

SOIL SURVEY OF THE JOHNSTOWN AREA, PENNSYLVANIA.

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DESCRIPTION OF THE AREA.

The Johnstown area is situated south and west of the center of the State of Pennsylvania. It includes the southern half of Cambria and Blair counties and a small part of the northern portion of Bedford County. The top of Tussey Mountain separates the area from Huntingdon County on the east, while Westmoreland and Indiana counties lie to the west. Somerset County touches the area at the southwest corner. Except for irregularity at the south corners, the area in shape is an oblique parallelogram. It contains 457,216 acres, or about 714 square miles.

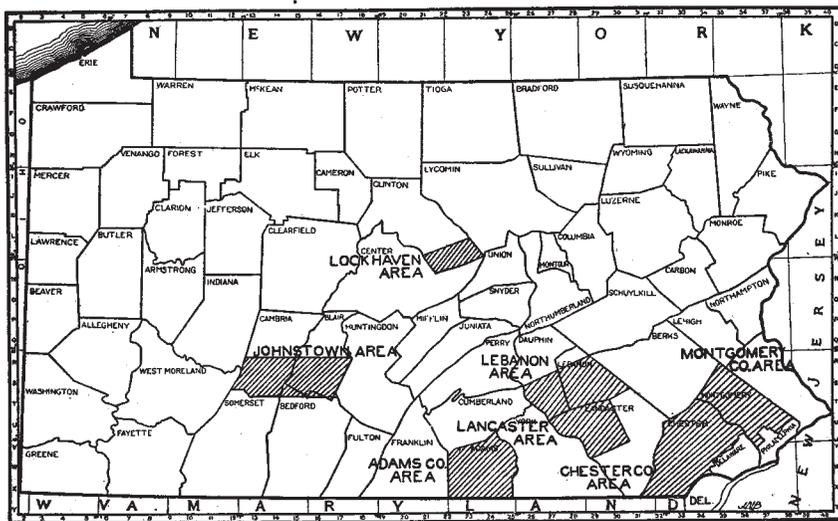


FIG. 2.—Sketch showing location of the Johnstown area, Pennsylvania.

The base map used was made by the United States Geological Survey and published as the Johnstown, Ebensburg, Hollidaysburg, and Huntingdon quadrangles. On these sheets the area is located between $78^{\circ} 10'$ and 79° west longitude and $40^{\circ} 15'$ and $40^{\circ} 30'$ north latitude.

The entire area is situated in the central part of the State of Pennsylvania, in the Appalachian province, which in this area has three well-marked natural divisions. These are the Allegheny Plateau in

the western part, the Appalachian Valley region in the eastern part, and the Allegheny Front, which passes through the center of the area in a general northeast-southwest direction.

The characteristics of a plateau can be recognized only in a general way and only when the district is viewed from a high point, because severe erosion has caused a very hilly, uneven, and in some places even a rough topography. The Allegheny Front is the boldest physiographic feature in the survey and forms a high escarpment, facing toward the east, through which streams have cut deep, precipitous ravines. The Appalachian Valley region is made up of successive valleys and mountain ridges.

East of the Allegheny Front is the shale valley of the Juniata River. This is separated from the limestone valley of Morrisons Cove by Dunning, Short, Loop, and Lock mountains. East of the cove and on the eastern edge of the area lies the mountainous ridge known as Tussey Mountain.

The crest of the Alleghenies, which follow closely the Cambria-Blair county line, forms the watershed of the principal drainage systems of the eastern United States. Two stream systems are well developed in the Johnstown area. The main stream in the eastern system is the Juniata River, which receives the drainage from the east side of the Allegheny Mountains through small streams, and from the southern end of Morrisons Cove through McKees Gap. At the foot of Short Mountain it turns abruptly to the northeast and receives the drainage from the Horseshoe Curve section through Beaverdam Creek at Hollidaysburg. It continues thence in a general northeasterly direction through Lock Mountain Gap, where it is joined by Clover Creek, and flowing north leaves the area at the base of Tussey Mountain.

The western system is not so simple. The Little Conemaugh rises near Cresson and flows southwest, receiving the drainage of the western slope of the Alleghenies and the region north. At South Fork, South Fork branch joins it from the northwest. At Johnstown it unites with Stony Creek, a stream of nearly equal size, and maintains the course of that creek to the northwest, passing out of the area through Conemaugh Gap. A small district north of Cresson drains north, but west of Ebensburg the South Fork of Blacklick Creek forces a passage westward through the Laurel Ridge, draining the rough northwest corner of the area.

There seems to have been no permanent settlement in the area until about 1756, when Stephen Frank located at Frankstown, in Blair County. Subsequent settlements were comparatively slow, because the Indians were a constant menace. A permanent white settlement was made at Moxhom, Cambria County, in 1774. It is said there were settlers in Morrisons Cove as early as 1749, but it is probable that no

permanent settlements were made there until about 1800. The pioneers of Cambria County were mainly Scotch-Irish, although there were some English and Welsh. Morrisons Cove was largely settled by Germans.

When the development of the natural resources of the region, such as the mining of iron, coal, and lead, and later the working of the clay and limestone deposits, was begun, there followed a rapid increase in population, which centered in the cities of Johnstown and Altoona. The rural population also increased rapidly, but not in proportion to the cities.

Martinsburg, in Morrisons Cove, is the only strictly agricultural town in the area. Ebensburg derives most of its income from agricultural products, but as it is the county seat of Cambria County and a delightful summer resort, it has been materially benefited from outside sources.

Johnstown is the largest city in the area and most of its inhabitants find employment in the various industries. The claim is made that it has doubled in population during the last decade. Several small mining towns are situated on the Pennsylvania Railroad between Johnstown and Altoona, which lies just outside the area. Holidaysburg is the second town of importance in the area, and is a railroad town receiving the agricultural products from a large territory. Williamsburg is the headquarters of the limestone industry, although manufacturing and agriculture are also important.

The rural districts in the vicinity of the larger towns are fairly thickly populated, although in some parts lumbering camps are the only dwellings.

In the larger towns there is such a demand for truck crops and all kinds of farm products that nearly all of the produce is consumed in the towns and little is shipped outside the area.

Although the marketing of crops is attended by more or less difficulty, owing to steep roads and in many cases long hauls, the main roads are kept in good condition through the use of crushed rock, which is everywhere obtainable. Toll roads are still in existence in certain localities, but these are not altogether popular and will doubtless be done away with in the near future.

The area is traversed by the main line of the Pennsylvania Railroad and its many branches and by a branch of the Baltimore and Ohio Railroad to Johnstown.

CLIMATE.

The climate of this section of Pennsylvania is moderate and healthful and suited to a wide range of crops. The temperature rarely exceeds 100° F. in summer or falls below 15° F. in winter. At Johnstown, which has an elevation of 1,177 feet, the average annual tem-

perature is 51.3° F., and at Cassandra, near the center of the area, 47.8° F. This difference of 3.5° is probably caused by the difference in elevation of 623 feet. Cassandra has a normal growing season of one hundred and fifty-one days.

General farm crops, with the exception of corn grown on the higher levels, which is sometimes caught by frosts, mature in this section without injury. An early maturing variety of corn which would insure a crop each year should be sought for. Owing to the fact that corn suffers in this way, some of the higher lands which were once cultivated to it have now been abandoned. Late frosts in spring sometimes injure fruit buds, or wheat and grass in the heavy, undrained soils may be damaged by freezing unless protected by a covering of snow. On the eastern slopes, however, fruit seems to do very well.

The area has abundant rainfall. The table below shows about 15 inches of precipitation from December to March, inclusive. The annual precipitation at Denny, Everett, and Huntingdon is given as 45.11, 41.43, and 42.38 inches, respectively.

During the growing season, from April to August, an average of 20.87 inches of rain falls. This is ample for all crops, and droughts are of rare occurrence. If the planting of spring crops is retarded, buckwheat is planted in June, so that the farmer's income is not materially lessened. Stock can be pastured during at least half the year.

The following tables give the normal monthly and annual precipitation and temperature at Johnstown, Altoona, and Cassandra, and the dates of the first and last killing frosts at these places for seven years:

Normal monthly and annual temperature and precipitation.

Month.	Johnstown.		Altoona.		Cassandra.	
	Temperature.	Precipitation.	Temperature.	Precipitation.	Temperature.	Precipitation.
	°F.	Inches.	°F.	Inches.	°F.	Inches.
January.....	29.2	4.00	25.3	2.84	25.4	3.19
February.....	29.1	3.97	24.1	2.58	23.8	3.17
March.....	39.7	3.91	38.4	4.17	36.9	3.93
April.....	49.7	3.81	47.7	3.32	46.5	3.16
May.....	61.4	4.43	59.9	4.06	59.2	4.58
June.....	69.7	5.11	66.7	3.99	65.8	4.70
July.....	73.2	4.71	72.0	4.48	69.8	4.84
August.....	71.1	4.46	69.6	3.46	67.5	3.52
September.....	65.0	3.35	62.9	2.60	61.6	3.04
October.....	58.6	2.71	52.3	2.90	50.0	2.74
November.....	41.5	3.36	39.9	2.55	38.5	3.02
December.....	32.6	3.58	28.8	2.90	29.1	3.14
Year.....	51.3	47.40	49.0	39.85	47.8	43.03

Dates of first and last killing frosts.

Year.	Johnstown.		Altoona.		Cassandra.	
	Last in spring.	First in fall.	Last in spring.	First in fall.	Last in spring.	First in fall.
1899	Apr. 11	Oct. 1	Apr. 17	Oct. 1	Apr. 11	Oct. 1
1900	May 6	Oct. 17	May 6	Oct. 17	May 5	Sept. 19
1901	Apr. 12	Oct. 4	Apr. 17	Oct. 4	May 14	Oct. 2
1902	May 29	Oct. 15	May 29	Sept. 15	May 10	Oct. 22
1903	Apr. 24	Oct. 28	May 2	Sept. 29	May 5	Sept. 29
1904	Apr. 17	Sept. 22	May 12	Sept. 22	May 12	Sept. 21
1906	May 11	Oct. 11	May 10	Oct. 8	May 10	Oct. 8
Average.....	Apr. 29	Oct. 10	May 5	Oct. 1	May 5	Oct. 2

AGRICULTURE.

The early settlers found the soil well adapted to corn, wheat, and other grains, flax, and potatoes. Corn was the favorite crop and hominy (hulled corn) was a staple food until the first gristmill was established near Summerhill in 1801. Growing flax and wool from which to make homespun cloth was early an important industry. In fact, the first farmers produced nearly everything they needed.

Corn, it is said, in the early days yielded 100 to 125 bushels in the ear, wheat 30 bushels, and potatoes 250 bushels. The first grain crops were cut with a sickle and later the cradle came into use and is still employed in the mountainous parts. The advent of the mower and reaper gave an impetus to agriculture, and the surplus crops were exchanged in markets farther east for articles which could not be supplied at home. The opening of State roads was of great benefit to agriculture also.

The principal occupation of the inhabitants, however, was lumbering, farming being secondary until within the last thirty years. Since then the increasing scarcity of timber, the development of new markets, and the establishment of great industries has led to the practice of general agriculture on a larger scale. Market gardening is also carried on to a large extent. The valuable mineral rights on many of the farms have been sold, and the money received from this source has improved the financial condition of the farmers.

Formerly many sheep were raised, but the decline in the price of mutton and wool, together with the ravages by dogs, has caused a lack of interest in this industry, and now, even with higher prices, sheep raising is on the decline. About 1890, on account of low prices, the breeding of choice horses received a check, although many carloads of horses of ordinary grades are still raised and sold for use in the cities. Some western horses are brought in each year. With the exception of some blooded Percherons there are no particular breeds raised at the present time, the farmers being content with heavy grade horses of good quality.

Dairying has always been followed, though not as a specialty, except in Morrisons Cove and vicinity, where there are many dairy farms. The cows are of various breeds, with a predominance of Jerseys. Transportation has developed the milk industry near the towns and shipping centers, the farmers either delivering milk to a skimming station for pasteurization or shipping it direct to the cities. The milk is often bought according to its butter-fat content, and this fact should give an incentive to the breeding of high-grade cows yielding rich milk. Milk usually retails at 8 cents a quart in summer and 9 cents a quart in winter. Doubtless dairying will be conducted on a more scientific basis, as silos are becoming general and the tendency is toward improvement in breeding and management.

Raising cattle for beef has never been an important industry and not enough is supplied to meet home demands. Since beef has become more expensive some farmers have bought steers in Pittsburg in the fall, fed them until spring, and sold them at a good profit, in addition to utilizing their coarse fodder and obtaining more manure. On farms remote from markets which have good pasture the production of beef cattle is to be recommended.

Enough hogs have always been kept to supply home needs, the number depending upon the supply of grain available and the number of cows on the farm. Grade Chester Whites predominate, but there are many Berkshires on the farms in the western part of the area. Although few farmers raise more than a half dozen pigs, the sale of spring-weaned pigs is a growing industry, as the villagers in mining towns usually keep one or more.

Every farm supports a considerable flock of poultry. Eggs are always in demand and find a ready sale at remunerative prices. The large urban population consumes nearly all the poultry products, and very little is shipped to outside points.

Many new orchards are being planted. Apple and peach orchards predominate. Grapes are produced for local consumption. At present the demand for grapes can not be supplied. The common varieties of apples are the Summer Rambo, Winter Rambo, Astrachan, York, Baldwin, and Gravenstein. Plums are grown near Hollidaysburg, and quinces and cherries seem to do well. The number of pear orchards is increasing. Raspberries and blackberries are grown for domestic use, and the soils are well suited to their production.

Market gardening has been greatly stimulated by the demand from the large towns in the area, where manufactures of various kinds are conducted. The development of the coal mines, quarries, and the steel industry has done much to bring about this demand. As a result the majority of the farmers plant from a fraction of an acre to several acres of truck, which is either marketed by the farmer or sold to hucksters. Tomatoes, cabbage, beets, rhubarb, turnips, onions, and

squash are produced, the first three predominating. Among the small fruits the strawberry is the most profitable.

The acreage of potatoes has nearly doubled in ten years; fair yields are reported and very profitable prices obtained. There is an immense loss each year from blight and rot—a loss that could be lessened, if not prevented, by spraying the vines with Bordeaux mixture.

Clover is an important crop both for hay and seed, especially in Morrisons Cove. Timothy hay is a money crop and seldom brings less than \$15 a ton. In the spring of 1907 the price reached \$24 a ton.

The development of market gardening has called attention to the adaptation of soils to crops. This is especially noticeable in the market gardening districts near Johnstown and Hollidaysburg. The new orchards are being set out with a view to good location, a well-drained soil, preferably originating from shale rock, having a southern or southwestern exposure, being selected. Much fruit is seen on the eastern slopes of Lock and Dunning mountains.

Crop rotation is practiced by some farmers, but is confined largely to the general farm crops. Truck farmers do not practice systematic crop rotation. The system usually employed is corn, wheat, oats, and timothy. Frequently corn will be planted on the same land for two successive years, but it is not considered best to keep an intertillage crop on the land for more than one year, because of danger from washing and leaching, except in the limestone valleys, where the practice is much safer. Wheat and oats are usually manured and fertilized. Timothy is left on the same land as long as a remunerative crop is obtained, ordinarily from two to five years. In Morrisons Cove clover has a place in the rotation along with timothy. No leguminous catch crops are used, so far as learned, although these offer an excellent opportunity to increase the humus in the soil. When unseasonable conditions prevent a stand of corn, buckwheat is usually planted to take its place.

The price paid for labor ranges from \$20 to \$25 a month with board and lodging; during harvesting and haying \$1 to \$2 a day. One dollar a day is a common daily wage. Italians, Poles, and Hungarians furnish most of the farm labor. On account of the lack of steady labor many farm hands work in the forests during the winter. On dairy farms help is more readily obtainable, as steady employment is assured. Farm values are increasing, and near Johnstown some of the truck land has trebled in value in the last ten years. The increase in the price of farm products has naturally enhanced the value of all farm lands. The price of the timbered area varies according to the kind and condition of the timber growth, the altitude, nearness to markets, and the improvements.

The average size of farms in Cambria County is 95.7 acres, 118 in Blair, and 132 in Bedford County. About three-fourths of the

farms are operated by owners. The tendency is toward a decrease in the size of farms.

According to the United States census reports for a long period of years, the acreage of buckwheat has increased, that of wheat has decreased, owing to western competition, and that of corn is less in Cambria County, but slightly more in Blair County. Rye, never an important crop, has decreased, and the number of sheep kept is steadily diminishing, owing to the damage done by dogs. The acreage of oats has been enlarged, but the greatest increase has been in vegetables and potatoes. Attention is now being particularly given to the growing of hay, vegetables, and potatoes, and to the development of the dairy herds.

In order that the soils of this area may give maximum yields, the supply of humus must be carefully kept up. The natural organic content in newly cleared land is probably sufficient, but after a few plowings and subsequent exposure this supply is largely exhausted and the decrease undoubtedly has a direct bearing upon the decrease of crop yields. This is particularly noticeable in the sandstone and shale soils and only less so in the limestone soils, because the supply has not been allowed to become so much diminished. Where sufficient manure can not be obtained to maintain the humus content, green manuring, particularly with leguminous crops, can be employed instead. Near the larger cities manure from livery stables usually can be obtained for the asking, and sometimes farmers are paid for hauling it away. This permits large applications of the best fertilizer or humus material obtainable, but there is some risk of introducing weeds. Lime is almost universally applied to these soils. It can be obtained from several companies in the area, although many farmers who own limestone deposits burn their own lime. Results obtained at the experiment station, however, would indicate that it is better to apply the powdered rock in all cases, rather than to burn the stone. On a number of the sandstone soils an application of lime is effective for two or three years only, on account of the rapid leaching permitted by their open structure. The ground or powdered rock would not dissolve so rapidly, and hence would be more effective in keeping the soil sweet for a longer period. On the heavier limestone clays it is a common practice to apply lime in order to improve the physical condition of the soil by breaking up the close structure and lessening the tendency of the soil to pack.

Commercial fertilizers are commonly used throughout the area, although not in great quantities. Those high in potash are most frequently bought, and apparently give the best results. The fertilizer requirements of a soil can best be determined by test plots. Such plots can be made and the tests conducted by the farmer himself, and the results observed will be of the highest value, because they will

apply to the soils and conditions on his own farm. Fertilizers are usually applied to wheat, buckwheat, and oats. If home mixing of fertilizers were practiced a considerable saving could be effected, and probably better results could be obtained.

The yield of corn could be increased if careful corn breeding were begun and a definite type of ear and kernel selected. Care should, of course, be taken to select and save the most perfect ears for seed. Certain forage crops—for example, millet and cowpeas—have proved valuable under similar conditions elsewhere. Rape has proved a valuable summer pasture crop for hogs and sheep. Carrots, turnips, mangels, and beets, as winter feed for horses and cattle, are recommended.

A few farmers have tried alfalfa on a limited scale with fair success. It is very probable that with a thorough knowledge of its culture, and of its soil and fertilizer requirements it would be a valuable crop for forage and for improving the soil. It would probably do well on deep, well-drained productive soils that will grow red clover.

On the limestone and Dekalb soils tobacco is not grown, although on the same types under similar climatic conditions it is grown very successfully in other parts of the State.

In certain sections some of the land has been sold to timber and coal companies, who are developing these resources. This unfortunately has led to abandonment of many of the farms. Some of the land in the mountains, on account of altitude and character, is suited only to forestry, and in these places farming should not be attempted. The area has always been the scene of extensive lumbering, and at the present time there is great demand for wood pulp, cooperage material, and construction timber. Locust and chestnut grow very well and are very valuable for making posts, mine props, ties, and poles. Many farmers have a small lot of locust, and this growth is considered by some as a very valuable, if not the most valuable, timber on the farm. Much of the forest land can be used for pasturing stock, and the returns from the farms in this way be increased.

SOILS.

There are so many variations in the soils of the Johnstown area that a study of their formation and classification becomes at once interesting. Some of the soils have been formed by the weathering of the rocks in place, and are therefore residual; some represent the same material reworked by water, and are therefore alluvial; and others are colluvial, or made up of material which originally occupied the highlands, but which gradually has been washed down and accumulated at the foot of the slopes.

The residual soils cover practically all of the upland, and therefore have the greatest extent. As these soils are derived entirely from the underlying rock, some knowledge of the many different geological formations which occur in the area will assist in understanding the consequent soil variations. The rocks of the area are all sedimentary, and were laid down in the Paleozoic era. There were five periods of sedimentation. Named in order, beginning with the latest, these are the Pennsylvanian (Upper Carboniferous), in which the rocks west of the Allegheny Mountains were formed; the Mississippian (Lower Carboniferous), represented by the rocks of the Allegheny Mountains; the Devonian, comprising the rocks which form the eastern foothills and the Juniata Valley; the Silurian, including the mountainous ridges in the eastern half of the area, and the Ordovician, to which the rocks of Morrisons Cove belong.

These rocks are mainly sandstones, shales, and limestones. The sandstone and shale occur in the Appalachian Mountains and Allegheny Plateau, which constitute a distinct soil province.

Variation in color is one of the peculiar characteristics of the rock formations of this province. Most of them have shades ranging from gray to brown, and these give rise to gray and yellow soil. The other formations have a peculiar red color, which is usually intensified in the overlying soil. Both the yellow and the red soils vary widely in texture, which, too, depends upon the material forming the underlying rock. The shales are composed largely of fine material, while the grains in the sandstone may be fine, medium, coarse, or mixed. As a consequence, when the rocks disintegrate through the various agencies of weathering the soil thus formed is composed of the same sized particles as make up the parent rock. The size of its particles and their proportion determine the texture of a soil, and the relation of a soil to soils of similar nature, except in the one question of textures, is the basis of grouping soils in series. We have, then, soil series which are characteristically yellow, and others which are red. The yellow types, when thus grouped, form the Dekalb series. The red soils belong to the Upshur series, which is represented in the area by only three types—Upshur loam, Upshur stony loam, and Upshur stony sandy loam.

The limestone rocks are so radically different from the sandstone and shales in chemical and physical composition and manner of weathering that they constitute a separate soil province—Limestone Valleys province—and form an entirely different group of soils, known as the Hagerstown series. Morrisons Cove Valley, passing across the area in the vicinity of Hollidaysburg, represents this province in the Johnstown area.

Limestone weathers through chemical agencies, the soluble part of the rock being dissolved away and the relatively insoluble residue

forming the soil. Consequently, upon the relative purity of the rock and the character of the residue depends the type of resulting Hagerstown soil. Chert or flint occurring as strata embedded in the massive rock is the most common impurity in limestone. The pure rock yields a reddish soil, with a high clay content and no chert, which is classified as Hagerstown clay loam. The moderately pure limestone leaves a residue of small chert fragments and fine material of lighter texture and color, and this is the Hagerstown silt loam. The soil derived from a very impure rock contains many large chert fragments and is accordingly called Hagerstown stony loam. In places where considerable sand, even though it is derived from a sandstone, has been incorporated with limestone material, the resulting soil is included in the Hagerstown series as the Hagerstown sandy loam.

The alluvial soils are found in stream bottoms, which constitute the third main soil division of this area. All the streams have a decided fall and swift currents. As a result they are deepening, rather than widening, their stream beds, and a very large part of the soil particles which are washed from the uplands into the streams is carried by the water to lower levels outside the area. However, in times of high water strips along some of the larger streams have been overflowed, and narrow bottom lands have been formed by the accumulation of particles too large to be borne away by the current. As might be foreseen, this process results in an assorting of the soil particles according to size, the coarser particles being deposited near the streams, where the current in time of overflow is swiftest, and the finer particles being carried farther from the stream and deposited in slowly moving water. Thus we have a fine sandy loam where the current is the swiftest and a loam where the water is more sluggish. Most of this material has been washed from areas of Dekalb soils and has a distinctly yellowish brown color—a distinguishing characteristic of the Huntington series; consequently we have in the Johnstown area Huntington loam and Huntington fine sandy loam.

Along certain of the streams draining the Upshur stony loam, the red sand grains have accumulated in the bottoms and constitute a sandy loam, but as there is no group of soils with similar characteristics, this material has been classified with Meadow. Other areas occur in the bottoms, which are wet and have other properties foreign to any of the soil series, and these were also mapped as Meadow.

Colluvial material consists of soil particles which have been washed down hill slopes by the agency of water aided by gravity, and which have accumulated at the base of the slopes. While some of this material may be included with the alluvial soils, and although small spots of it occur in the uplands, where it is more extensively developed, it has been called the Lickdale clay loam. In spite of the fact that this

soil is composed of soil particles which at one time belonged to the Dekalb soils and retains many of the characteristics of those soils, it is not included among them, because it differs so radically from them in the manner of its formation.

There are other soils, such as Frankstown stony loam, Morrison sand, Morrison fine sandy loam, and Morrison sandy loam, which have characteristics so foreign to any series that they are given local names. The names Rough stony land and Steep broken land are sufficiently definite and need no explanation.

The following table gives the name and actual and relative extent of each of the soil types:

Areas of different soils.

Soil.	Acres.	Percent.	Soil.	Acres.	Percent.
Dekalb stony loam	144,512	31.7	Huntington fine sandy loam.	4,992	1.1
Rough stony land	63,424	13.9	Chemung stony loam.....	3,328	.7
Dekalb silt loam.....	46,464	10.1	Dekalb clay	3,072	.7
Upshur stony loam	39,680	8.7	Morrison sandy loam.....	2,560	.6
Dekalb shale loam	35,200	7.7	Upshur stony sandy loam....	2,368	.5
Hagerstown silt loam.....	34,432	7.5	Frankstown stony loam.....	2,048	.4
Dekalb stony sandy loam....	18,688	4.1	Hagerstown sandy loam	1,792	.4
Hagerstown stony loam	11,648	2.6	Steep broken land.....	1,792	.4
Meadow	9,792	2.1	Morrison fine sandy loam....	1,600	.3
Dekalb loam.....	9,472	2.1	Upshur loam.....	1,536	.3
Lickdale clay loam.....	7,040	1.5	Morrison sand.....	576	.1
Hagerstown clay loam.....	6,144	1.4			
Huntington loam.....	5,056	1.1	Total.....	457,216	.....

MORRISON SAND.

The Morrison sand to a depth of 6 inches is a mixture of white sand and organic matter, giving a gray, loose, and incoherent sandy soil. The subsoil to 36 inches is a yellow loamy sand or sand which as it is brought up by the auger is loose and incoherent, but which, when exposed to air and sun, dries into small aggregates easily crushed with the fingers. Some small sandstone fragments are found on the surface, but not in sufficient quantity to interfere with tillage.

This soil is found in small spots in the barrens in Morrisons Cove. These occupy usually the tops of knolls and ridges at elevations of about 1,600 feet, or about 200 feet above the general level of the limestone valley. Owing to the loose texture of the soil and its topographic position it is very thoroughly drained, and if cultivated the crops would probably suffer more or less from drought.

The Morrison sand has been derived by weathering from a sandstone stratum in the limestone, the particles having accumulated on high level tracts where washing is at the minimum.

So far as known none of this type is under cultivation, but is covered by a dense second growth of chestnut, with some jack pine and

scrub oak. Underbrush consisting mostly of blackberry bushes is very common. Under the present forest conditions with the covering of vegetable mold the sand seems to retain moisture well, and this soil may well be left in forest, although the general character of the growth can be greatly improved.

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

Mechanical analyses of Morrison sand.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17172.....	Soil	0.4	6.5	15.0	56.3	4.2	12.1	5.9
17173.....	Subsoil.....	.4	7.1	17.2	50.9	3.6	12.7	7.6

MORRISON FINE SANDY LOAM.

The surface soil of the Morrison fine sandy loam, which is seldom over 6 inches in depth, consists of a gray very sandy fine sandy loam or fine sand, moderately loose and incoherent in structure. The subsoil from 6 to 36 inches in depth is a light-yellow, very loose incoherent fine sand or light fine sandy loam containing considerable sand of all grades. This material becomes whiter and finer with depth, until at 36 inches it is a white fine to very fine sandy loam which contains considerable silt. Small rounded quartz gravel occurs on the surface and throughout the soil and subsoil, and occasional small spots are found which carry sufficient of this coarser material to warrant classification as a gravelly soil. There are also some small sandstone and conglomerate fragments scattered over the surface, but seldom in such quantities that removal is necessary.

The Morrison fine sandy loam occurs in a very narrow band and is found associated with the Frankstown stony loam, being the second soil encountered in ascending the slopes of the limestone ridges in the vicinity of Frankstown from the east. Occurring on the hillsides and having a gently sloping to very steep topography, the drainage is both rapid and complete, while the open, incoherent structure of the soil renders cultivation easy.

The Morrison fine sandy loam has been formed by the disintegration of the Oriskany sandstone, which is exposed in a narrow band between the water lime rocks of the Lower Helderburg and the shales of the Hamilton formation. The type is about half in oak and chestnut timber and the other half is devoted to general farming or garden plots. As cultivated fields on these slopes usually contain some Dekalb shale loam, some Morrison fine sandy loam, and Frankstown stony loam, and as little effort is made to specialize crops on these

soils, it is difficult to estimate the crop yields accurately, but the Morrison fine sandy loam is not considered a good general farming soil because of its inability to hold fertilizers and lime. However, if brought to a high state of productiveness with manure it would make an excellent truck soil. It is usually of sufficient extent on the farms where it occurs to produce a great deal of truck, for which there is a ready market.

The soil is not adapted to general farming, and yields of corn, wheat, and oats are comparatively low. Lime, manure, and commercial fertilizers are applied at the rate of about 200 pounds each to the acre.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Morrison fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17086.....	Soil	3.1	6.7	8.9	39.6	13.9	16.9	10.8
17087.....	Subsoil.....	4.2	7.6	5.8	29.7	23.4	20.9	8.2

MORRISON SANDY LOAM.

The Morrison sandy loam is a gray to yellow sandy loam about 8 inches deep, underlain by a yellow subsoil, which becomes heavier with depth until at 36 inches it is a heavy loam or clay loam. From 5 to 20 per cent of the soil mass is made up of sandstone fragments. These, however, are rarely an impediment to cultivation. The soil is not uniform, as small areas occur which vary to lighter or heavier textures.

This soil is not extensive, but occurs in several isolated areas in the western part of Morrisons Cove. It occupies slopes and ridges in the "barrens," which have an elevation of 1,500 feet, and consequently drainage is excellent. Droughts do not have the damaging effect upon crops that might naturally be expected on so light a soil, though, nevertheless, a good mulch is necessary to maintain the soil moisture.

The Morrison sandy loam is derived from the same sandstone band in the limestone that gives rise to the Morrison sand, but the accumulation of sand grains has not been so great.

Little of this soil is in cultivation, and it is not considered nearly so good as the Hagerstown sandy loam, with which it is easily confused. Chestnut, pine, and oak trees, with considerable underbrush, constitute the principal vegetation. It is doubtful if this soil is adapted to general farm crops, but for trucking it should be one of

the best upland soils of the area. Fruit would doubtless be successful, and some few orchards of peaches, pears, and apples were seen. Pears appeared particularly thrifty. No accurate crop yields could be determined from the small areas in cultivation.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Morrison sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17880.....	Soil	2.3	12.6	16.0	34.6	9.0	18.8	7.0
17881.....	Subsoil.....	.3	9.7	15.9	33.4	9.8	17.0	13.5

DEKALB STONY SANDY LOAM.

The Dekalb stony sandy loam is a loose-structured, dark-gray or gray sandy loam, 7 or 8 inches in depth, underlain by dark-yellow slightly sticky sandy loam, which becomes little, if any, heavier to a depth of 36 inches. The line of demarcation between soil and subsoil is quite pronounced. The sand grains are mostly medium or coarse, although in some places the percentages of the finer grades may be appreciable. Small quartz gravel is found throughout the soil in some localities. Considerable organic matter is usually mixed with the top soil. At least 25 per cent of the surface is occupied by fragments of medium to coarse-grained sandstone or conglomerate, the removal of which is necessary before cultivation can be successful.

There are several isolated areas of this soil, the principal ones being in the vicinity of Ebensburg, Cresson, New Germany, and along the crest of the Allegheny Mountains and in Morrisons Cove.

The areas west of the Alleghenies have been formed by the weathering of the Saltsburg sandstone of the Conemaugh formation, those in the Alleghenies by the weathering of the Pocono sandstone, and those in Morrisons Cove from a sandstone stratum in the limestone the identification of which is uncertain. In all cases the incomplete disintegration has given rise to the stony character of the soil.

This soil is largely covered by timber growth, chiefly chestnut, although some maple, pine, and hemlock are seen. Little of the land is under cultivation, that cultivated being mostly by small farmers, whose principal livelihood is derived from the timber rather than the soil. The low yields of buckwheat, hay, and vegetables do not warrant cultivation further than to supply home demands.

Fertilizers and lime are applied in some localities, but the texture of the soil allows rapid leaching. Barnyard manure seems to have the most enduring effect upon this soil.

It is so easily handled that in places convenient to markets where the altitude allows sufficient length of season the trucking industry could be more fully developed. In Morrisons Cove it is probable that orchards of apples, plums, pears, and other fruits would be profitable. If proper varieties of chestnuts could be selected the groves would prove profitable.

The character of the original timber and the difficulties connected with the production of other crops are evidences that this soil should be left in forest, which undoubtedly in time to come will prove remunerative.

The following table gives the average results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Dekalb stony sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17056, 17872.....	Soil	2.4	16.1	21.9	16.8	5.0	25.1	12.1
17057, 17873.....	Subsoil.....	3.1	17.8	18.8	17.1	4.6	25.0	13.1

DEKALB LOAM.

The surface soil of the Dekalb loam varies from a light to dark gray or brownish fine-textured loam, 6 to 8 inches in depth, underlain by a yellow loam which, owing to a slightly increased clay content, becomes somewhat heavier with depth. Strewn over the surface and distributed throughout the soil and subsoil, the quantity usually increasing with depth, is found from 5 to 20 per cent of small sandstone fragments, which, however, do not materially hinder cultivation. Freshly disintegrated and broken sandstone rock often comes within 24 inches of the surface.

The Dekalb loam occurs in isolated bodies, the greatest number being in the vicinity of Geistown and Ebensburg and Morrisons Cove. The area southwest of Ebensburg is distinctly more sandy than the Geistown areas. A phase of the loam was seen near Noel station, and other small bodies which are micaceous were found. In these spots, although the surface is practically typical, the subsoil becomes lighter with depth.

Situated on high, gently rolling uplands, the drainage of the Dekalb loam is usually sufficient, but near the heads of streams artificial drainage could well be employed.

The Dekalb loam has been formed by the weathering of fine-grained sandstone and sandy shales of the Conemaugh formation and, in Morrisons Cove, by the weathering of sandstone, although it is possible that limestone has here had some part in the formation of the soil.

Chestnut and oak were the original tree growth, but the forests have largely been cleared off and the land put under cultivation. This is one of the best soils of the area and is devoted to general farming. In the areas nearest Johnstown potatoes and cabbage are important crops and do well. Orchards are numerous and are apparently productive. Commercial fertilizers are used to some extent, but manure and lime are the favorite fertilizers and seem to give the best and most lasting results.

More of this land could be brought under cultivation, especially where markets are available. It would seem that this type is eminently adapted to growing fruit, especially apples and, possibly, peaches.

The organic matter content of the Dekalb loam should be increased, not only by more frequent applications of manure, but also by the growing of leguminous crops, such as clover and cowpeas.

The land varies in price from \$50 to \$200 an acre, depending largely upon its situation in regard to markets.

The following table gives the average results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Dekalb loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17054, 17064, 17124.	Soil	1.5	3.0	2.6	21.6	9.6	44.9	16.3
17055, 17065, 17125.	Subsoil.....	1.1	3.5	2.5	20.2	9.7	41.8	21.0

DEKALB STONY LOAM.

The soil of the Dekalb stony loam, which has an average depth of 8 inches, is a light yellowish-brown or gray heavy loam or loam containing considerable fine sand. The virgin soil has a rather compact and close structure, but when cultivated the soil particles have a tendency to aggregate, and then it becomes more open, friable, and easily tilled. The subsoil, from 8 to 36 inches, is a yellow loam, becoming somewhat heavier with depth until a distinct clay loam is developed. The aggregated structure prevails in the subsoil also. The distinctive feature of this soil is its high stone content. Sandstone fragments of all sizes, and of all textures, from fine-grained to coarse conglomerate, are found strewn or piled on the surface and disseminated through the soil and subsoil in such quantities that cultivation without their removal from the surface is impossible, and even then often difficult. It is seldom possible to bore into this soil more than a few inches.

The Dekalb stony loam is well distributed over the area, occupying the mountainous areas. It is most extensively developed in the

Johnstown quadrangle, where it occupies the approaches to Laurel Ridge and the severely eroded areas adjoining the Conemaugh River and its branches and Blacklick Creek. In these sections is found a phase of the type in which the subsoil may be a sandy clay instead of a clay loam. The second largest area of the soil occurs at the eastern boundary of the Conemaugh formation, which extends from the northeast to the southwest corner of the Ebensburg quadrangle. Other prominent areas are found on the approach to Brush Mountain, northeast of Hollidaysburg, and the approaches to the mountainous ridges which form the boundary of Morrisons Cove. The Brush Mountain area and the one on the western side of the Loop Mountain ridge have a subsoil which in places has a distinct reddish tinge, although the texture is nearly typical.

In general, the Dekalb stony loam is formed by the disintegration of sandstone and shale rock, but the character of the rock may vary in the different areas. The western areas are formed from the Conemaugh series of rocks, which consist of alternate strata of sandstone and shale. The shale weathers more rapidly than the sandstone, and in the worst eroded regions of these formations the shale has not only disintegrated, but has eroded away, leaving the sandstone fragments in the soil. The Brush Mountain area and the one on the western approach of Loop Mountain ridge have been formed partly from disintegration of the Clinton shales, but largely by the accumulation of fragments of Medina and Oneida sandstones which have rolled down from the higher mountain slopes. The areas on each side of the cove were formed in a similar manner by the accumulation of Medina and Oneida sandstone fragments over the Hudson River shales. The Pocono formation has also given rise to some of the type west of the Allegheny front.

From the character of the topography it is plainly evident that natural drainage is well established, and while erosion is very active, where cultivated the land is seldom washed or gullied.

The natural tree growth is largely chestnut, but hemlock, oak, and beech are common. Most of the timber has been cut and the land left in a very bad condition, although a few areas occur where the underbrush is kept down and the land is used for pasture.

Owing to the very rough topography and the excess of stones only a small proportion of the type, usually adjacent to other types, is under cultivation. It is, in such cases, used for garden or general farming crops. The main source of revenue from the Dekalb stony loam is derived from the sale of timber or mining rights. The stones are so numerous and the underbrush so thick and dense that the cost of clearing is not warranted where the land is to be used for extensive general agriculture. The great demand for truck and dairy products has brought about the improvement of the greater part of

this soil now cultivated, and this will continue, particularly where the land lies accessible to markets and is less stony. The value of this soil depends, therefore, more upon the topography and the quantity of stones than upon any particular crop adaptation. Nearly all of the crops of the area are produced in the cultivated areas, but yields are relatively poor.

Permanent pasture on which cattle and sheep can be raised is one of the best uses to which the Dekalb stony loam can be put. With proper care orchards might be remunerative, but this industry should be entered upon with considerable caution. A good variety of chestnut grafted upon native stock would probably pay, but so far as learned this has not been tried. On the other hand, the soil is naturally adapted to forestry, and if planting and management is conducted along scientific lines most of it can be put to profitable use with little difficulty.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Dekalb stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17050.....	Soil	0.3	2.8	4.3	21.5	6.1	48.4	15.6
17051.....	Subsoil.....	2.0	5.4	7.1	14.6	7.1	40.5	23.0

DEKALB SILT LOAM.

The soil of the Dekalb silt loam, to a depth of 6 to 8 inches, is a dark grayish-brown silt loam of rather open structure and easy tillage. It is underlain by a lighter colored loam or clay loam which becomes somewhat heavier with depth and is usually mottled with yellow or drab. A large quantity of small shale fragments occurs on the surface and throughout the soil and subsoil, the quantity usually increasing with depth. Some sandstone fragments are also found, but these are usually well scattered and small, although on the tops of some of the knolls and ridges there may be a sufficient number to hinder cultivation. Freshly disintegrated or solid shale rock can usually be found at 24 to 30 inches, and this imparts a greasy feel to the subsoil.

This soil occupies rolling to hilly topography and is characterized by knobs and steep-sided ravines; consequently the land suffers more or less from erosion and the soil profile is not very uniform. On the tops of knolls and ridges the material is removed almost as fast as broken down, leaving a very shallow covering, which is more a mass of shale fragments than a true soil. The accumulation of silt and clay from above has formed a heavier, deeper soil on some of the

slopes and narrow flats, but these areas, as a rule, are so small that separation was impracticable. Except in some places where the soil is heavier drainage is usually good, and although the soil has a very open structure it is claimed that it withstands drought well.

The Dekalb silt loam is found on the two ridges running north of Johnstown, and on the general slope from Ebensburg to Cresson and Wilmore, extending southwest to the vicinity and north of Elton. Smaller areas occur throughout the Carboniferous formations.

Variation in this soil is due in part to the fact that it is formed through weathering from the Conemaugh shales, which in themselves differ greatly. These have not weathered to a uniform depth, and the soil may be several feet deep in one place and in another, only a few feet distant, comparatively shallow.

Being the most important type of soil derived from the Conemaugh formation, except for the steeper slopes along streams, in forests of hemlock, oak, beech, and chestnut, it is nearly all under cultivation. Although a great many farms are neglected and have depreciated because of poor cultural methods, where well cared for produces fair crops. Oats yield about 40 bushels and wheat about 20 bushels to the acre. It is not a corn soil, as corn, owing to the short season, is not a sure crop, but in good years yields about 75 bushels in the ear. Constant fertilization and manuring is absolutely essential to the production of good crops. Lime and manure do best if applied immediately after the hay is removed from the meadow. This promotes a strong root growth and when plowed under increases the quantity of humus, which is the most difficult of soil ingredients to maintain. Little grain is sold, although some wheat and rye, baled straw, and hay are disposed of. The income is derived principally from stock and stock products. Some farmers feed young stock during the winter and sell them the following summer. Land of this soil type is worth, on an average, about \$35 an acre, depending upon improvement and market facilities.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Dekalb silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17052.....	Soil	3.9	3.9	1.3	3.6	8.2	60.1	18.9
17053.....	Subsoil.....	5.8	6.5	2.3	4.5	8.7	49.8	22.1

DEKALB SHALE LOAM.

The Dekalb shale loam to a depth of 6 to 8 inches consists of a gray, yellowish, or brownish-gray silty loam, underlain by a somewhat heavier and lighter colored subsoil which extends to depths rarely exceeding and often less than 24 inches. From 10 to 60 per cent of the surface is occupied by shale and sandstone fragments varying in size from mere chips to large flat pieces one-half inch to 1 inch in thickness and 1 to 2 feet in circumference. The shale nearly always predominates and the content increases with depth until the subsoil gives way to the bed rock. The presence of this shale has a great influence upon the physical condition of the soil, giving it the character of a light-textured soil, and consequently it can be worked at almost any time.

Three phases of the Dekalb shale loam are found in the area. The largest body occurs as a band from 1 to 3 miles wide, running in a general north-and-south direction between Altoona and Queen. The next largest area is situated just east of Frankstown, and the third occurs as a broken band at the foot of the high terrace which surmounts Morrisons Cove. The latter area carries more than the usual quantity of sandstone and less of the large shale fragments, but the usual large quantity of shale chips. A stony phase occurs along the western border of the first area adjacent to the Chemung stony loam. Here the number of large shale and sandstone fragments is so great that many must be removed to permit satisfactory tillage of the land.

The main part of the type is characterized by a succession of rounded knobs, with elevations of about 1,800 feet, from which radiate in all directions except west narrow ridges that slope rapidly to the flood plains of the many streams, which are from 900 to 1,100 feet in elevation. Small rounded knobs peculiar to shale formations are also found at intervals on the ridges. Steep-sided ravines are very numerous in this type. Owing to the rough topography the drainage is thorough or even excessive, though the evidence of severe washing or gullying is rarely observed. The open structure caused by the shale fragments permits a large percentage of the rainfall to be absorbed, and this reappears in spots as seepage, making the soil in these places soggy, cold, and wet.

The greater part of the Dekalb shale loam has been formed by the disintegration of the slates and shales making up the Chemung, Nunda, Genessee, Hamilton, Marcellus, and Upper Helderburg formations of the Devonian age. The small areas in the vicinity of Hollidaysburg have been formed from the Clinton shales of Silurian age, and the areas surrounding Morrisons Cove have been derived from the Hudson River shales and Utica shales of Siluro-Cambrian age. Most of these formations are made up of shales of various colors with sandstone lentils. The shales are comparatively soft and

have weathered quite rapidly, while the sandstone, being harder, has accumulated on the surface. Hence the Chemung formation, which contains a great deal of sandstone, has given the stony phase of this type, or even in places the Dekalb stony loam. The Clinton and Hudson River shales have weathered more completely than the others, and consequently fewer of the larger shale fragments occur in these formations. From some of the higher elevations the soil particles have been removed by washing almost as fast as made, leaving only a mass of shale particles, while the accumulation of these on the lower slopes has given a deeper soil.

With the exception of its stony phase this type is largely under cultivation. The general farm crops are grown on it, although it is not considered a strong corn soil, the average yield per acre ranging from 30 to 50 bushels in the ear. Wheat averages 10 to 12 bushels, oats 30 to 35 bushels of good quality, but buckwheat is not generally grown on this soil.

The practice of general farming is rapidly giving way to trucking, potatoes, tomatoes, and cabbage being leading crops. The good roads make it possible to market these products, so that the farmer plants enough grain and cuts enough hay for his own use and depends largely upon truck as the money crop. Dairying is not so general as it should be, considering existing market conditions and the demand for manure created by the trucking industry.

It is said that lime effects a marked increase in crop yields on this soil, and commercial fertilizers are also used to some extent.

Land of this soil type is held at \$30 to \$100 an acre, depending upon the location and convenience to markets.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Dekalb shale loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17132.	Soil	1.8	5.7	1.5	2.0	1.0	67.5	20.6
17133.	Subsoil.....	2.0	6.3	1.7	2.5	1.7	63.2	21.6

UPSHUR LOAM.

The Upshur loam consists of a brownish-red heavy loam, 7 inches in depth, which has a slight tendency to bake, but which is not difficult to bring into a good condition of tilth. The subsoil to a depth of 36 inches is a deep Indian-red clay loam which becomes heavier with depth and is in many places mottled with yellow in the lower depths. The soil carries about 20 per cent of sandstone fragments which doubtless come from formations higher up the slopes.

The soil occurs in a rather narrow, broken strip about 2 miles west of the Allegheny Front. It occupies gentle to rather steep slopes, although where the topography is very rough it has been mapped as Rough stony land. It is well drained, but does not suffer from drought.

The Upshur loam has been formed by the weathering of the red shale in the Mauch Chunk formation and has been influenced by the accumulation of fragments of sandstone from the Pocono formation.

Very little of the soil is under cultivation and accurate estimates of yields are hard to secure, but it is considered a good type, and in places quite productive. Small farms could be cleared on this type, but they would be isolated and very inconvenient to markets.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of the Upshur loam:

Mechanical analyses of Upshur loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17066.....	Soil.....	0.7	5.0	3.7	7.9	3.6	52.1	26.5
17067.....	Subsoil....	.7	5.7	4.9	11.0	5.7	43.9	28.0

UPSHUR STONY LOAM.

The soil of the Upshur stony loam, which has an average depth of 6 to 8 inches, consists of a fine-textured, reddish-brown loam, containing an appreciable quantity of fine sand and a marked proportion of silt. It has a rather open structure and is easily tilled. The subsoil becomes somewhat heavier with depth and consists of a rather compact dark Indian-red clay loam, which overlies sandstone rock at depths varying from a few inches to several feet. Strewn over the surface and disseminated through the soil and subsoil are from 10 to 35 per cent of red, flat, sandstone fragments, which vary in size from mere pebbles to pieces 2 feet in circumference. Many soft red shale fragments also occur in the soil and subsoil.

The Upshur stony loam occupies two distinct areas. The largest and most important is situated in the central part and the other surrounds Morrisons Cove on the side of the mountain. The former body lies in a strip at the foot of the Allegheny Front and varies in width from 1½ miles at the northern boundary to about 6 miles in the center and about 4½ miles at the south boundary.

In topography this area is steep and broken. It is made up of very steep slopes and hogback ridges and knobs. The elevations range from about 1,500 to 2,400 feet above sea level, and consequently drainage is rapid though apparently not excessive, and except in a

few places where the rock comes close to the surface the soil seems to stand drought well.

This body of the Upshur stony loam has been formed by the disintegration of soft red shales and fine-grained sandstones, alternate layers of which make up the Catskill formation. The sandstone weathers more slowly than the shale, and its accumulation on the surface and in the soil gives the type its stony character.

The greater part of the area is in chestnut and oak, generally of excellent quality. The farms are usually small and are located along the streams where water can be easily obtained. General farming is carried on, but crops must be cared for and harvested by hand. Sleds are in common use on these hillsides where wagons are impracticable, as the type has the distinction of having steeper slopes in cultivation than any other in the area. This is probably due to the fact that it is considered a very strong soil. Wheat gives from 10 to 20 bushels, oats 20 to 35 bushels, corn 40 to 60 bushels, and buckwheat from 15 to 20 bushels per acre. Only enough grain is produced to supply food for the family and for feeding farm animals. Little stock is kept, so that little of the cleared land is given up to meadow or pasture. On areas favorably situated the growing of truck crops is becoming more general. The sale of wood forms an important part of the farmer's income.

At present very little of this area is accessible, or at least convenient to market, so that products when marketed must be in small bulk, on account of difficulties of transportation. Stock should be kept in greater numbers, as by using the manure the humus content of the soil could be increased. Again, the land would not have to be so thoroughly cleared for stock raising as for the cultivated crops. Although little attention is paid to fruit growing here, from the success attending such efforts elsewhere on similar soil it seems highly probable that certain varieties of apples and grapes, if well cared for, would prove highly profitable. On the roughest part forestry is now and will probably always be the predominating industry.

The value of the land depends largely upon the standing timber, and varies from \$10 to \$100 an acre.

The second area referred to is on the upper slopes of the mountain chains which border Morrisons Cove. It is found usually between elevations of 1,600 and 2,000 feet and has consequently a steep topography and thorough drainage. Immediately above the Upshur stony sandy loam the surface of this body is a gentle slope and well suited to general farming, although the soil is inclined to be droughty. Practically none of this area is under cultivation, but is covered with an excellent growth of chestnut. The inaccessibility of this area and the lack of water will probably retard cultivation in this section.

The soil in this area has a somewhat higher content of sand, due no doubt to the fact that it is derived principally from the red Medina sandstone and less from red shale than in the other area mentioned. Generally a greater quantity of stone, in larger fragments, is found in this soil than in the area first described.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Upshur stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17126.....	Soil	0.9	3.2	0.9	8.8	14.0	55.0	16.9
17127.....	Subsoil ....	.6	4.8	1.5	6.5	11.9	55.8	18.5

UPSHUR STONY SANDY LOAM.

The soil of the Upshur stony sandy loam has a depth of about 8 or 10 inches, and consists of a reddish-gray sandy loam. This material becomes sandier and redder with depth, until at 36 inches a rather loose-structured Indian-red sandy loam is found. Occasional spots of loose, incoherent sand occur throughout the type. Except in local spots this soil is not as stony as either the Upshur stony loam or the Dekalb stony loam, but the sandstone fragments and boulders are sufficient to make clearing and cultivation difficult.

Of rather small extent, the type is confined to the high terraces that occur at intervals along the sides of the mountains bordering Morrisons Cove. These terraces lie about 400 feet above the valley, at elevations of 1,700 to 1,900 feet, or about half way up the mountain sides. They are not level, but have gentle to rather steep slopes, which, with the character of the soil, insure complete drainage.

In origin the type may be traced to the red Medina and gray Oneida sandstones, from which it has been derived through the various processes of weathering. To the sandstone, which is very hard and resistant, is attributed the formation of the terraces. The land is left exclusively to forest. A fair quality of chestnut and a few oaks represent the tree growth. It is probable that forestry is the best use to which it can be put, though proper methods should be used to improve the trees. Clearing the land of forest and stones for tillage would be very expensive, and it is likely that the crops would suffer from drought. Water for domestic use would also be very difficult to obtain.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of the Upshur stony sandy loam:

Mechanical analyses of Upshur stony sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17170.....	Soil	0.7	4.8	14.4	36.9	2.4	33.1	8.2
17171.....	Subsoil.....	.0	3.9	19.6	41.3	3.2	24.0	8.3

HAGERSTOWN SANDY LOAM.

The Hagerstown sandy loam consists of 10 inches of a reddish-yellow sandy loam, underlain by a subsoil which becomes heavier with depth and grades into a sticky reddish-yellow loam or clay loam at 34 inches. Typically some small sandstone and flint fragments occur on the surface, and local areas where the quantity is detrimental to agriculture have been indicated on the map by symbol. While this soil is fairly uniform, the depth of the sandy loam surface soil may vary somewhat in the different, isolated areas where it is found. It usually occurs adjacent to the so-called "barrens" of Morrisons Cove, and occupies gentle to steep slopes. Drainage is always good and in times of extreme drought the crops suffer for moisture to some extent, though such instances are very rare.

The Hagerstown sandy loam is locally called mixed sandstone and limestone land. The processes of its formation are somewhat doubtful, but it is evident that there has been an accumulation of sand and sandstone over weathered limestone, either from direct disintegration of sandstone or by wash from the sandstone formation which occurs in tiers on the hills above. The latter process seems the more probable.

Most of this type is devoted to general farming, but more or less truck is also grown. It is a very good soil on account of the ease of cultivation. Commercial fertilizers, lime, and manure are applied with good results, the heavy subsoil preventing leaching, which is a very common fault with sandy soils.

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

Mechanical analyses of Hagerstown sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17168.....	Soil	1.4	10.4	13.4	26.5	3.3	34.3	10.8
17169.....	Subsoil.....	.5	7.6	12.7	26.7	3.1	26.0	22.7

HAGERSTOWN CLAY LOAM.

The Hagerstown clay loam consists of 10 inches of brownish-red heavy silt loam or clay loam, underlain by a heavy red clay loam or clay subsoil of very compact and tenacious structure. At depths varying from 15 to 25 inches there usually occurs a few inches of gray silty material, which when rubbed rapidly turns red and assumes the character of the subsoil. Solid limestone rock immediately underlies this material at depths varying from 18 to 34 inches. Hard blue limestone fragments are found on the surface in varying quantities, but are seldom numerous enough to affect cultivation. Outcrops of the limestone are numerous, but no chert was found in this soil.

Hagerstown clay loam occurs in small isolated areas in Morrisons Cove and on the limestone ridges in the vicinity of Hollidaysburg and Frankstown. It occupies gentle to steep slopes and narrow, flat-topped ridges, and in general has good surface drainage.

Derived from the pure Trenton chazy and calciferous limestone in Morrisons Cove and from the Lower Helderberg near Hollidaysburg, all of which belong to the Cambrio-Silurian age, the soil is found in those places where erosion has been sufficiently active to remove the silty material which is characteristic of the Hagerstown silt loam and leave only the finest material which has accumulated immediately above the rock. Such areas were originally covered with oak forests, but the larger part has been cleared, and this is considered the strongest soil in the area. Owing to its fine texture and close structure, however, great care must be taken to plow it under the proper moisture conditions; if it is dry too great a draft is required to do the work economically, and if too wet good physical condition of the seed bed is impossible, because of the great number of clods formed. Fall plowing is essential, so that the soil may be loosened up by the winter frosts.

Commercial fertilizers are used very sparingly on this type, but lime is often applied, not to correct acidity in the soil, but to flocculate the fine particles, thus making it more open in structure and easier to work. Although the yields on this soil are not much greater than on the Hagerstown silt loam, a good crop is considered assured without regard to season. Corn, wheat, and oats are the favorite crops, but timothy and clover are extensively grown and the disagreeable feature of constantly working the soil thus eliminated. Alfalfa is grown to some extent and appears to do very well.

HAGERSTOWN SILT LOAM.

The Hagerstown silt loam consists of 8 to 10 inches of a brown, grayish, or reddish-brown silty loam or very fine-textured loam, immediately underlain by 15 inches of yellowish heavy silt loam or clay

loam which at 24 to 28 inches grades sharply into a tenacious reddish clay loam or clay, extending to unknown depths. The organic-matter content is comparatively high, and some small chert fragments are nearly always present, and in some cases as much as 20 per cent of the surface may be occupied by them. Usually they do not interfere appreciably with handling the soil, though it is sometimes beneficial to remove some of the larger fragments from cultivated fields.

Except for slight variations in depth and the quantity of chert, there are no well-defined phases of this type, and in general it is remarkably uniform. The structure is such that the soil is much more easily worked than might be expected from the mechanical analysis. Under field conditions it is a light, open soil, loose and friable, and very rarely subject to baking or puddling. In wooded areas, where the incorporated organic matter is less, the soil is a little more yellow in color and has a more mealy texture than in the cultivated fields.

The Hagerstown silt loam is extensively developed in Morrisons Cove in the eastern part of the area and in the vicinity of Hollidaysburg. It occupies by far the greater part of the limestone land in the survey, and Martinsburg is largely dependent on the agricultural products grown upon it. It has a rolling topography, occupying broad-topped ridges and knolls, and along streams the gentle slopes to the lowlands. It has, therefore, good surface drainage, and has been injured only to a very limited extent by washing. The soil retains moisture well and appears to be capable of withstanding any drought likely to occur.

In Morrisons Cove the Trenton and Chazy limestones and calciferous sandstone, a transitional formation, give rise to this soil, and near Hollidaysburg the Lower Helderburg has resulted in important areas of it. It represents the insoluble residue from large masses of limestone, the calcium carbonate having been removed in solution. The soil accumulation is remarkably deep in places, a depth of 90 feet having been noted, but outcrops of limestone occur frequently, especially along ravines, and in such places bodies of Hagerstown clay too small to be shown on a map of the scale used also occur.

This is the most popular soil in the Johnstown area. Its ease of cultivation, inherent fertility, and comparatively smooth topography make it a very desirable soil for general farming. Corn is probably the principal crop and yields on the average from 75 to 100 bushels in the ear. Wheat yields about 25 bushels, oats 40 bushels, and hay about 2 tons to the acre. Dairying is the principal occupation and most of the income is derived from milk, for which the farmers receive a good price in Altoona and Johnstown. Some butter is also made and shipped. Little attention is given to raising beef cattle, and hogs are not kept to any great extent. Silos are common, the

farm buildings are well improved, and the farms have an air of prosperity. Renting farms is a common practice, and the tenants remain upon the same farm usually for long periods. Clover is extensively produced and alfalfa is being experimented with and, so far as known, no complete failures have been experienced, while on the other hand some marked successes have been achieved. Commercial fertilizers in which phosphorus and potassium are the principal elements are claimed to increase crop yields and are applied extensively at the rate of about 200 pounds to the acre. Although this is a limestone soil, the calcareous material has been very completely dissolved and acids detrimental to crop yields have accumulated in the soil. It has therefore been a long established practice for the farmer to burn limestone, which is usually obtainable on his farm, and to apply the resulting lime to the land. Lime can be purchased at the kiln for about 8 to 10 cents a bushel. It was formerly applied in large quantities at infrequent intervals whenever diminishing yields seemed to demand it, but it is becoming more common to apply it at the rate of about 30 bushels an acre every two or three years. With dairying large quantities of manure are being made and applied to the land. Farms of this type of soil are held at \$60 to \$75 an acre.

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

Mechanical analyses of Hagerstown silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17884.....	Soil	0.8	2.0	1.2	2.8	3.4	71.13	18.4
17885.....	Subsoil.....	1.4	3.7	3.9	4.7	6.2	48.1	3.1.

HAGERSTOWN STONY LOAM.

The fine earth composing the first 8 inches of Hagerstown stony loam is a silty loam, the upper 4 inches of which is gray in color and the second 4 inches yellowish gray. The subsoil, extending from 8 to 36 inches, is a heavy silt loam, becoming heavier and passing from yellow to reddish in color, until at about 24 inches a heavy reddish clay loam is found.

A striking characteristic of this soil is the large number of chert fragments on the surface and disseminated throughout the soil and subsoil. Boring through the subsoil is seldom possible, and cultivation at the surface is very much hindered by the stones. However, in many places they have been removed at great expense and the land brought under cultivation. This type has been confined to

areas which have at least 25 per cent of flint fragments on the surface.

The Hagerstown stony loam is found principally in Morrisons Cove, where it occurs in fairly uniform bodies occupying in a general way the land adjacent to the sandstone ridges of the valley. A few areas are also found on the limestone ridges in the vicinity of Hollidaysburg, but for the most part these areas are too small to be indicated on the map. The soil has good surface drainage.

The Hagerstown stony loam has been formed by the solution and subsequent filtration of a very impure limestone. The impurity consists largely of chert or flint, which, being but slightly soluble, has remained and given the soil its stony character.

Known locally as "flinty land," the Hagerstown stony loam is considered the least productive of the limestone soils. However, when care is taken to rid the surface of stones, fair crops are nearly always secured. Corn will probably average 35 bushels, oats 35 bushels, and wheat 15 bushels to the acre. Liming is extensively practiced on this type. Light applications of commercial fertilizers, of which potassium seems to be the most valued constituent, are also made.

Improved soil of this type is held at \$50 to \$75 an acre, the quantity of chert in the soil influencing the price considerably.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Hagerstown stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17882.....	Soil	3.2	5.7	2.6	5.1	5.4	63.7	13.4
17883.....	Subsoil.....	1.6	5.6	3.3	5.4	5.0	42.3	36.1

HUNTINGTON LOAM.

The Huntington loam consists of about 8 inches of brown fine-textured loam, underlain, to a depth of 36 inches, by a very light brown silt loam or loam. In areas receiving wash from limestone soils a darker brown predominates. The surface soil varies little in texture, although in places the color changes to yellowish. The subsoil, however, varies greatly in both texture and color, and may be lighter in texture than the soil and of a decided shade of yellow. The areas of yellow-colored material, which are scattered throughout the type, are likely to be confused with the Lickdale clay loam. Gravel and rounded stones are quite common in this type, and areas where the agricultural value is affected by them have been indicated by symbol.

The largest bodies of Huntington loam occur in the valley of the Juniata and its tributaries, where they occupy comparatively wide bottoms, though separated from the streams by other types of soil. This land is level or rises gently to the upland, is very seldom overflowed, and is usually sufficiently elevated to give good drainage.

An alluvial deposit, the Huntington loam is composed largely of particles washed from adjacent shale and sandstone formations and redeposited in slowly moving water. It is one of the most valuable soil types in the area, and is more generally used for and better adapted to general farm crops than the Huntington fine sandy loam. However, potatoes, tomatoes, and cabbage do well and are extensively cultivated. It is a desirable soil, both on account of ease of cultivation and because of its natural fertility and adaptation to a wide range of crops. Fertilizers, although not so much used on this soil as upon the soils of the uplands, have lasting beneficial effects. Corn is one of the best crops and yields about 80 bushels in the ear, while the other farm crops yield correspondingly well. Trucking has proved very profitable. Good roads are found throughout the districts covered by this soil, and as the markets are near, the land has a high value.

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

Mechanical analyses of Huntington loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17134.....	Soil.....	0.2	1.4	1.1	14.8	15.0	53.0	14.7
17135.....	Subsoil.....	.1	.3	.4	6.4	10.0	58.3	23.9

HUNTINGTON FINE SANDY LOAM.

The soil of the Huntington fine sandy loam, to a depth of 8 or 10 inches, is a brown fine sandy loam, loose in structure and easily worked. The subsoil is a somewhat lighter colored fine sandy loam, becoming more sandy with depth. Occasionally a band of heavy loam occurs in the lower depths.

This soil occupies stream bottoms mainly in the vicinity of Johnstown and along Stony Creek and Conemaugh River, but other areas are found along the Juniata River and its tributaries. It is an alluvial soil, having been formed by the deposition in moving water of soil particles washed from the adjacent shale and sandstone formations. This soil is frequently overflowed, but generally at times when the least damage results to crops.

As the capillary power of this soil is marked and a supply of water is always present in the lower subsoil, there is no trouble from drought. This is the favorite truck soil, and much more of it could be used for this purpose than at present. In many places irrigation can be practiced by piping the water from springs. The areas are nearly all convenient to markets that can dispose of more truck than is produced. Barnyard manure is used abundantly on this land, although some farmers use commercial fertilizers in addition.

The following table gives the average results of mechanical analyses of samples of the soil and subsoil of the Huntington fine sandy loam:

Mechanical analyses of Huntington fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17060, 17130.....	Soil	0.3	2.2	8.5	38.1	16.3	22.4	12.4
17061, 17131.....	Subsoil.....	.0	2.8	10.8	38.2	15.3	19.7	13.1

LICKDALE CLAY LOAM.

The surface soil of the Lickdale clay loam, to a depth of 8 inches, is a gray silt loam to clay loam. Beneath this is a few inches of yellowish heavy silt loam or clay loam, which at about 15 inches grades rapidly into a heavy mottled blue, drab, yellow, and gray silty clay, which rests upon brownish, friable, freshly disintegrated shale rock at depths varying from 24 to 30 inches. Some small sandstone fragments are found in areas west of the Allegheny Front, but here the soil is really a phase of the type and differs also in being more yellow in color throughout the soil section.

Under natural conditions there is difficulty in working this soil, as it has a tendency to clod and to run together like a heavier soil.

This type is found in small bodies throughout the area, the largest being situated near Hollidaysburg. It occupies level or very gentle slopes, extending from the hillsides into the stream bottoms. Occasionally a small part may be overflowed. The drainage is insufficient and much of it remains damp or wet the greater part of the year, making it a cold, late soil.

The Lickdale clay loam is made up largely of colluvial material which has been washed from the shale and sandstone formations on the adjacent slopes. The lower parts doubtless represent a mingling of colluvial and alluvial material.

Most of the chestnut and oak timber has been cut off of this soil and the land used for hay, for which purpose it is admirably adapted. Lack of good drainage alone prevents this from being an excellent soil for general farm crops. Its texture and power to

retain moisture are favorable and the effects of fertilizers are lasting. It is believed that shallow open ditches or, where practicable, tile drains would more than repay the expenditure necessary to install them. Lime is applied and appears to be necessary to secure the best yields. At present its greatest value is for growing hay, of which it yields about $1\frac{1}{2}$ tons of good timothy to the acre. Alsike clover is grown to a limited extent, but should be more universally sown, as it withstands the wet conditions better than the other clovers. When moisture conditions are satisfactory, corn yields about 75 bushels in the ear, and wheat and oats give fair yields, although neither crop has a very large acreage.

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

Mechanical analyses of Lickdale clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17062.....	Soil	0.3	1.3	2.3	9.4	11.6	46.2	28.8
17063.....	Subsoil.....	.5	2.6	4.4	12.8	10.4	35.6	33.4

FRANKSTOWN STONY LOAM.

The surface soil of the Frankstown stony loam is a gray silt loam 6 to 8 inches deep. Immediately underlying this is a floury light-gray silt loam which becomes yellow and more loamy with depth until, at 36 inches, a yellow true loam is found. In some local spots the surface soil may be a loam. A distinct characteristic of this type is its content of 15 to 60 per cent of angular rock fragments the size of large gravel, which are called locally "bastard" limestone. They are composed mainly of a comparatively soft rock, easily cut with a knife. As much as 15 per cent of the same character of stones mingled with chert fragments cover the surface in places. The quantity of the fragments seems to increase with depth, and boring below 24 inches is very difficult. The type is locally called "gravel land."

The Frankstown stony loam is of small extent and is found as a narrow band between the limestone ridge and the Morrison fine sandy loam in the vicinity of Frankstown and north of Duncansville. This band varies from a few rods to nearly a quarter of a mile in width.

This soil has been formed by the disintegration of water limes, fragments of which predominate in the soil. Bed rock usually lies within 3 to 6 feet of the surface. The soil occupies rather steep slopes, usually extending from the top of the limestone ridges nearly to the bottom of the slope, where the fine sandy loam occurs. This

type is considered much better than the sandstone, but not so good as the limestone land, both of which border it. It is easily tilled and is quite generally cultivated. It is devoted to general farm crops, of which wheat and corn yield well. Corn gives 40 bushels, wheat 12 bushels, and oats 35 bushels per acre. The soil seems to be very deficient in organic matter and the topography and drainage is such that the effects of applications of manure or lime are not lasting. This soil could be used for clover for pasturage or mowing, either of which would tend to increase the humus content and prevent washing and leaching.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Frankstown stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17088.....	Soil	3.8	8.0	2.1	3.3	1.5	62.2	20.0
17089.....	Subsoil.....	2.6	7.8	2.8	9.3	8.2	54.1	14.3

DEKALB CLAY.

Under the Dekalb clay are grouped a number of variable areas. Most of the soil is a brown tenacious clay loam or clay about 10 inches deep, resting upon a very hard and tenacious yellow to greenish-yellow silty clay. It contains many shale fragments which give the material a greasy feel. Very fossiliferous shale rock is usually found at a depth of about 24 inches. Some blue limestone fragments occur on the surface, although these are never numerous. The soil may vary widely from this description, as small areas of Dekalb silt loam and shale loam and Hagerstown clay loam are included, but in bodies entirely too small to be mapped.

The Dekalb clay is found in narrow bands in the vicinity of Hollidaysburg and south of Frankstown. It has a rather rolling topography, although nearly all of it can be cultivated. Surface drainage is well developed and artificial drainage is seldom necessary, although the texture is heavy and the structure compact.

The local name "clay land" is given to this soil. It is derived from the upper part of the Clinton shale formation, which is composed of thin strata of limestone, calcareous shales, and clay shales, and the complex interbedding of these formations is the cause of the variable character of the areas mapped under this head.

This is a valuable agricultural soil, and is for the most part under cultivation. Its natural productiveness is high, and while fertilizers are sometimes applied, they are not considered essential to obtain good crops. Considerable judgment is required in cultivating this

soil, because of its heavy texture, the resulting tendency to clod and puddle, and the difficulty of securing a mellow seed bed. For these reasons much of the land is devoted to hay and pasture, and it is admirably suited for these uses. A fair alfalfa field was seen on this soil, and it is believed it could be used to good advantage in growing this crop.

There are no farms which include this soil only, and the yields of crops can be but roughly estimated. Hay produces $1\frac{1}{2}$ tons to the acre, wheat 15 bushels, and corn about 60 bushels in the ear.

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

Mechanical analyses of Dekalb clay.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17888.....	Soil	0.6	2.3	1.3	3.4	2.9	50.4	39.5
17889.....	Subsoil.....	.9	3.4	1.5	3.1	3.3	38.7	48.2

CHEMUNG STONY LOAM.

The Chemung stony loam has about 8 inches of chocolate-colored fine loam, carrying dark-colored shale chips, resting upon a subsoil of similar color and texture, though it may be lighter in both color and texture. It is quite friable and is easily tilled, unless it be for the large quantity of flat chocolate-colored stones about $1\frac{1}{2}$ inches thick and from 6 to 24 inches in diameter. In some places, on account of the number of stones in the soil and subsoil, boring to any great depth is difficult, and many of the larger fragments must be removed before cultivation is practicable. In other places the soil is a true loam, but such areas are small and scattered.

An area of this soil extends across the survey in a strip from a point west of Altoona, Hollidaysburg, and Queen, following in general the western boundary of the Dekalb shale loam, with which it is closely associated. It is characterized by rough or rolling topography, and consists of steep slopes descending from high knolls to the stream valleys, and varying in elevation from 1,500 to 1,700 feet. Natural drainage is completely developed, but no effects of erosion were seen. The soil has an open structure, but probably is not very droughty.

The Chemung stony loam, known locally as "black slate land," is derived from the upper half of the Chemung formation, composed of chocolate-colored shale and sandstone. The fine earth is probably drawn largely from the direct weathering of the shales. The sandstone strata, being harder, have weathered less completely and form

the most of the fragments remaining on the surface and in the soil and subsoil.

Little of this soil is under cultivation, but more of it should be cultivated, as it is fairly productive. Although no crop yields could be ascertained, it is rated as slightly better than the Dekalb shale loam. It is probably suited to fruit, although none is grown on a commercial scale. The prevailing timber growth is oak and locust.

The following table gives the results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Chemung stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	<i>Per cent.</i>
17866.....	Soil	5.7	6.2	2.0	4.0	11.0	47.9	22.4
17867.....	Subsoil.....	4.9	7.6	1.7	4.4	9.8	45.9	25.3

ROUGH STONY LAND.

Rough stony land represents land where agricultural pursuits have never been and probably never will be carried on to any appreciable extent. Areas of this kind occur on the precipitous slopes along the Conemaugh River and its branches, on the steep slopes of the Allegheny Front in the Johnstown quadrangle, and on the mountainous ridges on each side of Morrisons Cove. Many large rock fragments are found in these rough areas, the removal of which would be next to impossible, and even if this could be done the topography is unfavorable to the cultivation of crops. The fine earth of this type may be of any texture or color.

These lands are by no means valueless. In many places the stone is taken out for building purposes and as ganister rock, and many small farmers derive their principal income from the sale of these rocks.

The lands should be used for forestry, and although a great deal of timber has been removed, some is still standing. Chestnut, oak, beech, hickory, birch, and jack pine are the trees usually found. Much of the forest is in bad condition, though there is every reason to believe that with careful management valuable timber could be obtained from most of these areas.

MEADOW.

Meadow is the term applied to the soil occurring in narrow stream bottoms. It is usually a clay or clay loam in texture, bluish drab in color, though in quite small areas, as along Bobs Creek in the vicinity of Pavia, the soil is a red sandy loam. It is composed of the finer soil

particles from the adjacent shale, sandstone, and limestone formations. It has very poor drainage and is used mostly for hay or pasture. Unless drained it could hardly be used in any other way. If drainage were improved it would be a very good soil for the general farm crops.

STEEP BROKEN LAND.

There are certain isolated areas, mainly adjoining the Dekalb silt loam, where erosion has been so active and the approach from the streams to the uplands is so steep that agriculture can not be profitably practiced on them. Such areas have been indicated on the map as Steep broken land. The soil is usually very similar to the Dekalb silt loam, though possibly somewhat heavier in texture, and generally shallow. It is derived from the Conemaugh shale, but few stones larger than small shaly chips occur either on or in the soil. Drainage is usually excessive.

The type is of little agricultural use except for pasture. The timber, hemlock and locust, is valuable, and areas where there is a covering of forest are worth as much or more than those that have been cleared.

SUMMARY.

The Johnstown area is situated south and west of the center of Pennsylvania and is about 714 square miles in area, forming an oblique parallelogram across the counties of Cambria, Bedford, and Blair.

The area has three natural physiographic divisions, viz, the Allegheny Plateau to the west, the Allegheny Front in the middle, and the Appalachian Valley region to the east.

A stream system is established on each side of the Allegheny Mountains, which form the main watershed of the eastern United States. The Juniata River is the main stream of the eastern section, the Conemaugh River of the western section. South Fork, Stony, and Blacklick creeks are important minor streams.

The first permanent settlement was made at Frankstown in 1756 by Stephen Frank. The pioneers were largely Irish, Welsh, and Scotch. The development of the mines and dependent manufactures caused a rapid increase in population, which centered in the cities of Johnstown and Altoona. The rural population has increased more slowly.

Transportation facilities to the city markets are of the best, consisting of good railroads and, for the most part, of good country roads. Martinsburg, Williamsburg, Hollidaysburg, Ebensburg, and Cresson are towns which depend wholly or in part upon the agriculture of the area.

The wide range in elevation is largely accountable for the different climatic conditions. Johnstown, at an elevation of 1,177 feet, has an average annual temperature of 51.3° F., while at Cassandra, 623 feet higher, it is 47.8° F. The temperature may differ therefore considerably over the area, but there are normally a sufficient number of days in the growing season to mature all farm crops except corn planted late or on very high places. Rainfall is abundant and well distributed throughout the year. The normal precipitation is about 43 inches annually.

With the decline in lumbering a general line of farming was developed and in the eastern part of the area this is still the prevailing system, although stock farming, which includes dairying and raising horses and swine, has been introduced in Morrisons Cove with marked success. General farming has given way to trucking near the cities of Johnstown, Altoona, and Hollidaysburg. Potatoes, cabbage, strawberries, and all truck crops are produced, and the demand is apparently greater than the supply. General farming is practiced on the farms farther removed from towns.

The general rotation of crops is corn, wheat, oats, and hay, consisting of timothy or clover or both. Buckwheat is introduced into the rotation upon the failure of corn to make a good stand. Alfalfa is grown on a number of the soil types and bids fair to become an important crop. Silos are rapidly gaining favor and the number is increasing on the dairy farms. Apples, peaches, pears, and plums also are a source of revenue in certain sections.

Commercial fertilizers, especially high in potash, are used throughout the area. Lime is applied wherever it can be secured without too great cost, and barnyard manure is universally saved, and if possible obtained from sources outside the farm. It is considered the most valuable fertilizing agent.

More attention should be given to the maintenance of humus in the soil to aid in the conservation of soil moisture, prevent leaching, and increase crop yields. Systematic forestry is to be recommended on the nonagricultural lands, which are of considerable extent in this area.

There are three classes of soil in the area, residual, alluvial, and colluvial. The residual soil occupies the uplands and is the most extensive. The rocks from which these soils are derived are sandstone, shale, and limestone. The sandstones and shales give rise to two soil series—the Dekalb and Upshur series. Six types of the Dekalb series were mapped, of which the Dekalb stony loam is the most extensive.

The Dekalb stony loam is cultivated only when market conditions are such that it pays to rid the land of stones and brush. The most of it is in timber, to which it is best suited.

The Dekalb silt loam is the soil next in extent and is used extensively for general farming and trucking, the kind of farming depending upon nearness to markets and conveniences. It is a fairly good potato, cabbage, hay, oats, buckwheat, and wheat soil.

The Dekalb shale loam is used for general farming and produces crops equal to the silt loam when well handled, and is better than that soil for fruit.

The Dekalb loam is a valuable soil, usually lies well, and is admirably adapted to all the crops of the area.

The Dekalb stony sandy loam is not used for farming, and can probably be made to yield better returns if devoted entirely to forestry.

The Dekalb clay, though of limited extent, is a valuable soil and is for the most part under cultivation.

Of the Upshur soils the Upshur stony loam is the most extensive and one of the best fruit soils in the area, but is little developed. General farming, trucking, and forestry are all practiced to some extent.

The Upshur loam is of small extent and little of it is cultivated, although it is a strong soil.

The Upshur stony sandy loam covers a considerable area, but is suited only for forestry.

The miscellaneous soils of residual origin are the Chemung stony loam, Frankstown stony loam, Morrison sand, Morrison sandy loam, and Morrison fine sandy loam. The most of these types are of small extent and relatively little agricultural importance. The Morrison fine sandy loam, however, is used largely for trucking and general farming.

The soils derived from limestone belong to the Hagerstown series, in which the Hagerstown silt loam is the most important. This is the best soil in the area for general farming, being particularly adapted to corn, oats, and wheat. Dairying and apple orcharding are also extensively practiced.

The Hagerstown clay loam is naturally the most productive soil of the area, but is of small extent.

The Hagerstown stony loam is only cultivated after removal of the chert fragments, which is often expensive and difficult, and does not compare with the other limestone soils in agricultural value.

The Hagerstown sandy loam is of limited occurrence, but is valuable for producing general farm crops.

The alluvial soils are largely included in the Huntington series.

The Huntington fine sandy loam occurs immediately along the streams and is the most valuable trucking soil in the area.

The Huntington loam lies farther back from the streams, and is suited to general farming as well as to truck. Of the truck crops tomatoes do particularly well.

Meadow is used mostly for hay or pasture, and unless drained is unsuited for other purposes.

The Lickdale clay loam is the only type which belongs to the colluvial class, and small isolated areas are common. Naturally this is not a productive soil, but when drained and improved it is a most valuable type for hay and general farm crops.

Rough stony land and Steep broken land are largely nonagricultural and can only be used for forestry or grazing in some places.

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