlying deposits of talus from the mountain slopes cover much of its extent, greatly restricting the area of Berks soils, which under other conditions would be coextensive with the underlying shales.

The Berks shale loam is largely under cultivation and is considered, on the whole, a little more productive than the associated Dekalb shale loam. It is utilized principally for the production of corn, wheat, oats, and hay. A little rye and occasionally some buckwheat are grown. A small acreage is devoted to fruit, garden vegetables, and Irish potatoes on nearly every farm, and these crops are depended upon to a greater extent as a source of income on this type than on the more productive Hagerstown soils. Very few farmers carry on dairying, and only a few head of stock usually are kept.

Where the soil has been limed and highly manured and its original productiveness maintained the yields of the general farm crops are comparable to those obtained on the Hagerstown soils. In general, corn is not a successful grain crop, and on many farms which have deteriorated through erosion and failure to maintain the or-

ganic-matter supply yields of only 15 to 20 bushels per acre are obtained. Wheat of good quality is grown, the ordinary yield being about 15 bushels per acre. With the addition of lime and manure, clover can be grown successfully. This soil seems well suited to Irish potatoes, yields of 100 to 150 bushels per acre of tubers of good quality being obtained on the small patches planted.

The soil has a loose structure and is easily tilled. It is, however, especially susceptible to blanket or sheet erosion, which removes the finer soil material, and most of the farms which are referred to as "run down" have deteriorated because of erosional loss. The soil is thin and not retentive of moisture, and corn is especially subject to injury from droughts.

Commercial fertilizers of various grades are used in applications of 100 to 200 pounds per acre. There is likely to be, however, considerable loss of fertilizer constituents through leaching.

The better improved farms on the Berks shale loam have a selling price of \$25 to \$40 an acre, depending upon the location.

In farming this type it is necessary to keep up a good supply of organic matter and to prevent erosion. Liming is beneficial, but the material can not safely be applied in such large quantities as on the limestone soils. Manure is one of the most valuable fertilizers, but very few farms under the present system of agriculture maintain sufficient live stock to produce the quantity needed. The more extensive growing of leguminous crops would doubtless improve the soil.

HAGERSTOWN GRAVELLY LOAM.

The Hagerstown gravelly loam consists of a brown, friable silt loam or fine loam, underlain at a depth of about 8 to 10 inches by yellow or yellowish-brown, gritty clay loam, which passes into dull-reddish, moderately friable clay. The surface soil contains sufficient gray and bluish-black chert fragments materially to influence its structure and to interfere to some extent with cultivation, while there is also a sufficient quantity of coarse rock particles in the sub-soil to produce a somewhat more friable structure than in the silt loam and clay loam types. This type is locally termed "flinty" land to distinguish it from the more stone-free Hagerstown types. The depth to bedrock ranges generally from 3 to 6 feet.

In a few places adjacent to the sandy ridges occupied by soils of the Morrison series the surface soil of the Hagerstown gravelly loam is brown, granular loam and a few small blocks of grayish quartzite are mingled with the chert fragments. This variation is very similar to the Murrill gravelly loam and can not be sharply differentiated from that type.

There are a few included areas of Hagerstown stony loam shown on the soil map with stone symbol. This type differs from the

gravelly loam chiefly in the larger size of the fragments, which consist mostly of quartzite. The principal stony area lies north of Martinsburg.

The principal development of the Hagerstown gravelly loam occurs in Morrisons Cove, near Roaring Spring and Martinsburg. Small areas occur also near Williamsburg and in Sinking Valley. The type occupies low, inconspicuous ridges and very gentle to moderately steep slopes. All the land is naturally well drained.

Probably 90 per cent or more of this type has been cleared and placed under cultivation. On the whole it is probably less durable and slightly less productive than the Hagerstown silt loam. The same crops are grown and the system of farming is the same.

The rock fragments interfere to some extent with plowing and cultivation and cause greater wear upon tillage implements. Good tilth is, however, easily maintained. Liming of the soil is practiced and small quantities of commercial fertilizer are used.

HAGERSTOWN SILT LOAM.

The surface soil of the Hagerstown silt loam is a brown, mellow silt loam, 8 to 12 inches deep. The upper subsoil consists of a yellow silty clay loam, which grades within a few inches into yellowish-brown, stiff, compact clay, this in turn changing to reddish-yellow or dull-red, compact but rather brittle clay at a depth of 24 to 36 inches. The reddish clay rests directly upon the underlying undecomposed limestone rock, with a distinct plane of separation between the two. The residual mantle of disintegrated rock has an average thickness of 3 to 5 feet. A few small areas of a somewhat darker brown, granular fine loam and also small spots of clay loam on the steeper slopes are included with this type as mapped, but on the whole the soil is fairly uniform in texture, color, and structure throughout the county. Small fragments of chert gravel are generally present on the surface, but not in sufficient quantity materially to influence the structure of the soil or to affect tillage. The subsoil structure is favorable for the retention of moisture and crops are seldom seriously damaged by drought.

The largest areas of this type occur in the broad limestone valley in the southeastern part of the county known as Morrisons Cove, and in its northern extension, known as Canoe Valley, around Williamsburg and near Yellow Spring. It is also the principal soil type in Sinking Valley. Smaller, separate areas occur on the slopes of the narrow limestone ridges in the vicinity of Altoona, Hollidaysburg, and Frankstown.

The topography is gently rolling to moderately hilly. Drainage is good, but the land is nowhere subject to severe erosion.

The soil is residual from limestones—in the Morrisons Cove, Canoe Valley, and Sinking Valley sections from the Ordovician group of limestone formations, and in other parts of the county from the Helderberg formation of Devonian age.

The Hagerstown silt loam is regarded as the most desirable soil in the county for general farming, and it is all in farms, 95 per cent or more being improved land. General farming is carried on in conjunction with dairying. Corn, oats, wheat, and hay (timothy and clover) are grown in rotation on practically every farm. Wheat and dairy products are the principal sources of income, the other crops being largely consumed on the farms. The farmers situated near transportation lines or cities sell whole milk, while those in less favorable locations market cream and butter. The dairy animals generally are grades, the Jersey and Holstein bloods predominating.

Nearly every farm has 2 to 10 acres in apples, the surplus fruit from which is generally sold. Irish potatoes are commonly grown in patches of 1 to 4 acres. Alfalfa has been successfully grown in a small way on a few farms; but has not become an important crop.

The Hagerstown silt loam is superior to all the other soils of the county in average productiveness. The yields are fairly uniform throughout the county and are maintained with no great variation from year to year. Corn yields ordinarily 40 to 50 bushels, oats about 35 bushels, wheat about 20 bushels, and hay $1\frac{1}{2}$ tons per acre. Crops mature about two weeks earlier than in the more elevated and mountainous sections of the western part of the county.

The surface soil has no tendency to compact or bake, and is easily maintained in good tilth where moderate care is taken to maintain the supply of organic matter. The topography is such that modern farm implements can be used to advantage. Lime and barnyard manure are principally depended upon to maintain profitable yields, but commercial fertilizers are used by a large percentage of the farmers to supplement the manure. Phosphatic fertilizers are most generally used, 8-2 and 10-2 grades being the most common, although some farmers have used fertilizers containing from 5 to 10 per cent of potash. Applications of 100 to 200 pounds per acre are commonly made for the grain crops. Burned lime is usually applied at the rate of 75 to 150 bushels per acre, and in a few instances even larger quantities have apparently been beneficial.

The selling price of farms on this type with average improvements and between 50 and 150 acres in size ranges from \$75 to \$100 an acre, the variation in price depending largely upon the location.

Yields on this type can be increased and the productiveness maintained by more thorough cultivation and a more judicious use of lime and commercial fertilizers. Although large applications of lime are the rule, many farmers have reached the conclusion that smaller

and more frequent applications give in the end the best results. It would doubtless be profitable to grow more leguminous crops. It has been demonstrated that alfalfa can be grown successfully, and it should be especially valuable on those farms where dairying is carried on throughout the year.

HAGERSTOWN CLAY LOAM.

The Hagerstown clay loam consists of about 6 to 8 inches of brown to dark reddish brown, rather stiff, fine clay loam, underlain by dull-red, moderately stiff clay. The hard underlying limestone rock generally is encountered at less than 3 feet from the surface and rock outcrop is common. In many places the surface is so thickly strewn with large fragments of limestone and chert that a partial removal of the stones is necessary before fields can be successfully cultivated. On many of the steeper slopes dark-red, stiff clay is turned up in plowing and there are a large number of scattered small bodies of clay included with the type as mapped. The soil has a high moisture-holding capacity, and notwithstanding the thinness of the soil layer, crops seldom are seriously injured by droughts.

This type occurs in a number of small areas in close association with the Hagerstown silt loam. It occupies the more eroded crests of narrow ridges and hills and the steeper slopes along creeks and the intermittent drainage ways which are characteristic of the larger limestone valleys. All the land is well drained, and fields on the steeper slopes are liable to serious erosion and gulying.

The differences between this type and the silt loam are due to topography and erosion rather than to any difference in the lithologic character of the underlying rock. The total area of the clay loam is less than that of the silt loam and it has a somewhat lower agricultural value. The greater part of it has been cleared, but on many of the farms there is considerable forested land that is too steep or rough for any agricultural use.

General farming is practiced on this type, the crops grown and the farm methods followed being similar to those on the adjacent Hagerstown silt loam. The soil is strong and durable and where it is properly handled the crop yields are but little lower than those obtained on the more arable silt loam. For the most efficient cultivation somewhat heavier teams are required, owing to the stiff, intractable nature of the clay loam. Unless it is carefully handled poor tilth soon results. Liming is beneficial, and there is special need for maintaining a good supply of organic matter, either by large applications of manure or by the more extensive growing of legumes.

MORRISON STONY LOAM.

The Morrison stony loam consists of a brownish to yellowish fine sandy loam or light loam, 2 to 4 inches deep, underlain by yellow, friable loam which grades into yellow, moderately compact but friable sandy loam or sandy clay. Large blocks of quartzite are scattered over the surface in such abundance that they seriously interfere with tillage and lessen the value of the land for agriculture. In places the type bears a close resemblance to the Hagerstown stony loam, the subsoil being reddish. There are some included areas of Morrison stony sandy loam and sandy loam, too small to separate on the soil map.

The principal areas of the Morrison stony loam occur on the quartzite ridges in Morrisons Cove and to the north of Williamsburg in association with other types of the Morrison series. Most of it occupies the moderately steep slopes of ridges and is well drained.

Only a very small proportion of the land has been placed under cultivation and it is rather difficult to form an estimate of the comparative productiveness of the soil. On the few fields cultivated only fair yields of the general farm crops have been obtained. The structure of this soil is more favorable for the retention of moisture and fertilizers than that of the sandy loam type.

MORRISON SANDY LOAM.

The Morrison sandy loam generally consists of 2 to 4 inches of grayish loose sand to brownish or yellowish loamy sand, underlain at about 8 to 10 inches by yellow, light sandy loam which passes downward into yellow sandy loam to sandy clay. The subsoil becomes more sandy and friable at a depth of about 3 feet and grades into disintegrated rock. In places the subsoil is mottled with reddish yellow and dull red. The surface soil varies somewhat in texture from place to place in accordance with the lithologic character of the underlying rock, but is predominantly composed of medium sand. Small gravelly fragments of sandstone or quartzite and a few scattered stones are generally present. Small areas of deep sandy soil are included, as well as some stony areas, shown on the map by means of the stone symbol.

The principal areas of the Morrison sandy loam are developed on the low, broad ridges of quartzite in Morrisons Cove and Canoe Valley. The greater part of the type occurs on the ridges extending from Martinsburg to Williamsburg and occupying the central part of the valley. Smaller bodies occur near Orehill and in the northern part of Sinking Valley. There are also some small areas on the crests and slopes of narrow ridges near Hollidaysburg, and in other places in association with narrow strips of Frankstown and

Hagerstown soils. The type lies 50 to 100 feet above the general level of the limestone valleys. All the areas are well drained.

The soil in Morrisons Cove and Sinking Valley is mainly residual from white quartzite and sandstone, both thin and massive bedded, which probably has a calcareous element, and seems to represent the most siliceous phase of a group of rocks transitional in their lithologic character from the nearly pure limestone giving rise to the Hagerstown soils to nearly pure quartzite. The quartzite is generally deeply weathered, in places being friable and easily crushed to a depth of 15 to 18 feet. In other places the soil is derived principally from the coarse grit and sandstone of the Oriskany formation, with probably some slight influence from the calcareous Helderberg formation which lies adjacent and which weathers into the Frankstown and Hagerstown soils.

Only a very small percentage of the total area of the Morrison sandy loam is utilized for farming, most of the land being covered with a dense second growth of chestnut and other vegetation very similar to that on the more sandy Dekalb soils. The soil is poor and is not suited to general farming. Fair yields of rye have been obtained where the land was well manured. Small orchards of apples, pears, peaches, and other fruits have been set out in places and seem to be giving good results.

This type is easily handled on account of its light texture and loose structure. It is not very retentive of moisture, however, and general farm crops suffer from droughts. By the use of liberal quantities of commercial fertilizer, together with the extensive growing of leguminous crops, such as soy beans, it is probable that this soil can be made to return profitable yields. It seems to be naturally best suited to truck crops and fruits and might be profitably used for these crops where market conditions are favorable.

UPSHUR STONY LOAM.

The Upshur stony loam consists predominantly of a dark reddish brown to Indian-red or chocolate-red loam, 6 to 10 inches deep, underlain by friable Indian-red clay loam, which grades into more friable loam and disintegrated rock at a depth of about 3 or 4 feet. Minor textural and structural variations occur, which bear a close relation to the lithologic character of the underlying rock. Where the soil material has been derived largely from mudstone or shales there is a higher percentage of silt in the surface soil than usual and the subsoil is a very dark red clay with a peculiar greasy appearance and feel. In places where the underlying rock consists principally of sandstone the soil is a lighter red, loose fine sandy loam or fine loam, underlain by friable gravelly loam or

gritty gravelly clay, which changes into more loamy material and porous, disintegrated rock at a depth of about 30 inches.

Large blocks and flat slabs of sandstone are scattered over the surface of this type to such an extent that their removal is necessary before the land can be profitably utilized for farming or orcharding. Small, angular, sandstone and shale gravel particles are distributed throughout the soil section. The soil mantle on the smoother areas and steeper slopes generally is 3 to 5 feet thick, while at the bases of slopes where conditions have been favorable for colluvial accumulation the layer of soil and loose rock is in places 8 to 10 feet thick. This soil generally is deeper and retains moisture better than the contiguous Dekalb soils.

A number of areas of Upshur stony fine sandy loam are included with the stony loam as mapped, because of their small size and minor agricultural importance. There are also included numerous very small areas of Upshur loam.

Lying at the base of the Allegheny Front and also on the mountain terraces to the eastward there is a considerable development of soil which represents a mixture of Upshur and Dekalb material. Much of this consists of wash or talus from gray sandstones of the mountain escarpments spread out over the Upshur soil or mingled with it, thus producing a brownish or yellowish surface soil and a red (Upshur) subsoil. There also occurs at the bases of mountain slopes and in the beds of runs coarse alluvial wash representing a mixture of detritus from red and gray sandstones. These soils are excessively stony, have poorly defined boundaries, and are of very little agricultural value. They do not seem to be of sufficient importance to warrant separate mapping in this county, and have therefore been included for the most part with the Upshur stony loam and to a less extent with the Dekalb stony loam.

The Upshur stony loam has its largest development in the western part of the county, where it occurs in a continuous belt extending entirely across the county, parallel to the Allegheny Front escarpment. This belt varies in width from less than 1 mile to about $1\frac{1}{2}$ miles in the northern and central parts of the county and attains a width of about 5 miles on the Bedford County line. The country here ranges in elevation from about 1,700 to 2,400 feet above sea level. It is deeply dissected by ravines and small creeks which have cut gorges 300 to 700 feet below the higher levels and have produced in general a mountainous topography. Fairly gentle slopes occur directly at the base of the Allegheny escarpment, although these generally are excessively stony. A high, plateaulike area, rolling or only moderately hilly, occurs near Blue Knob in the southwestern part of the county. The type also is developed on the high, narrow

erosional terraces or benches lying 100 to 400 feet below the crests of the mountain ridges in the central and eastern parts of the county, its distribution coinciding with the belts of red sandstone and shale of the Medina formation. Much of the land on these benches is fairly smooth or level, but it is for the most part covered with large blocks of stone, many of which have rolled down from the crests of the mountains.

This type is in general well drained, and the steeper slopes, when placed under cultivation, are susceptible to serious blanket erosion and gulying. In places at the base of the Allegheny Front and on the high benches of the mountain ridges of the Appalachian Valley seepage water collects and keeps the land continually wet.

The Upshur stony loam occupies a little more than 12 per cent of the total land area of the county and is one of the most important agricultural types, notwithstanding its generally rough and stony character. It is estimated that about 30 per cent of the western belt has been cleared for farms. The areas lying on the terraces along Brush, Tussey, and other mountains are all arable and fairly smooth, but usually so stony and difficult of access that only a very small proportion of the land has been cleared. On the basinlike area on Brush Mountain, east of Altoona, known as The Kettle, there are a number of small farms on which orchard fruits, raspberries, strawberries, garden vegetables, and flowers are grown for the Altoona market.

The soil is productive and good yields of the general farm crops are obtained, although general farming can not be carried on extensively, mainly on account of the rough topography. Fruits, garden vegetables, and minor products of the farm are depended upon to a greater extent as sources of income than on the more arable and accessible valley lands to the east. Corn, oats, and hay (timothy and red clover) are the principal field crops. The acreages devoted to rye and wheat are about equal. Most farmers grow a small quantity of buckwheat, the fields ranging from 1 to 5 acres in size. Wheat, very small quantities of rye, straw, and hay, and sometimes a small surplus of buckwheat are sold. Only a few head of animals are kept on the farms.

This type is considered an excellent soil for the production of fruit, particularly apples, and every farm has a small apple orchard which affords a dependable source of income. A few commercial orchards have been established, and there is considerable land suitable for such use, although the greater part of the type is too rough or inaccessible.

Corn yields ordinarily about 30 bushels, oats 25 bushels, timothy and clover $1\frac{1}{2}$ tons of hay, rye 18 to 20 bushels, and wheat 15 bushels

per acre. Buckwheat yields 8 to 20 bushels per acre, depending upon seasonal conditions and productiveness of the soil.

The Upshur stony loam is easily plowed and maintained in a mellow condition where the stones have been removed. On most of the farms the cost of clearing has been in excess of the present value of the land, although the labor and expense have been in most cases distributed over a period of years. A considerable part of the land is too steep for the use of binders and the grain is cut with cradles and hauled from the fields on sleds. Side-hill plows are used on the steepest slopes. Very small quantities of commercial fertilizers are used and lime is applied where the cost of obtaining it is not prohibitive. Manure is highly valued and all that is available is utilized.

Cultivated land of this type ranges in value from \$25 to \$60 an acre, depending upon location with reference to railways and markets. Unimproved land, aside from the value of timber, has a selling price of \$5 to \$10 an acre.

The Upshur soils can be made much more productive by a more extensive use of lime and commercial fertilizer. Manure is most efficient, but the quantities available generally are insufficient on account of the small quantity of stock usually kept. Owing to the shortage of manure, it might be found advantageous to grow leguminous crops to a greater extent.

UPSHUR LOAM.

The Upshur loam does not differ essentially in color or structure from the stony loam, but is comparatively free from the large rock fragments which so seriously interfere with tillage on the latter type. The soil consists predominantly of a dark purplish red or Indian-red fine loam, underlain at a depth of 6 to 8 inches by dark Indian-red, moderately friable clay loam, and in places by clay. Most of the areas are moderately gravelly.

This type occurs mainly in small areas scattered throughout the Upshur stony loam belts, where it occupies the smoother slopes and more level land. Because of its freedom from large stones and its smoother topography, it has a higher agricultural value than the stony loam.

There are a few bodies of this type on the Allegheny Plateau. Its development here, however, is not very uniform, as it includes numerous patches or narrow strips of Dekalb soil. The type here consists of a brownish or reddish-brown fine loam, and in places clay loam, underlain at 10 to 15 inches by dark Indian-red, friable clay. It is moderately gravelly and has a lower agricultural value than the areas to the east.

CHEMUNG STONY LOAM.

The typical Chemung stony loam consists of a light-brownish or chocolate-colored, fine silty loam, underlain at a depth of 6 to 10 inches by a light chocolate colored or yellowish-brown, friable silty clay loam, and to a less extent by moderately friable silty clay. In the area mapped the soil is not uniformly chocolate colored, but consists of strips and patches of the darker soil alternating or mixed with light-brownish and yellowish soils resembling those of the Dekalb series. Large, flat slabs and blocks of chocolate-colored and grayish sandstone are scattered over the surface, and in the upper one or two feet of the soil section in such quantities that their removal is necessary before the land can be profitably farmed. In addition to the stones there is generally a large percentage of shale and sandstone fragments of gravel size, which impart a friable structure. The depth to the hard, undisturbed bedrock generally is 3 or 4 feet. On the whole the residual mantle of weathered material is somewhat thicker and the subsoil slightly more retentive of moisture than in the adjacent Dekalb stony silt loam and shale loam areas. The virgin soil to a depth of 6 to 8 inches apparently has a fair content of organic matter.

The only development of this type is in the western part of the county, where it occurs in a narrow belt, extending from the Bedford County line in a northerly direction to about 2 miles north of Bellwood. Deep gorges have been cut through this belt by the numerous runs flowing eastward from the Allegheny Mountains, so that it consists of a series of rough hills and mountainous knobs upon which there is very little smooth or level land. All the type has good natural drainage. Many of the steeper slopes, if cleared for field crops, would probably be subject to serious erosion and gullyng.

This is not a soil of much agricultural importance. It is estimated that 75 to 85 per cent of the total area still remains in forest. The rough topography and stony character of the land and the fact that much of it is difficult of access has hindered extensive development. Corn, wheat, oats, and rye have been grown in small patches, and it seems to be the opinion of the farmers that the type is slightly more productive than the associated Dekalb stony and shale loams. Both the topographic position and soil seem to be favorable for the production of orchard fruits and berries.

DUFFIELD CLAY.

The soil mapped as the Duffield clay is extremely variable in color and other characteristics and is really a complex of a number of phases and types which can not be shown separately on the soil map because of the small size of the individual areas. The predominating

soil is a reddish-brown, compact clay, underlain at 6 to 8 inches by a somewhat stiffer, dull-reddish, plastic clay. Light-brown and yellowish clays also are common and in spots the color is a deep Indian-red. A common characteristic is the stiff and impervious structure of both the surface soil and subsoil. Small patches of brownish and reddish shale loam occur on the more eroded hillsides and in many places flattish fragments of limestone are strewn over the surface. The depth of weathering is nowhere great, hard rock being encountered generally at less than 3 feet.

The principal areas of this type are near Altoona and Hollidaysburg. There is a considerable development on the southern and eastern slopes of Brush Mountain, extending from Hollidaysburg north-eastward for a distance of several miles. The topography ranges from gently rolling to moderately hilly, generally having sufficient slope to carry off the excess rainfall, so that drainage is good. In places on the slopes of Brush Mountain, however, the soil is clammy and wet, on account of its highly retentive character.

The Duffield clay is one of the inextensive soil types in the county, occupying but 9 square miles. It is fairly productive and practically all the land has been improved. General farming, with some dairying, is carried on. Corn, wheat, hay, and oats are the principal crops. Alfalfa has been successfully grown in a number of small fields. The soil is not well suited to orchard and truck crops. The average yields are apparently but little less than those obtained on the Hagerstown soils in the most favorable seasons. Corn yields from 40 to 50 bushels, wheat 20 bushels, oats 30 to 35 bushels, and hay 1½ to 2 tons per acre.

The principal disadvantage in cultivating this soil is its heavy, stiff structure. Plowing is difficult, except under the most favorable moisture conditions, and the soil if worked while wet tends to puddle and clod.

The use of large quantities of barnyard manure has proved most efficient in maintaining the soil in a good state of tilth. Liming is practiced and has given good results. Very little commercial fertilizer is used.

FRANKSTOWN GRAVELLY LOAM.

The Frankstown gravelly loam consists typically of a light-brown, loose silty loam, 6 to 10 inches deep, underlain by a very pale yellow or cream-colored silty loam, which changes within a few inches to yellow, friable silty clay loam. When very dry the surface is grayish. Both the surface soil and subsoil contain a high percentage of angular, flattish fragments of soft, yellowish rock, with some bluish flint. This material is residual from impure limestone. These rock fragments, although mostly only of gravel size, are so abundant as

to interfere to some extent with cultivation. In a few places the soil has been modified by stones and fine material from an adjacent sandstone formation.

The principal areas of the Frankstown gravelly loam occur in the vicinity of Frankstown, Hollidaysburg, and Altoona. The type is developed in very narrow strips, contiguous to strips of Hagerstown and Morrison soils, closely conforming in direction to the ridges and to the geologic structure of the underlying rock. It occupies generally the crests and steeper slopes of narrow ridges in valley areas. The land is thoroughly drained without being subject to severe erosion or gullying.

This type has a comparatively small acreage. Almost the whole of it, however, has been placed under cultivation and it is locally important. Fair yields of the general farm crops are obtained. Corn gives nearly as good results as on the Hagerstown soils, yielding from 35 to 40 bushels per acre. Oats produce fair yields. The type is not so well suited to wheat and the hay crops as are the heavier soils, but seems to be fairly well suited to orchard fruits. A commercial apple orchard has been established on this soil near Frankstown. In Bedford County, where the type is more extensively developed than in Blair County, it is recognized as a good fruit and potato soil.¹

The land generally is easily plowed and, owing to its gravelly nature, is easily maintained in a mellow condition. Commercial fertilizer is used in small quantities. Lime can not be safely applied in as large quantities as on the heavier soils.

MURRILL GRAVELLY LOAM.

The Murrill gravelly loam consists of a brown, mellow loam or light-brown silt loam, 8 to 15 inches deep, generally underlain by yellow, moderately compact clay. Shades of reddish yellow or dull red are common in the lower subsoil or substratum. The depth to hard bedrock generally is 3 to 8 feet. The surface soil generally contains flattish fragments and blocks of sandstone and other rocks in sufficient quantity to produce a loose structure. There are a number of minor variations due to local differences in drainage and source of the soil material. Much of the soil closely resembles the Hagerstown gravelly loam, while in places it merges into the Dekalb gravelly loam. Areas of silt loam comparatively free from stones are included with the dominant type. A considerable area of Murrill stony loam is shown with stone symbol, this type differing from the gravelly loam chiefly in the stone content.

¹ See Soil Survey report of Bedford County, Pa., Field Operations, Bureau of Soils, 1911.

The Murrill gravelly loam occurs in long, narrow strips and also as small, detached areas along the bases of the slopes of mountains and ridges. The topography for the most part is very gently sloping or nearly level. Natural drainage, however, is generally adequate.

The soil material is colluvial, mostly from Dekalb but in places contains material from Upshur soils. The subsoil in places contains residual material from shale and associated limestone.

There are no large uniform areas of this type in any one locality, although in the aggregate it is extensive, covering 17.7 square miles. Much the greater part of the land is farmed, corn, oats, wheat, and hay being grown. It is rather difficult to form an accurate estimate of the agricultural value of this soil on the basis of yields, since it is for the most part farmed in connection with other types. There are a large number of fields which are as productive as the Hagerstown soils, although on the whole it has a somewhat lower agricultural value. Irish potatoes are grown in small patches and seem to give good results, probably better than on the adjacent Hagerstown soils.

The soil generally is easily tilled. Liming and manuring are practiced. The farming methods are much the same as on the Hagerstown soils.

A variation of the Murrill gravelly loam is developed on the slopes of the narrow ridges occupied by Frankstown, Morrison, and Hagerstown soils, principally near Frankstown, Hollidaysburg, and Altoona. The soil here consists of a colluvial mixture of the soils of the three series named, overlying either the shales which weather into the Berks shale loam or the shaly limestone and black, calcareous shale which underlie the Frankstown soils. The color and structural characteristics are similar to those of the typical Murrill gravelly loam, except that reddish colors are not so common in the subsoil. The gravel consists of angular fragments similar in lithologic character to those in the Frankstown gravelly loam, together with a smaller quantity of fragments from the sandstone or quartzite which weathers into the Morrison soils. The agricultural value of the land and the farm practices are about the same as on the typical Murrill gravelly loam.

LICKDALE SILTY CLAY LOAM.

The Lickdale silty clay loam consists of a light-brown to grayish, compact silty clay loam, 6 to 10 inches deep, underlain by mottled yellow and gray, compact, impervious silty clay. Generally at a depth of about 3 feet the subsoil becomes a little more friable in structure and grades into soft, decomposed shale. Included stony areas are shown on the soil map by stone symbols.

This type occurs in small, widely distributed areas. It has been formed at the bases of hill and mountain slopes and occupies nearly level, gently sloping land, which grades into flat bottoms along the streams. The soil is poorly drained and has a tendency to hold seepage water from the higher slopes.

The greater part of this type, with the exception of the areas shown with stone symbol, has been placed under cultivation, notwithstanding its poor drainage. It is, however, of little agricultural importance. The stony areas are covered with forest and brush and are used only for pasture land.

The general farm crops, corn, oats, wheat, and hay, are grown. The soil is rather cold and plant growth is delayed in the spring. Where the land has been properly drained, however, the average yields are better than on the adjacent Berks and Dekalb shale loams. The soil seems to be best suited to the production of hay crops. Timothy grown alone yields from 1 to 2 tons of hay per acre. Mixed timothy, clover, and alsike, or alsike and red clover seem to give the best results.

The soil tends to compact and clod unless worked under the most favorable moisture conditions. Rolling is necessary for the preparation of a good seed bed for small grain. Barnyard manure is generally used, and liming has been found beneficial. Phosphatic fertilizers could probably be used to advantage.

Thorough drainage is most necessary in the improvement of this soil. Where the land is in cultivation drainage has been effected cheaply by the construction of stone or "blind" drains.

HUNTINGTON LOAM.

The surface soil of the Huntington loam is predominantly a brown mellow loam, about 8 to 12 inches deep. The subsoil varies from a friable, yellowish-brown loam, only slightly heavier in texture than the surface soil, to a moderately compact, yellowish-brown clay loam. Faint reddish brown and light-salmon shades are also common in the subsoil. At a depth of about 3 feet the material generally becomes sandy or gravelly and more friable and porous. The surface is comparatively free from gravel or stones. There is generally a fair content of organic matter. Areas of Huntington sandy loam and silt loam, too small for separate mapping, are included with this type.

The largest areas of the Huntington loam occur in the bottoms along the Frankstown Branch of the Juniata River and along the Little Juniata River. The bottoms are in most places less than one-fourth mile and in but few places more than one-half mile wide. The land lies only 5 to 10 feet above the level of the streams, but is seldom completely inundated by floods. The topography ranges from

quite level to slightly billowy or hummocky. Natural drainage is generally adequate, owing to the rather porous, open structure of the soil.

Practically all this type is utilized for farming, but because of its comparatively small extent it is of little agricultural importance. It is utilized mainly for general farming, corn, wheat, oats, and hay being the staple crops. In the vicinity of Hollidaysburg, Altoona, and Tyrone considerable truck is produced for the local markets, the loose, sandy texture of much of the type making it well suited to such crops.

The soil is productive, and on the better farms as good average yields of corn, oats, and wheat are obtained as on the better limestone soils. Mixed hay crops, consisting of timothy and red clover or timothy, red clover, and alsike, usually are grown, and these yield $1\frac{1}{2}$ or 2 tons per acre. Very good yields of timothy alone have been obtained on some farms. On at least one farm an excellent stand of alfalfa has been obtained.

The soil is easily maintained in good tilth. Commercial fertilizers are not in general use except for truck crops. Lime has been found beneficial in most places, and manure is commonly utilized.

Land suitable for general farming has a selling price of \$75 to \$100 an acre. Small farms conveniently located for the production of truck crops command much higher prices.

HUNTINGTON SILTY CLAY LOAM.

The Huntington silty clay loam consists of a brown silty clay loam, commonly underlain at a depth of 8 to 10 inches by yellow or yellowish-brown compact silty clay loam to silty clay. As mapped the type includes some areas of Holly silty clay loam in the more poorly drained situations.

This type occurs as narrow, elongated strips and detached areas of small extent along the streams originating in limestone areas or deriving their alluvium in part from limestone strata. The topography is level, and all the type is poorly drained. The area south of Altoona and a few others, shown on the map with the swamp symbol, really represent Dunning clay, consisting of a black to bluish plastic clay underlain by mottled yellow, rusty-brown, and bluish impervious plastic clay.

The Huntington silty clay loam is utilized to only a small extent. The areas along the smaller streams and those more subject to overflow are largely in grass and are valued chiefly for pasture and the production of hay. Where the soil has been properly drained it produces good yields of corn, wheat, oats, and hay.

POPE LOAM.

The surface soil of the Pope loam where typically developed is a brown, mellow loam, 10 to 15 inches deep, containing a rather high percentage of fine and medium sand. The subsoil is a friable, yellowish-brown or light reddish brown sandy clay loam or loam grading into sand and gravel at a depth of 2 to 3 feet. In many places there is no marked change in the texture or structure of the material within those depths. The underlying material is generally a porous, open stratum of sand, gravel, and cobbles. Included with the type are some areas of Pope sandy loam too small to be mapped separately. These have a moderate content of gravel.

Some included gravelly areas which differ little in other respects are shown on the map with gravel symbol. A few areas of reddish soil, representing the Moshannon gravelly loam, are also included; these occur mostly along Poplar and South Poplar Runs and Bobs Creek, in the southwestern part of the county.

The Pope loam is developed along the bottoms of the larger creeks and runs which have their source in the Allegheny Mountains and flow eastward to the main branches of the Juniata River. The broader bottoms lie at the mouths of the runs, and this type so closely resembles the Huntington soil along the main branches of the Juniata River that the line of division on the soil map is necessarily arbitrary. The bottom land generally lies only 3 to 5 feet above the creek beds, but is seldom subject to destructive flooding. The alluvium is pervious, and the gravelly substratum is a natural drain for the excess rainfall. Westward, toward the mountains, the bottoms decrease in width and the soil becomes increasingly gravelly and stony.

The total area of this type is only 9.5 square miles, but it is of considerable agricultural importance because of its local value for truck crops. It is utilized for growing the common garden vegetables and also for strawberries, raspberries, and other fruits. The products are sold principally on the Altoona market. Where the general farm crops are grown fair yields (about equal to those on the Huntington loam) are obtained.

The truck farmers use large quantities of stable manure, which is obtained chiefly from Altoona and other near-by towns, and also nitrogenous and phosphatic commercial fertilizers.

The farms are all small, and the price of the land is high. Farms lying near the cities and having an especial value for trucking bring from \$100 to \$400 an acre. Land suitable for general farming has about the same value as that of the Huntington loam.

HOLSTON GRAVELLY LOAM.

The surface soil of the Holston gravelly loam is a light-brown to pale-yellow, silty loam or loam, commonly about 8 to 10 inches deep. The subsoil is generally yellow in color and ranges in texture from a loam to a moderately compact, gritty clay. The substratum is a bed of gravel and sand or large cobbles embedded in sandy clay, resting upon shale at a depth of 4 to 10 feet. The surface is strewn with waterworn and subangular gravel and cobbles, generally rather large and in places of such size as to make the soil a stony rather than a gravelly type.

The principal areas of the Holston gravelly loam lie along the lower courses of the larger creeks issuing from the Allegheny Plateau, the type occurring as terraces or benches 10 to 25 feet above the present overflow bottoms. The topography is gently sloping to nearly level. Except in a few low areas and depressions, drainage is adequate.

This soil is inextensive, but it has all been cleared and the greater part is utilized either for growing general farm crops, in connection with soils of other types, or for small truck farms. A small proportion is included in towns and their suburbs. The soil is probably somewhat less productive than the Pope and Huntington soils.

A few areas of Elk gravelly loam are included with the Holston gravelly loam, owing to their small extent. The largest of these lie near Bellwood and Tipton. This type consists of a brown or light-yellow fine loam, 8 to 10 inches deep, underlain by yellow, friable loam or clay loam. The soil material generally becomes lighter in texture and grades into sand or gravel at a depth of 3 or 4 feet. In many places the subsoil is light reddish brown or reddish yellow. Coarse gravel and cobbles of sandstone generally are very abundant at the surface and interfere to some extent with tillage.

The Elk gravelly loam has been formed from alluvial terrace deposits and is very similar in topography and origin to the Holston gravelly loam, differing from that type only in containing a small quantity of alluvium washed from limestone areas. The soil seems to have on the whole about the same agricultural value as the Holston gravelly loam.

In places, especially in the area at Hollidaysburg, this type contains spots of a heavy silt loam or silty clay loam soil resembling the Holston silty clay loam.

ROUGH STONY LAND.

Rough stony land includes those areas which, because of excessively steep slopes and an abundance of large stones, are unsuitable for farming. Most of the Rough stony land occurs on the steeper

slopes and crests of the Allegheny Mountains and the Appalachian Valley ridges, in association with areas of the Dekalb and Upshur stony loams, and simply represents the excessively stony and rough parts of these types. In a few places it includes precipitous bluffs along streams.

There is in most places sufficient soil to support a forest growth, but along the crests of some of the Appalachian ridges the finer material of rock disintegration has been almost entirely removed by erosion, leaving a mass of fragments of gray quartzite, barren or supporting only scant vegetation.

It is estimated that about 17 per cent of the total area of the county is too rough and stony for cultivated crops. These lands are valued chiefly for their timber. The gray quartzite on the Appalachian ridges is extensively quarried for ganister and to a lesser extent for building stone. The areas in the Allegheny Mountains afford fair pasturage for cattle.

SUMMARY.

Blair County is situated in the south-central part of Pennsylvania. It comprises an area of 534 square miles. The county lies partly within the Allegheny Plateau and partly within the Appalachian Valley physiographic provinces. The topography in general is mountainous and hilly. The valley areas vary from rough and hilly to gently rolling and range in elevation from about 900 to 1,400 feet above sea level. The mountain crests have altitudes ranging from about 1,800 to 3,000 feet above sea level. The country generally is well drained.

The population of the county, according to the 1910 census, is 108,858, of which about 37 per cent is rural.

The climate is characterized by mild summers and rather severe winters. The mean annual temperature is about 50° F., the mean for the winter months being about 30°, and that for the summer months about 70°. The mean annual precipitation, which amounts to about 42 inches, is well distributed throughout the year. The normal growing season is about 150 days in length.

A system of general farming is followed on the more productive valley lands, with dairying an important interest. On the rougher and less easily cultivable lands a mixed system of general farming, fruit growing, and trucking is carried on. Wheat, corn, oats, and hay are the general farm crops, wheat being the principal money crop. There is a large acreage of land well suited to orchard fruits, especially apples, and various small fruits can be profitably grown.

In all, 13 series of soils, embracing 22 distinct types, exclusive of Rough stony land, are mapped in Blair County. Stony loam, shale

loam, and silt loam soils predominate. Residual soils are by far the most extensively developed, alluvial and colluvial soils forming only a comparatively small part of the total area.

The Dekalb soils are most widely distributed, covering about 29.3 per cent of the area of the county. These are yellow soils derived from shales and sandstones, and have a rough, hilly to mountainous topography. They are but moderately productive, and only a very small percentage of the stony types is utilized for farming.

The Berks shale loam is somewhat similar in color and structure to the shale soils of the Dekalb series. It is not widely distributed, occurring only in the Appalachian Valley division of the county. This type is largely under cultivation and is considered a little more productive than the associated Dekalb shale loam. Corn, wheat, oats, and hay are the principal crops.

The Hagerstown series includes light-brown to brown surface soils and yellow to dull red subsoils. These soils are derived from limestone and are the most valuable soils in the county for general farming.

Most of the red soils of the county are grouped in the Upshur series consisting of material residual from red shales and sandstones. These soils are largely rough and difficult of access, but they are generally regarded as more productive than the associated Dekalb soils. They are well suited to fruit growing.

Other residual and colluvial soils of less agricultural importance than the foregoing, because of their smaller extent, are embraced in the Chemung, Morrison, Frankstown, Duffield, Murrill, and Lickdale series.

The alluvial or bottom-land soils are mapped in the Huntington and Pope series. These soils are generally under cultivation and are productive, being utilized both for truck and general farm crops.

The Holston gravelly loam is an inextensive terrace soil occurring along the lower courses of the larger creeks issuing from the Allegheny Plateau. It is usually farmed in connection with other types. The soil is moderately productive, but probably inferior in this respect to the Pope and Huntington soils.

Much of the farm land of the county has deteriorated in productivity, mainly from failure to maintain an adequate supply of organic matter and to prevent erosion. This is especially true of the shale soils on steep hillsides,

[PUBLIC RESOLUTION No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided,* That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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