Issued June 3, 1910.

U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE PENNSYLVANIA STATE COLLEGE, SCHOOL OF AGRICULTURE AND EXPERIMENT STATION, THOMAS F. HUNT, DEAN AND DIRECTOR.

SOIL SURVEY OF CENTER COUNTY, PENNSYLVANIA.

BY

CHARLES N. MOONEY, CHARLES F. SHAW, LAWRENCE A. KOLBE, HUGH H. BENNETT, AND RISDEN T. ALLEN.

[Advance Sheets—Field Operations of the Bureau of Soils, 1908.]

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1910.

[PUBLIC RESOLUTION—NO. 9.]

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

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

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

Approved, March 14, 1904.

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

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., December 2, 1909.

SIR: In furtherance of the cooperative arrangements between the Bureau of Soils and the Pennsylvania State College School of Agriculture and Experiment Station, Thomas F. Hunt, dean and director, one of the projects carried on in that State during the field season of 1908 was a soil survey of Center County.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1908, as authorized by law.

Very respectfully,

MILTON WHITNEY.
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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SOIL SURVEY OF CENTER COUNTY, PENNSYLVANIA.

By CHARLES N. MOONEY, CHARLES F. SHAW, LAWRENCE A. KOLBE, HUGH H. BENNETT, and RISDEN T. ALLEN.

DESCRIPTION OF THE AREA.

Center County is situated in the center of the State of Pennsylvania, getting its name from the fact that the geographical center of the State is located within its confines. The meridian of 78° west longitude and parallel of 41° north latitude intersect within the county. It is one of the largest counties in the State, comprising an area of 715,520 acres, or 1,118 square miles. Its outline is irregular or roughly anvil-shaped, with the long point extending to the east. The

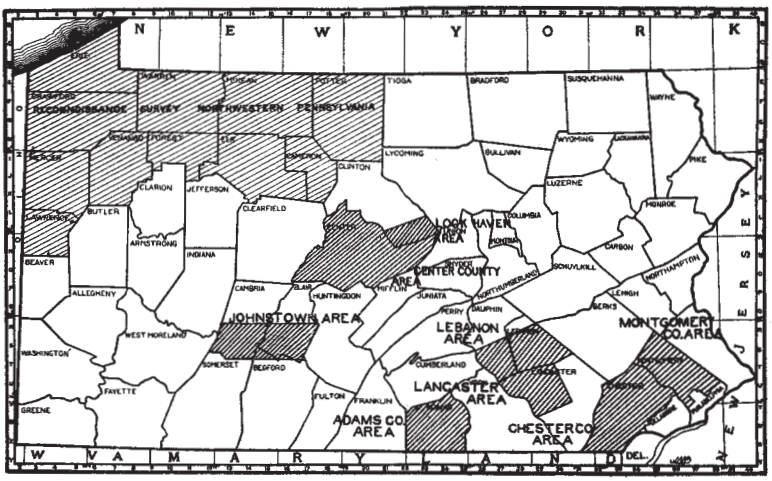

FIG. 1.—Sketch map showing location of the Center County area, Pennsylvania.

western boundary is defined by Moshannon Creek and the west branch of the Susquehanna River, the former being a tributary of the latter. Both follow a winding course. The counties surrounding Center County are Clinton, Union, Mifflin, Huntingdon, Blair, and Clearfield.

Center County lies in two grand physiographic provinces called by geologists the Allegheny Plateau and the Appalachian. In the latter province only one division is represented, that known as the Appalachian Valley division, which extends from the Appalachian Mountains on the east to the escarpment of the Allegheny and Cumberland

plateaus on the west. These provinces and their subdivisions are separated upon marked physiographic differences, each having its characteristic forms and geological formations. The Appalachian Valley section covers three-fourths or more of the county's area, occupying all that part east of the Allegheny front or escarpment. Its topography is similar to that of the valleys of southeast Pennsylvania, the valley of Maryland, and Virginia. It consists of rolling anticlinal limestone valleys separated by long, narrow, steep, parallel synclinal mountainous ridges of sandstone. The largest of the valleys is Nittany, which has a width of several miles, the widest part being on a line northwest and southeast through State College. This valley extends across the county through the central part from southwest to northeast, and this same trend is followed by all the other valleys and mountain ridges. The Brush, Penn, and minor valleys in the eastern part of the county are tributary to Nittany. The surface configuration of these valleys is broadly rolling to somewhat hilly, with sides extending as gentle slopes up the mountains. The average elevation of the valley ridges is about 1,200 feet above sea level. The main stream courses lie 100 to 200 feet lower. The slopes as a rule are gentle. Along some of the streams gorgelike channels have been formed, but nowhere is there any great amount of surface erosion. A few miles to the west of State College and extending southward out of the county is a broad area known as the Barrens. This area is marked by a number of small knobs and irregular ridges that result in a rather complex topography. The Barrens are from 100 to 200 feet higher than the average elevation of the surrounding limestone areas, but the change in elevation from one to the other is not abrupt.

The Bald Eagle Valley is next to the Nittany in extent. It occupies the section between Bald Eagle Mountain and the Allegheny Front. However, the valley proper is limited to that part lying along Bald Eagle Creek and consists of flat bottoms, with here and there an occasional terrace. From this valley proper there is a hilly belt of country that extends to the foot of Allegheny Mountain. It is composed of shales and thin-bedded sandstone, the weathering and erosion of which has resulted in an extremely hilly topography. It consists of sharp, narrow-topped hills and irregular-shaped ridges with steep slopes, but with a smooth contour—topography that is characteristic of shale formations. From the valley proper the rise to the top of the first hills or ridges is from 100 to 300 feet and the elevation increases as the Allegheny Mountain is approached until part of it becomes really mountainous though not rugged. The elevation reached is about 1,400 feet above sea level, or 600 to 700 feet above Bald Eagle Creek. This belt is intersected every mile or two by streams that head upon the Allegheny slope and flow in narrow and comparatively straight valleys.

The mountain ridges separating the valleys owe their presence to the resistance of the sandstones of which they are composed. All of these mountains, with the exception of Bald Eagle Mountain, which is a monocline, are synclinal. Their upper slopes are steep and in many instances precipitous, and their summits are narrow and remarkable for their even crest line. The lower slopes merging into the valleys are generally long and gentle. The crest of Bald Eagle is from 1,700 to 1,800 feet above sea level and that of Nittany Mountain about the same, with some higher points near the terminus at Lemont. Brush Mountain probably has also about the same elevation, but no data as to that fact are available. The Tussey Mountains, lying along the southeastern county boundary, rise to a height of 2,400 feet above sea level. All these mountains are composed of the Oneida and Medina gray sandstones, between which occurs the red Medina, which, being more easily weathered, has resulted in making in part of each range a double range of sharp ridges. On the sides these mountains are flanked by shale and slate formations, which form the gentle slopes from the foot of the steep or precipitous part of the ridges to the valleys below.

The western part of the county is occupied by the Allegheny Plateau. It, too, has a northeast and southwest trend. Its escarpment or front, locally called the Allegheny Mountain, when viewed from the valley appears as a steep-sided—in places precipitous—mountain ridge. Upon reaching the crest one finds a broad, dome-shaped top, and looking to the west a plateau or plainlike surface of the same general elevation with a few higher broad-topped knobs.

In reality, there is a gradual decline in elevation to the west, the surface finally dropping off rather suddenly into the valley of Moshannon Creek and the West Branch of the Susquehanna River. The elevation of the crest averages 2,200 to 2,400 feet above sea level, with some points in the southern part a few hundred feet higher. This plateau is cut by a number of streams, so that in traveling over it it appears ridgy, but these interstream areas are broad and generally quite flat. At the heads of the streams the slopes are gentle and not so stony and rough as elsewhere, but only a short distance down the slopes become steep and stony—often so stony that they may be classed as rugged. Along the lower course of Moshannon Creek and the West Branch of the Susquehanna River the slopes are quite steep. This plateau owes its origin to the Pocono sandstone and Pottsville conglomerate and to the barren and productive Coal Measures. The first two mentioned are hard, resistant rocks, the Pocono holding up the crest of the Allegheny Front.

Center County lies in the drainage basin of the Susquehanna River, and the immediate drainage of the greater part of the county is by way of creeks flowing into the West Branch of the Susquehanna River. Moshannon and Bald Eagle creeks with their tributaries are

the most important of the streams. They flow in a north to northeast direction. Moshannon Creek is fed by a number of mountain streams, among which are Cold Stream, Black Bear and Six Mile runs, and Little Moshannon Creek. Into the West Branch of the Susquehanna itself empty a number of runs from the Plateau section. Bald Eagle Creek flows northeast through the central part of the county and enters the West Branch of the Susquehanna near Lockhaven, in Clinton County. Its largest tributary on the west is Beech Creek, which for some distance forms the boundary between Center and Clinton counties. A large number of runs empty into Bald Eagle Creek from the west, draining the section from the Allegheny Front. Bald Eagle Creek, besides carrying off the water from Bald Eagle Valley, drains a large part of the Nittany Valley through its tributaries, Spring and Fishing creeks, and their affluents.

The eastern part of the county, comprising Penn, Brush, and the other smaller valleys, is drained to the east by Penn Creek and its tributaries, the former emptying into the Susquehanna River below the junction of its two branches. Half Moon Creek, in the southern part of the county, flows to the south into the Juniata River, a tributary of the Susquehanna. The drainage of these limestone valleys is unique. There are few surface streams, these being Buffalo Run and Half Moon Creek, along the Bald Eagle Mountains, Fishing Creek and Spring Creek draining Nittany Valley and the head of Penn Valley, and Penn Creek and its tributaries draining the eastern part of Penn Valley. Many square miles of the valleys have no surface streams whatever, the drainage waters sinking to the underground channels, which are evidenced by the numerous sink holes. Of the streams and runs that flow from the sandstone mountains, all except a few disappear into sink holes as soon as the limestone strata are reached. These may reappear as great springs, as, for instance, Rockspring, the head of Spruce Run, near Baileysville, and the famed Penn Cave, the source of Penn Creek. This cave is worthy of mention, as it consists of over a quarter of a mile of underground river, which can be traversed only by boat, a large sink hole affording a means of entrance.

Sinking Creek, as its name indicates, is a stream that at places along its course sinks into the rock, and appears again farther on as a surface stream. From its last "sink," about 2 miles west from Spring Mills, it exists on the surface as a small stream, dry most of the year, the main body of water following some underground channel and reappearing from beneath a massive limestone ledge as "Rising Spring" on the bank of Penn Creek at Spring Mills.

Another unique drainage system is known as Dry Hollow. This consists of a "fossil" river. At no place in the whole of this system of gorges, valleys, and tributary valleys are there any surface streams, the whole drainage being under ground. This system extends from near Rock, on Spring Creek, toward the west, spreading out as an

extensive drainage system, some tributaries of which reach nearly to Fairbrook. The topography and land forms are strikingly like a river system, but no surface streams exist. In some cases the presence of subterranean streams can be proven by sinks or by hearing the water rushing along in the underground channel during the flood seasons.

The settlement of Center County began only a few years prior to the Revolutionary war, the first authentic settlement being made near or at what is now Milesburg, in the Bald Eagle Valley. Scattering settlers came in in the next few years, locating in the valleys in the eastern part of the county. In the decade from 1790 considerable numbers came to the county and from that time on the population increased steadily. The settlers came largely from the eastern part of the State, and were for the most part "Pennsylvania Dutch," Scotch-Irish, and Germans. Some of the earlier pioneers came from Europe direct. The earlier settlers came to occupy the land and engage in farming, while in later years others were attracted by the mineral resources.

Center County, according to the census of 1900, had a population of 42,894. The valleys are thickly settled; the mountainous parts, except where mines are located, are scarcely settled at all. In fact, large areas, as on the Allegheny Mountain or Plateau, are wild lands and unoccupied except for hunters and lumbermen's camps, the former only occupied during the hunting season.

Bellefonte, the county seat, is the largest town, with about 5,000 population. Philipsburg, on Moshannon Creek, is next, with about 4,000. It is the center of an important mining section in Center and Clearfield counties. State College is the largest of the smaller places, and is the site of the State College of Agriculture. Other towns in the county, having populations between 500 and 1,000, are Howard, Milesburg, Unionville, Port Matilda, Sandy Ridge, Snow Shoe, Millheim, and Center Hall, and besides these are numbers of small villages. In the agricultural sections of the county, mainly the valleys, the present population is still largely that descended from the original settlers, but in the mining sections a large part of the population is foreign, representing a number of European countries.

The transportation facilities of Center County are fairly good, a number of railroads passing through the county and affording communication with the main trunk lines reaching the large cities in the State and elsewhere. The Pennsylvania Railroad has a number of branch lines connecting with their main trunk lines in all directions. The Bald Eagle Valley branch follows the Bald Eagle Valley, connecting Tyrone and Lock Haven, both on main trunk lines. The Lewisburg and Tyrone division extends from Bellefonte east to Lewisburg, on the main line, in Union County. The Tyrone and Clearfield branch from Tyrone climbs over the mountain to Philips-

burg and passes through the mining section in that vicinity, and on into Clearfield County. The Snow Shoe branch from the Bald Eagle Valley line taps the coal field at Snow Shoe. The New York Central Railroad is represented by the Beech Creek Division, which also affords an outlet to the Snow Shoe and Philipsburg mines. The Central Railroad of Pennsylvania runs through the northern part of the Nittany Valley from Bellefonte to Mill Hall, in Clinton County, and the Bellefonte Central Railroad between Bellefonte and State College. From Philipsburg an electric line extends into Clearfield County to Winburne and Morrisdale, near which places are located large coal mines. The county roads reach all points in the county and are kept in good repair. Many of them are stone pikes, some having been the pikes of early days, still kept in use and repair. On some of these tolls are now collected.

The products of the farm meet with a good demand in the larger towns and in the mining sections. With the good railroad facilities the markets in the larger cities are within comparatively easy reach.

The schools are numerous and good. Besides the high schools in the towns, the State College of Agriculture is located at State College, as also is the State Experiment Station. In the valleys the farmers have the advantage of rural telephone lines and the rural free delivery of mail reaches most of the settled parts of the county.

CLIMATE.

The appended tables, compiled from the records of the Weather Bureau station at State College, show the mean monthly, annual, and seasonal temperatures and precipitation, together with the absolute maximum and minimum temperatures for each month, and the rainfall during the years of greatest and least precipitation. The dates of the last killing frost in spring and first killing frost in fall at State College and also at Lock Haven are given. State College is located in a broad, rolling valley, and the figures represent no doubt the average climatic conditions obtaining in similar places throughout the county. There being, however, considerable differences in elevations and topography, it would seem that there are many local conditions to which the figures may not apply. Certain it is that there is some difference in temperature and probably also in precipitation between the Allegheny Plateau and the valleys, on account of the higher elevation of the former, and in fact the growing season is much shorter, frosts occurring later in the spring and earlier in the fall on the plateau. This season (1908) a light killing frost occurred in the latter part of August.

The winters are quite severe, the temperature falling as low as 20° below zero, and there is a heavy fall of snow generally throughout the winter both in the valleys and on the mountains.

The summers are cool, the summer mean being 69° F. The absolute maximum is 96° F. The extreme range in temperature is 116°.

As in all temperate latitudes sudden changes of temperature are common.

In the valleys the growing season is of sufficient duration to mature all crops, but at the higher altitudes the season is too short for corn.

The rainfall is ample and appears to be well distributed. However, droughts are expected in the late summer and early fall.

Normal monthly, seasonal, and annual temperature and precipitation at State College.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	°F.	°F.	°F.	Inches.	Inches.	Inches.	Inches.
December	31	64	− 4	3.0	2.8	4.1	.....
January	27	65	−17	2.8	4.2	4.1	.....
February	26	69	−20	2.8	0.2	5.3	.....
Winter	28	.....	.....	8.6	7.2	13.5	.....
March	35	69	− 6	3.4	1.0	4.1	.....
April	48	88	17	2.9	2.2	1.5	.....
May	59	93	27	4.5	2.2	1.9	.....
Spring	47	.....	.....	10.8	5.4	7.5	.....
June	68	95	30	4.2	6.7	4.2	.....
July	71	96	41	3.8	3.1	5.6	.....
August	69	96	30	4.0	3.7	5.4	.....
Summer	69	.....	.....	12.0	13.5	15.2	.....
September	63	93	30	2.8	1.8	2.2	.....
October	50	88	20	3.0	1.0	4.4	.....
November	40	72	9	3.0	1.7	3.0	.....
Fall	51	.....	.....	8.8	4.5	9.6	.....
Year	49	96	−20	40.2	30.6	45.8	.....

Dates of first and last killing frosts.

Year.	State College.		Lock Haven.	
	Last in spring.	First in fall.	Last in spring.	First in fall.
1899	Apr. 17	Sept. 30	Apr. 17	Oct. 1
1900	May 10	Sept. 19	May 6	Oct. 20
1901	Apr. 12	Sept. 20	Apr. 17	Oct. 25
1902	May 29	Oct. 10	May 29	Oct. 22
1903	Apr. 27	Oct. 13	Apr. 5	Oct. 26
1904	May 12	Sept. 21	Apr. 4	Oct. 7
1906	May 10	Oct. 8	Apr. 24	Oct. 12
Average	May 4	Sept. 30	Apr. 23	Oct. 16

AGRICULTURE.

The early settlers in this part of Pennsylvania grew wheat, corn, rye, potatoes, hemp, flax, and the grasses. Wheat and corn were their principal crops, but rye soon became of even more importance, as it could be changed into a product—distilled spirits—of less bulk for transporation. With the development of the iron industries the demand for agricultural products increased and there was also created a pressing need for better transportation facilities. This was first met by the building of turnpike roads, a most important factor in the early development of the county. Their building began soon after 1800 and continued for the next fifty years. The most important of these roads was the plank road constructed between Milesburg and Tyrone in 1849, which connected at Tyrone with the great road between Harrisburg and Pittsburg, a main artery of travel between the east and the west. Three years prior to the building of the plank road to Tyrone, or in 1846, a canal was completed between Bellefonte and Lock Haven, a distance of 25 miles. Up to this time the pig iron made in the county had to be transported on the backs of horses, a slow and expensive process. The canal continued important until damaged by freshet in 1865.

Railroad building was agitated as early as 1834, when the Bald Eagle Valley Railroad was incorporated, but construction was not begun until a quarter of a century later. The first railroad to be built was the Bellefonte and Snow Shoe Railroad, which was completed in 1859 and in operation that year. Bituminous coal had been discovered in the vicinity of Snow Shoe soon after 1800 and it was to get out this coal that the railroad was built; it was also designed to be used in getting out the timber from the top of the Allegheny Mountains. The rich mineral and timber resources soon led to the construction of other lines.

Keeping pace with these several advances in transportation and with the exploitation of the mineral deposits, agriculture made steady and marked progress. Rye, which had become the most important crop before good transportation facilities were available and which even as late as 1840 was four times as important as wheat, decreased in acreage and by 1850 the ratio between the two grains had been reversed. In that year the production of wheat was 433,612 bushels and of rye 109,051 bushels. The next census shows a decline in wheat and some increase in rye, but this may have been a seasonal fluctuation. During this decade there was a marked increase in the production of corn, oats, and barley. In 1870 the wheat crop slightly exceeded that of 1850, and in fact there has not been much change in wheat production since 1850 except in 1860, the variations reported being probably due to seasonal conditions. The average

annual production is around 400,000 bushels, taking the data of the census years. That the acreage in this cereal is practically stationary is shown by the data returned by the census for 1880, 1890, and 1900, the figures being 37,310, 31,008, and 36,716 acres, respectively. On the contrary, the growing of rye, at least for grain, has practically ceased, the census of 1900 giving the acreage as 1,828 acres, and the production as 18,350 bushels. Corn has been a leading crop of the county since an early date. It led rye in 1840 by nearly 100,000 bushels with a production of 204,122 bushels, though in 1850 it was considerably exceeded by the production of wheat. In 1870 it reached its highest reported yield of slightly over 1,000,000 bushels. Since that time there has been a slight falling off in production, though the acreage has varied but slightly in the past three decades. It occupies an acreage of 27,664 acres, or 10,000 acres less than that of wheat. The wheat crop is sold from the farms, but the corn is principally fed to live stock.

Oats and barley were grown to some extent before 1840, and the acreage of each has increased since that time. Barley is of lesser importance. In 1899 there were 2,057 acres in this cereal, yielding 47,340 bushels. The increase in acreage and production of oats has been continuous since 1840. In 1899 this crop stood third among the cereals in area occupied, with an acreage of 20,223 acres and a production of 625,340 bushels, and having increased 100 per cent since 1879. Oats have gained in favor in the last few years, owing to high prices and the fact that the crop is more certain than wheat on certain lands.

Buckwheat was also a crop grown before 1840. The census of that year reported 6,919 bushels. The production gradually increased, reaching a maximum in 1880, when 32,688 bushels were harvested from 1,858 acres. Since that time there has been a decline and the acreage in 1899 was only 953 acres.

Potatoes have long been one of the staple crops of the county, and the acreage devoted to this crop has also increased gradually from year to year. In 1899 there were 2,478 acres under this crop, yielding 240,447 bushels.

The hay crop has been important from practically the beginning. The acreage cut for hay in the last three decades has been about the same as that given to wheat. The average yield per acre has slightly exceeded 1 ton. In 1889 there were about 35,000 acres cut for hay, of which about 4,000 acres were clover. Besides this there has always been a considerable area devoted to more or less permanent pasture.

Live-stock raising received attention from the first. The early assessment records show that nearly every family had one or more cows and many of them teams of horses or oxen. Oxen were used

quite generally for draft animals. Hogs were also kept by every family. About 1840 great interest was taken in the improvement of live stock, and some improved breeds, especially of horses and cattle, were introduced. The census of 1900 reported 297,564 acres in farms, or not quite one-half the area of Center County. Of the area in farms about two-thirds is reported as improved. A large part of the county is occupied by mountainous ridges and the high Allegheny Plateau, which is unsuited for agricultural use. On the former there is practically no cultivated land at all, while on the plateau the area is wild lands, mostly uncleared. A comparatively small part is cultivated, but the agriculture is of very little importance, the elevation and short season being unfavorable. The chief value of such lands lies in the forest products and in coal mines. There is, however, a comparatively large area included in the fertile limestone and shale valleys of the county. The farming operations are carried on upon such lands and their natural productiveness is such that Center County ranks high among the other counties of the State in agricultural production.

The average size of the farms is 127.2 acres. There are many fine farms much larger than this in all parts of the county. The indications point to a fairly prosperous condition of the farming class. The climate and soils are adapted to the production of the cereals and grasses, and this, with the large amount of wild lands affording more or less pasture, makes cattle grazing and dairying profitable. The farmers therefore follow general farming, in which cereals and grasses form the cultivated products, supplemented by dairying and cattle raising. Under this system on practically every farm all the cereal crops are produced at present. In order of importance as to acreage these crops are wheat, corn, oats, barley, rye, and buckwheat. In acreage the tame grasses cut for hay are second to that of wheat. Of the cultivated grasses timothy is the most extensively grown. Clover finds a place on most farms. Some potatoes are grown on every farm and every place has its vegetable garden, which plays an important part in the economy of the farm. The limestone soils ordinarily produce large crops, and the owners of the lands are as a rule most prosperous. The surplus of the small grains is sold from the farm and hay is also sold to some extent; but the corn crop is as a rule fed on the farm either in the form of grain and fodder or as ensilage.

Small and tree fruits are grown on most farms, there being no general effort to produce the former on a commercial scale. An exception is the production in the vicinity of Philipsburg of a few strawberries for the local market. There are a few apple orchards of commercial size in the county; also some peach orchards, but peach growing is being discontinued on account of the uncertainty of crop

and a consequent lack of profit. Some trucking is done, particularly in the Half Moon Valley. The growers make regular trips each week across the mountain by wagon, selling their varied products of garden, farm, and poultry yard in Philipsburg and the other mining towns in the western part of the county and in Clearfield County. A few have succeeded in truck growing in the vicinity of Philipsburg.

Live stock is an important factor on every farm; cattle and horses lead, but some attention is given to the raising of hogs and sheep. Both dairy and beef cattle are produced. The wild mountain lands afford good grazing for beef cattle. The elevations being high, flies are not troublesome; there is plenty of good water and feed, and the cattle thrive. Some large areas are under fence, but for the most part the land is open, the cattle running at large. They are hunted up by the farmer in the fall and returned to the stall for finishing for market. No particular preference is shown in breeds of cattle grown for beef. They are mostly common grades. In the limestone valleys the farmers raise horses suitable for heavy farm work and for draft purposes in the cities. These are mainly of the Percheron breed. Jersey and Holstein breeds are common on the dairy farms. The product of the dairy is chiefly butter made on the farm and this is sold on the local market, especially in the nearby mining towns. Some cheese is made, but the product is not important. Very little milk is shipped from the county. While dairying is practiced generally, there are no very large dairies in the county, each farmer keeping what cows he can conveniently pasture, feed, and tend. The value of all live stock on farms, as given by the Census of 1900, is $1,258,764.

The limestone soils, as well as being the strongest and most productive, are recognized as best adapted to general farming. Besides producing the largest crops of the small grains and corn, they give the best results with grass, both for hay and for grazing.

The red shale or Upshur soils in the Bald Eagle Valley and in the small areas between the mountain ridges and the Colyer silt loam are considered next to the limestone soils in productiveness. They will produce the same crops as the limestone soils, and give yields above the average. In addition these red shale soils are considered especially adapted to fruit, particularly apples, though pears, plums, and cherries do well. The apple trees grow thriftily and bear good crops of fruit of good color and fine flavor.

The Dekalb soils are not nearly so productive as the soils already mentioned. The shale type is droughty and is best suited to small grains, which mature before the summer droughts are likely to occur. Corn, which must go through the season, does not make a good yield. Being a well-drained soil it affords early pasturage, but during the summer the grass becomes short. In wet years it is found that oats

are a much more certain crop on the shale soils than wheat, the latter being more or less winterkilled. The clay loam, being a heavy soil, is recognized as best suited to grasses for hay and pasturage. The Dekalb loam, however, is a fairly productive soil and the general crops make good yields upon it. The Dekalb silt loam is a fairly good soil type, but its occurrence on the top of the Allegheny Plateau, where the season is short, does not permit of a wide range of crops. Corn does not mature as a rule. The best use of the type is for hay and pasturage, though it also is recognized as a good potato soil. The loose sandy and stony types of the plateau are not in demand, not being productive soils. Their best use is without doubt for forestry. The small extent of the bottom land soils makes them of relatively little importance, though where drained they make very large yields of corn and hay. They also make excellent pastures.

A crop rotation is practiced universally over the country on all soils, and is followed with very little variation. This consists of corn, wheat, oats, and grass, the latter consisting of timothy and clover, both cut for hay two seasons and then pastured for a year or two. Barnyard manure is applied to the corn crop. With the wheat an application of commercial fertilizer, usually a phosphatic mixture, is made. Lime is also used and is always found beneficial. It is said to be necessary, particularly on the Dekalb and Upshur soils, in order to get a stand of clover. Lime is of great value also on the limestone soils. Many farmers burn the lime they use in their fields. Farmers in the Bald Eagle Valley, where liming is general, haul the limestone over Bald Eagle Mountain from the Nittany Valley, obtaining the stone at a cost of 10 cents a load where they quarry it themselves. It is hauled to the farm, where there is plenty of wood, and coal can be obtained cheaply by hauling from the mines. The lime costs less in this way. Some, however, prefer buying the lime outright.

The application of lime to the soils has given very good results, but the methods used could be improved. The lime should be applied regularly in the rotations, at periods of from four to eight years and in amounts varying from 1,500 to 2,000 pounds. It has been the custom in the past to apply lime in enormous quantities, about once in fifteen to twenty-five years, or whenever the lack of lime was evidenced by the diminishing crop yields. The more regular applications in the smaller amounts, if used in connection with manures or fertilizers, would insure the maintenance of the crop yields and the elimination of any unfavorable effect on some crops that might occur when the very large amounts are applied.

The use of commercial fertilizers to supplement barnyard manure is general. The total outlay for commercial fertilizer in 1899, according to the census, was $26,200. Clover is grown not only for the forage

it produces but for its beneficial effect upon the soils. In general the latest improved cultural methods are followed, with the use of all kinds of improved machinery for special purposes. The land is given thorough preparation and the after-cultivation is good. The plowing is deep and on the heavier soils three horses are used. Disk, spring-tooth, and smoothing harrows are on nearly every farm, and the use of the roller is also common. Improved harvesting machinery is used. The hay crop is handled largely by machinery.

The census figures show that only 56.3 per cent, or a little over one-half, of the farms are operated by the owners. The share basis of rental is the most common, though cash rent is paid in some cases. Some farms are operated by hired labor. Labor is scarce and commands high wages. The mines make considerable demand for labor, though it is supplied largely by foreign elements.

Farm values vary considerably over the county. The rough mountainous lands have very little value for agriculture. Lands in the coal-mining sections, though not of high value for agriculture, are leased for very long terms for about $25 an acre, but for the full possession this land brings from $75 to $100 an acre.

The valley soils bring of course the highest prices, the limestone lands ranging from $40 to $60 an acre, with practically none on the market. The hilly shaly soils bring from $10 to $25 an acre, while the desirable bottom lands are held very high.

In general the farm practices of Center County are good and the farmers are in a fairly prosperous condition. In certain matters there is room for improvement. In dairying especially the profits could be greatly increased by improving the herds and by adopting some of the more recent plans of dairy management. The milk output can be increased by a more general use of soiling crops, to be fed when the pastures are dry, and by adding ensilage to the winter feed.

Another opportunity for increasing the net income of the farms is found in the manurial practices. With greater care of the barnyard manure and the more frequent use of green manuring crops, many of the farmers could save at least a part of the money now expended for commercial fertilizers. These mixtures are valuable, and, in special cases, absolutely essential to the best results, but they should not be depended upon in the case of farms where a little more forethought and well-directed effort can give satisfactory substitutes with practically no cash outlay. In this connection the clover crop should receive more attention and its acreage be increased, for this is one of the best ways to improve the soil naturally.

On the limestone soils the introduction of another valuable legume, alfalfa, would materially increase the value of the forage crops. It has been shown on the experiment station farms at State College and in some scattered fields in the Nittany and Penn valleys that

the crop can be successfully grown and large yields obtained. In preparing for this crop the land should be well limed and thoroughly tilled in order to provide a suitable seed bed and enable the crop to get through the first season. Both spring and fall seedings have proved successful. Alfalfa does best on the heavier limestone soils, the Hagerstown clay loam, clay, and silt loam being best adapted to its production. Yields of from 3 to 6 tons per acre per year have been obtained.

With the good markets afforded by the near-by mining towns, which are usually in sections where little farming is done, more attention could well be devoted to trucking where soils suitable for the purpose occur. Even if light truck crops are not grown, the heavier truck and vegetable crops would repay the effort. The potato acreage could easily be extended. The markets could stand an increased supply of tomatoes and sweet corn, both of which do well in this county. Cabbage and cauliflower should be produced in greater quantities. The dealers now obtain supplies from outside the county. The small fruits, particularly berries of different kinds, could be more widely grown with profit. All the tree fruits should also receive more attention, the plantings extended, and cultural methods adopted to produce fruit of good quality.

Finally, the advisability of preserving and even extending the forests can not be emphasized too strongly. There is much land that is suited to no other purpose.

SOILS.

The soils of Center County fall into five general divisions—the limestone valley soils, the related Barrens soils, the red shale foothill soils, the soils of the narrow synclinal mountain ridges and of the Allegheny Plateau, and the recent alluvium along the streams. Except in the case of the last named, the soils are closely related to the underlying geological formations, and with that one exception all are residual in character.

The most important, though not the most extensive, soil series of the county is the Hagerstown, derived from the solution and weathering of the Trenton limestone. These soils are composed of the more or less insoluble residue left in the rock during the process of solution and removal of the magnesian limestone of the Trenton period. They are rarely very deep, usually resting on the hard, unweathered rock at less than 15 feet from the surface. They have excellent drainage through the cracks and subterranean channels in the soluble limestone, yet because of the heavy nature of their subsoil are quite retentive of water.

There are five types of this series mapped in this area—clay, clay loam, silt loam, loam, and stony loam. Of these the clay loam is

most extensive, while the clay, silt loam, and stony loam are nowhere extensively developed. They occupy the rolling valley land and the types are rather closely related to the topography of the region—clay occurring on steep knobs and knolls, where erosion has been most active, the clay loam on the gentler slopes, and the silt loam in small local depressions in the other types, where the finer particles, washed from the higher soils, have tended to accumulate. The loam occurs on the crests of the broader anticlinal ridges where the base of the Trenton is approached and the soil derived from the more impure and cherty limestone.

These soils are very similar to the Hagerstown series of soils found in the limestone valleys of southeastern Pennsylvania, in Maryland, Virginia, Kentucky, and Tennessee. They occur wholly in the southern half—south of the Bald Eagle Mountains—in the Nittany, Penn, Brush, and smaller extensions of these valleys.

Closely related geologically to the limestone soils occur the soils of the Barrens, occupying eroded crests of the great anticlinal folds in Nittany and Penn valleys. These soils are generally sandy in character and are derived from a mixture of sandstones, clays, and some limestones, whose exact geological horizon has never been definitely established. They occupy irregular and much eroded ridges, are excessively drained, and have little water-holding capacity, and have been classified in the Morrison series, first mapped in the Johnstown, Pa., area.

The soils of the shale foothills, derived from the red shale rocks of the Clinton formation, probably rank next to the limestone soils in agricultural value. These soils occupy the Allegheny escarpment and the adjacent foothills. Owing to their topographic position, they are subject to rapid surface drainage and are liable to erosion. These soils have been classified in the Upshur series and correlated with soils mapped in other parts of Pennsylvania, in West Virginia, and other parts of the Appalachian uplift. A phase of the Upshur soils is found in the narrow synclinal valleys on the crests of the synclinal mountain ranges in the southern part of the county. Here the soil is derived from the weathering of the Medina red sandstone, and the soil is sandier in character than the soil from the shale formation. There were two types mapped in this series, the Upshur loam and Upshur stony loam.

The soils of the Allegheny Plateau and the synclinal mountain ridges fall in the Dekalb series. There are nine types developed in the county, ranging from a sand to a clay loam. Generally speaking, the heavier members of the series are found on the slopes of mountain ridges, while the lighter soils are developed on the plateau. The soils vary much in agricultural value, depending on the derivation and topography, as well as on the character of the soils themselves. The

soils on the mountain ranges are derived from the shale and sandstone rocks which lie above the Trenton limestone—the Utica and Hudson River shales, the Oneida and Medina sandstones. On the plateau they are derived from the Oriskany, Catskill, and Pocono sandstones and Pottsville conglomerate, from the Chemung and Hamilton shales, and from the rocks of the Barren and lower productive Coal Measures.

A related soil type—the Colyer silt loam—derived from the black carbonaceous shale which lies between the Trenton limestones and the Utica shales, has a rolling topography, excellent drainage, and a very high agricultural value. It is most extensively developed in Georges and Penn valleys, and is ranked as second to the Hagerstown clay loam in agricultural value.

The soils of the stream valleys, or the recent alluvium, are not extensively developed anywhere in Center County and are not of much agricultural importance. There are five of these bottom soils, falling into two series—Huntington and Moshannon. They exist as narrow, irregular bands along the larger streams of the area and generally are variable in texture. In most cases they are composed of the material from the adjoining soil and rock formation, and vary as these vary, though along the Moshannon and Bald Eagle creeks, where the development is most extensive, fairly uniform soil conditions exist.

Small areas of Meadow, some Swamp, and a large area of Rough stony land were also mapped in the county. These are all described at length in the following text.

The appended table gives the names and areas of the several types of soil developed in Center County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Rough stony land	248,064	34.7	Meadow	5,248	0.7
Dekalb stony sand	70,016	9.8	Colyer silt loam	4,928	.7
Hagerstown clay loam	65,920	9.2	Moshannon loam	3,968	.5
Dekalb silt loam	46,656	6.5	Moshannon fine sandy loam	3,584	.5
Dekalb stony loam	45,312	6.3	Hagerstown silt loam	3,136	.4
Upshur stony loam	39,808	5.5	Swamp	2,176	.3
Dekalb stony silt loam	27,712	3.9	Morrison stony loam	2,048	.3
Dekalb shale loam	25,536	3.6	Upshur loam	1,984	.3
Hagerstown loam	21,760	3.0	Morrison clay loam	1,280	.2
Dekalb sand	19,200	2.7	Dekalb fine sandy loam	896	.1
Morrison sandy loam	17,792	2.5	Morrison sand	640	.1
Dekalb clay loam	15,488	2.2	Huntington sandy loam	512	.1
Dekalb loam	11,904	1.7	Madeland	448	.1
Hagerstown stony loam	9,344	1.3	Huntington gravelly loam	384	.1
Huntington clay loam	7,424	1.0			
Hagerstown clay	6,592	.9	Total	715,520	.....
Morrison loam	5,760	.8			

HAGERSTOWN CLAY LOAM.

The surface soil of the Hagerstown clay loam consists of from 6 to 8 inches of a yellowish-brown or reddish-brown silt loam to silty clay loam. The subsoil is composed of a lighter colored silty clay loam which grades into a reddish-yellow heavy clay loam or clay at 18 to 20 inches.

The type as a whole shows considerable variation. The surface soil may range locally from a light silt loam to a heavy clay loam, depending largely on the topographic position. Surface wash, moving the finer particles to the local depressions, may make the surface soil much deeper and very silty. The same erosive action, carrying away the surface soil, leaves the soil much shallower at the tops of the ridges and "breaks" or changes of the slope. In some places where the erosion has been most active the soil approaches a clay in texture. These changes are common throughout the type, especially in those areas where the topography is more variable.

The subsoil also varies, though within narrow limits. The stratum of lighter colored material may be absent, the soil resting on a heavy reddish clay loam or clay at depths of 6 to 10 inches. Both soil and subsoil are friable and are very easily tilled. Even when plowed in a wet condition they do not clod readily, but may be easily reduced to an excellent condition of tilth.

The type for the most part is free from stones, though in places it becomes quite stony, as much as 15 per cent of rock fragment being present. Limestone ledge outcrops are numerous in some areas, being especially noticeable along the Brush Valley and Spring Mills pikes east of Center Hall. Northwest of State College some of the type contains considerable chert, being known as "flint land." Most of this "flint land," however, is Hagerstown loam. Wherever the ledges or stones are especially numerous they have been indicated on the map by suitable symbols.

This type is extensively developed throughout the valley regions. One area, varying in width from 2 to 6 miles, extends from Baileysville, on the southwestern county line, to Woodward, in Penn Valley, 35 miles northeast. This body forks between State College and Lemont, one large arm extending through the eastern part of Nittany Valley, being most extensively developed east of Bellefonte. The southern arm, forking again at Penn Cave, reaches in a long, narrow band thoughout the length of Brush Valley.

This type occupies all topographic positions in the valleys, occurring on ridges, slopes, in level stretches, and in the steep hilly districts. For the most part, it occurs as moderately rolling country, becoming hilly near some of the larger streams, notably along Spring Creek.

The Hagerstown clay loam is very well drained. Most of the rainfall passes directly through the soil mass into the subterranean chan-

nels and thence off to the regional drainage systems. There is little surface wash in evidence and surface run-off is at a minimum. The character of the underground drainage has already been discussed. The type is marked by a large number of sink holes into which the small amount of surface "run-off" disappears.

In common with the other limestone soils, the type is composed of the insoluble residue derived through the weathering and solution of the underlying rock. The mode of formation is evidenced in the fact that though the rock contains more than 70 per cent of calcium and magnesium carbonates, the soils are usually deficient in lime. These minerals are soluble and have been dissolved and carried away during the process of soil formation. It is estimated that it has taken more than 75 feet of rock to supply material to form one foot of soil.

These valleys were originally heavily forested with oak, hickory, and other hardwoods and pine. The forests have long been cleared away and much of the land has been farmed for over one hundred years.

The general farm crops are grown, the rotation usually followed being corn, oats, wheat, and grass. The yields are good. Corn yields from 70 to 80 bushels per acre, wheat 18 to 20 bushels, oats 20 to 30 bushels, and hay from 1 to 1½ tons. The hay is generally about half-and-half clover and timothy the first year, and principally timothy the second year, the clover dying out unless the land has been well limed.

In most cases the land has been very well handled since first clearing, and the yields have not decreased. The liberal use of lime is shown to be beneficial, especially when used with barnyard manure. Commercial fertilizers rich in phosphoric acid give excellent results also.

Land of this type of soil is valued at from $40 to $60 an acre, averaging about $50.

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

Mechanical analyses of Hagerstown 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.*	*Per cent.*
17074	Soil	0.6	1.5	0.9	2.0	6.4	58.8	29.9
17075	Subsoil	.2	.7	2.0	15.8	11.2	35.6	33.7

HAGERSTOWN LOAM.

The surface soil of the Hagerstown loam consists of 8 to 10 inches of brown or yellowish-brown loam, in places containing a high percentage of silt. From 10 to 20 inches the subsoil consists of a yellow-

ish brown or light-yellow heavy silty loam or silty clay loam which grades to heavy red clay within the 36-inch section. In some areas the lighter colored subsoil is not present, the surface soil resting on the clay at depths varying from 10 to 15 inches.

The soil is loose and friable and is very easily worked. Generally it contains from 10 to 25 per cent of small chert or limestone fragments and in some regions, notably on the ridges south of Fillmore and south of Center Hall, is known as "flint land." These stonier phases are not as productive as the areas which contain little or no chert.

The type occurs throughout the limestone valleys, but is most extensively developed in three large bodies, one southwest of State College, another south of Fillmore, and the third south of Center Hall, between that place and Center Hill. In each of these regions the type occupies the crests of anticlinal folds of the underlying rocks. The soil occupies gently rolling upland regions in the broad valleys, though in a few cases the topography becomes quite hilly.

Like the clay loam, this type is formed by the disintegration and solution of the dolomitic limestones of the valleys. It occurs where these rocks are more impure and contain larger quantities of silica, and other insoluble rock materials. Occurring mostly on the crests of the anticlines this type has been subjected to a longer period of weathering than has the clay loam, and is even more deficient in lime than that type.

The drainage is excellent, being largely subterranean. This type, even more than the Hagerstown clay loam, is marked by numerous sink holes. In some regions they are numerous enough to be a distinct feature of the topography. Usually around the edges of these holes erosion has removed the surface material, and the resulting soil is quite heavy; where the sink has not fully developed the interior consists of much deeper surface soil, loose and friable. Ledges are not uncommon on this type, but are not as numerous as in the clay loam. The usual farm crops of the region—corn, oats, wheat, and grass—are grown. The yields are much lower than on the clay loam. Corn gives from 60 to 70 bushels, oats 15 to 20, wheat 12 to 15 bushels, and hay about 1 ton. The reason for these lower yields is not apparent and with more careful fertilization this soil should produce as well as the clay loam.

The soil is deficient in lime and often low in organic matter. Lime and barnyard or green manure give marked results. Complete fertilizers containing relatively large proportions of phosphoric acid are very beneficial.

On account of the lack of good water supplies the number of stock kept on this type is much less than the land would support. Most of the farms depend on cisterns for their water supply. Wells have to be sunk to the depth of 100 to 300 feet.

With more stock, making more manure, and the liberal use of lime, these soils could be made very productive.

The land is valued at $20 to $50 an acre, depending largely on water supply and proximity to railroads or towns.

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 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.*	*Per cent.*
16824	Soil	1.3	3.4	2.9	5.7	11.2	55.6	19.0
16825	Subsoil	.7	1.9	1.3	3.9	13.6	39.4	39.7

HAGERSTOWN SILT LOAM.

The surface soil of the Hagerstown silt loam consists of from 10 to 12 inches of a dark-yellow or brown silt loam. The subsoil to a depth of about 24 inches is a slightly lighter brown to yellow silt loam or very silty clay loam. From 24 to 36 inches it grades into a reddish-yellow to red silty clay loam or clay. The soil is a deep, soft, and friable silt loam, very easily tilled. It is smooth and fine and rarely contains any stone fragments.

The silt loam is not an extensive type and is found in no large bodies. It usually occurs as small irregular areas scattered throughout the loam and clay loam areas, and in many cases the bodies were not extensive enough to show on the map. The largest areas occur south of State College and west of Pine Grove Mills.

Topographically the soil is made up of local depressed areas and more extensive level upland areas. The most common occurrence is in local depressions, where the slow surface erosion of the surrounding types has served to increase the depth of the fine, silty surface soil. The drainage is usually very good, though the soil does occupy depressions. The water passes through the subsoil to the underground channels and thence escapes into the regional drainage systems.

The soil was formed originally by the solution of the limestone rocks, but is mainly the result of gradual accumulation of the fine material removed from the more elevated regions by the surface "run-off," which flowing to these depressed areas and sinking to the underground channels, has year by year added to the depth of fine material until this deep silt loam has resulted.

The crops grown are those common to the other types of the region. Yields are rather higher than on the clay loam. Corn will yield from 70 to 90 bushels, wheat 18 to 25, oats 20 to 30, and grass from 1½ to 2 tons per acre.

Like the clay loam and loam, this type is benefited by lime and by phosphatic fertilizers. The need for barnyard manure and organic matter is not as marked as on the two former types.

The following table gives the results of the mechanical analyses of the soil and subsoil of the Hagerstown silt loam:

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.*	*Per cent.*
17156	Soil	0.1	0.6	0.6	1.0	3.4	68.9	25.3
17157	Subsoil	.5	1.0	.6	1.4	3.4	69.8	23.3

HAGERSTOWN CLAY.

The Hagerstown clay consists of from 2 to 6 inches of a dark-red or reddish-brown heavy silty clay loam, resting on a subsoil of stiff red clay. In a few places the immediate surface material is a light silt loam or loam about 4 inches deep resting on the typical subsoil.

Although the type is stiff and has a high clay content, it has a tendency on drying to break up into a loose and friable condition. The subsoil, too, shows some indication of jointing, and the water readily seeps through it. The type, though heavy, is not hard to till.

The soil is characterized by numerous ledge outcrops, and in most areas the bed rock lies within 3 feet of the surface. In a few areas loose stones are numerous. This is true of the area near Spring Mills and of much of the type in Brush Valley. Where stones and ledges are numerous symbols are used in the map to indicate their occurrence.

The soil occupies hills and ridges in the limestone valleys, being developed most extensively on the hills south of Lemont; near Houserville; in smaller areas near Pleasant Gap, and in a considerable area near Spring Mills and east of Penn Cave in Brush Valley.

Owing to its topographic position the soil has excellent surface drainage. Most of its drainage is through the underground channels, common to all these limestone soils.

The soil is formed by the disintegration and solution of the limestone rocks and represents that portion of the soil mass adjacent to the parent rock. There is no "rotten" or partly changed rock between the soil and rock, the change being abrupt from the clay soil to the hard limestone. This is characteristic of all limestone soils. Near the ledge outcrops in all the other Hagerstown types the clay is apt to be developed, but rarely in sufficiently large areas to be mapped.

The soil is cropped in the usual manner, giving good yields of corn, oats, and wheat, and excellent yields of hay. One field of alfalfa noted was giving excellent results.

The type is deficient in lime and organic matter. The addition of these not only increases the fertility but improves the physical condition, making the soil more loose and friable, which aids materially in its cultivation.

The following table gives the average results of mechanical analyses of fine-earth samples of the Hagerstown clay:

Mechanical analyses of Hagerstown 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.*	*Per cent.*
17070, 20063.....	Soil.....	0.3	2.2	1.7	5.1	4.4	45.7	40.3
17071, 20064.....	Subsoil.....	.3	1.7	1.3	7.8	7.3	38.8	42.4

HAGERSTOWN STONY LOAM.

The Hagerstown stony loam consists of from 6 to 8 inches of a brown silty loam, resting on a subsoil of heavy red clay. The soil and subsoil contain from 20 to 40 per cent of limestone fragments and the bed rock is usually within 3 feet of the surface. The texture of the surface soil and the character of the stone content vary considerably. In some areas this rock, instead of consisting mainly of loose fragments, is formed by numerous ledge outcrops. In most cases such areas have been mapped with the type in which they occur and marked on the map by symbols. In other areas where the soil is derived from an impure limestone the soil and subsoil contain large amounts of irregular angular chert fragments ranging in size from gravel to stones several inches in diameter. In these regions the surface soil is quite variable, ranging from a light loam, through silt and clay loam, to clay. The subsoil is invariably clay, but is much deeper, bed rock being rarely within 3 feet of the surface. The area along Dry Hollow, about 2 miles southeast of Fillmore, is characterized by the occurrence of this higher proportion of chert fragments, in some cases approaching 70 per cent of the soil mass.

The Hagerstown stony loam is scattered throughout the limestone areas, usually in small, irregular bodies. The most extensive occurrences are in the Dry Hollow region, along Spring Creek canyon, and in smaller areas east of Bellefonte and Linden Hall.

In topography the stony loam is generally hilly, occurring on steep slopes and hillsides, though some level areas are encountered. The drainage is good. The type is usually in forest, but where cleared it is either farmed to corn, oats, wheat, and grass, or is in pasture. By far the larger part, however, is covered with forests of oak and hickory, with some pine and hemlock.

Because of its topographic position and the difficulty of tilling such stony land, it is preferable to utilize land of this character in the growing of forest products.

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

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.*	*Per cent.*
17158	Soil	2.0	1.4	0.8	2.5	2.2	70.4	20.4
17159	Subsoil	1.2	1.4	.6	3.0	2.1	59.1	33.2

COLYER SILT LOAM.

The surface soil of the Colyer silt loam consists of 8 to 10 inches of silt loam, yellow or yellowish-brown in color and of loose, friable texture. The subsoil is a heavy, yellow, very silty clay loam which at depths of from 24 to 40 inches rests on soft, black carbonaceous shale. The soil has a tendency to bake somewhat after rains, but is easily worked up by use of the cultivator or harrow. The type is locally known as "soapstone land" and is considered a very good soil.

The Colyer silt loam occurs in small areas along the mountain slopes, wherever outcrops of the black shale are not covered by overwash material, but is most extensively developed in Georges Valley and in the "Loop" near Colyer. Two considerable areas occur southeast of Spring Mills and another large area north of Woodward.

Throughout its extent the soil is very uniform. It is formed by the weathering of the soft carbonaceous shales that lie between the limestone rocks and the thin-bedded shales giving the Dekalb shale loam. It occupies rounded hills and rolling areas on the synclinal folds, beyond the areas of the Dekalb shale loam, these soils being very closely related to the geological formations.

Surface drainage is very thorough, and during dry seasons crops sometimes suffer from lack of moisture. The land is farmed to the general crops of the region, with very good results. Corn yields from 60 to 100 bushels, averaging about 70 bushels per acre, oats from 20 to 25 bushels, wheat 15 to 18 bushels, hay 1 ton to 1½ tons, and potatoes from 75 to 125 bushels. As in case of the limestone soils already described, applications of lime give good results on this soil, and the use of lime and barnyard manure is very beneficial.

Land of this type of soil is considered but little lower in agricultural value than the Hagerstown clay loam, and is held at prices ranging from $40 to $60 an acre.

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

Mechanical analyses of Colyer 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.*	*Per cent.*
17090	Soil	0.0	0.5	0.5	0.9	0.5	73.1	24.4
17091	Subsoil	.0	.1	.4	1.0	1.0	60.7	37.1

MORRISON SANDY LOAM.

The surface soil of the Morrison sandy loam consists of 8 to 12 inches of fine to medium yellowish-brown, heavy sand or light sandy loam. The subsoil is a yellow or reddish-yellow, sticky, sandy loam, grading to a reddish clay at 36 inches. In the more loamy areas the surface soil is sticky when wet. Both soil and subsoil contain considerable sandstone fragments and certain parts of the areas where the stone content is high have been indicated on the map by symbols. In the area between Stormstown, Scotia, and Fairbrook the stones are very numerous, almost sufficient to make a stony sandy loam.

Soil of this description is found in the area known as the Barrens, in the western part of the Nittany Valley, and on the sand ridge near Bellefonte. The type really constitutes the Barrens region, a name which is decidedly misleading, as the region is not barren, but supports heavy forests. This soil occupies ridges and rolling to hilly areas and is very well drained. The subsoil is porous, and while some water can be found at 30 to 60 feet, wells must be driven much deeper, 300 to 600 feet, in order to obtain a satisfactory supply.

The soil is derived from weathered sandstones and quartzites. The rocks and soil contain large amounts of iron ore, and several "banks," or surface workings, are being operated. The bank at Scotia is the largest and has been in operation for over twenty-five years.

The soil supports a native growth of chestnut, oak, yellow pine, and some white pine. The last named formerly was much more abundant, but its place has been taken by the less valuable woods. A dense undergrowth of ground oak, sweet fern, blueberry, and other shrubs occurs.

But little of the type is cleared or tilled, most of it being in forest. It is held by lumber or mining companies in tracts of 1,000 to 5,000 acres, and by them leased to lumbermen who cut and clear the timber. The land then is usually allowed to lie idle until another crop of trees is ready for harvest. If the difficulty of lack of water could be overcome, it is believed this soil would be valuable for truck and

garden crops and for berries and small fruits. Careful manuring would have to be practiced, and the soil being leachy light applications frequently applied would give best results.

The following table gives the results of the mechanical analyses 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.*	*Per cent.*
16826	Soil	0.6	9.0	19.6	39.5	5.9	17.1	7.6
16827	Subsoil	.9	6.5	13.7	33.4	5.5	15.2	24.8

MORRISON SAND.

The surface soil of the Morrison sand consists of 6 to 10 inches of yellow or yellowish-brown fine loamy sand or sandy loam, resting on a subsoil of yellow or reddish-yellow sand or fine sand which in places is somewhat sticky.

The soil occurs in small areas through the Morrison sandy loam regions, the greatest development being between Scotia, Altro, and Krumrine. The type occupies gently rolling areas and is very well drained.

It supports a native growth very similar to that of the sandy loam, and like that type is largely covered with forest. Where timber has been removed and no valuable iron ore exists, this type and the sandy loam can be had at prices ranging from $2.50 to $10 an acre.

Both types lack organic matter, and good crops could not be obtained without generous applications of manures and fertilizers.

The following table gives the average results of mechanical analyses 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.*	*Per cent.*
17160, 19115	Soil	0.2	13.5	29.0	34.6	3.4	12.0	7.2
17161, 19116	Subsoil	.4	11.2	24.4	37.4	4.9	12.5	9.1

MORRISON STONY LOAM.

The Morrison stony loam consists of a heavy reddish-yellow sandy loam or loamy sand resting on a reddish-yellow heavy sandy clay loam to a sandy clay extending to a depth of 36 inches or more. Both soil and subsoil contain large quantities of iron-cemented sandstones of varying size. In some cases, on the highest ridges and near the iron mines, the stones are so numerous that the type approaches

Rough stony land in character. The topography is sharply rolling to hilly, with steep slopes, and if cleared the soil would be subject to severe erosion.

The Morrison stony loam is derived from the sandstones found in the Barrens region, and is very well drained. Practically none of it is cleared. It is low in agricultural value, but supports a good growth of chestnut, pine, and oak, which are being cut for mine timbers and for pulp wood.

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

Mechanical analyses of Morrison 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.*	*Per cent.*
16984	Soil	4.3	6.4	4.3	17.1	4.1	44.0	19.6
16985	Subsoil	3.5	7.0	3.8	12.6	4.3	44.2	24.3

MORRISON LOAM.

The Morrison loam consists of 8 to 10 inches of a rather sandy heavy loam of a yellow or brownish-yellow color, underlain by a subsoil of reddish-yellow clay loam to clay. In places both soil and subsoil contain considerable quantities of sandstone fragments, but the proportion of such coarser material is not sufficient to interfere with cultivation.

Small areas of this kind of soil are found in the Barrens region, the largest area occurring just east of Scotia. The topography is generally rolling, and the drainage conditions good. The soil is derived from the sandy rocks of the Barrens. Where cleared it gives good yields of the staple crops. In its native state it supports a growth of chestnut, pine, and oak, and where cultivated and planted to orchards it has given good results with apples and cherries. It is probably well adapted to the production of berries and bush fruits, as well as to truck and garden crops.

The land where cleared ranges in value from $35 to $50 an acre.

MORRISON CLAY LOAM.

The Morrison clay loam consists of from 6 to 8 inches of brown or yellowish-brown silty clay loam, resting on a red-brown or reddish-yellow friable clay or clay loam subsoil.

The type occupies rolling areas in the Barrens and along the line between the Barrens and the limestone soils. It is derived largely from the sandstone materials, with possibly some admixture of the residue from limestone near the boundaries of the type. In some cases the stone content is rather high.

At present the areas of this soil are largely timber or stump land. It will support good growths of chestnut, pine, and oak. Very little of the type is cleared and almost none of it farmed.

DEKALB CLAY LOAM.

The surface soil of the Dekalb clay loam, to a depth of 6 or 8 inches, varies from a heavy silt loam to silty clay loam, the latter texture being the more general. The color changes from drab or brownish on the immediate surface to pale yellow beneath. Where very dry the surface soil becomes light drab or gray. The first few inches of the subsoil is composed of a pale-yellow heavy silty clay loam which generally grades with depth into heavy plastic silty clay, usually yellow somewhat mottled with red and white or drab and brown. The mottling is the result of poor drainage, the subsoil being so close and impervious that water does not pass readily through it. The subsoil is generally moist and has a smooth, soapy feel, a characteristic found to some extent in the soil. Upon drying large cracks form in both the surface soil and, in exposures, in the subsoil.

At depths ranging from 2 to 6 feet the soil mass rests upon shale rock. Frequently, especially on the slopes of the shale hills in the Bald Eagle Valley, small weathered shale fragments occur upon the surface and in the soil and subsoil. On the mountain slopes, in addition to shale fragments, are found some subangular sandstone fragments and bowlders, both on the surface and in the soil mass. These stones are of the talus from the upper slopes of sandstone. Where these stones are of sufficient quantity to interfere materially with cultivation the areas have been shown in the map as Dekalb stony loam.

The largest development of the type is found on the gentle slopes of the shale hills in the Bald Eagle Valley. The other areas occur as narrow strips on the lower slopes of the mountain ridges, as for instance on Bald Eagle, Nittany, Brush, Tussey, and other mountains. The surface of these areas is moderately sloping, yet owing to the impervious subsoil the drainage is usually poor. That the type is more subject to erosion than the Dekalb loam is shown by the more frequent occurrence of gullies. There is thus considerable surface run-off, despite which the moisture conditions are not the best.

This type of soil is for the most part of residual origin, being derived from a number of slate and shale formations. In the Bald Eagle Valley, at the foot of shale hills, it is derived from the Hamilton and Genesee shales, which are clayey in character and Devonian in age. These areas are also modified by materials washing down from the slopes of the adjoining shale hills. On the north flank of Bald Eagle Mountain the Clinton shale formation has formed this soil, while on the south flank and on the slopes of the other mountain ridges it owes its origin to the weathering in situ of the Utica and

Hudson slates and shales. Strata of these shale formations on the mountain slopes are comparatively thin, so that the resulting bands of the derived soil type are narrow. They are limited further by the talus from the steeper upper slopes of sandstone which rolls down over the areas and covers their upper margins to a greater or less depth, changing their character completely.

On the slopes of the mountains the Dekalb clay loam usually marks the upper limit of cleared land, the stony loam and Rough stony land above it being timbered. The type formerly supported a fair growth of chestnut and other hardwoods and pine. At present it is mostly devoted to pasture. On account of its generally wet condition on the mountain slopes, but little of it is cultivated and the yields obtained are low. Probably the best use for this soil is as pasture or mowing land. Care should be taken to get a good seeding and to maintain it by the use of top dressings of fertilizers and the reseeding of thin places. There is a deficiency of lime in the soil and the seeding will be greatly benefited by using this salt liberally, preferably when preparing the land. In the Bald Eagle Valley the areas of this soil are considered fairly good farming land and are all cleared and under cultivation. Being naturally a cold, wet soil, its best use is for the cereals and grasses. On farms in these areas both barnyard manure and commercial fertilizers are used, and these are supplemented by applications of lime. With such thorough fertilization fairly good crops are grown, and the soil as compared to the contiguous hill farms is held in higher esteem.

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 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.*	*Per cent.*
17068, 20053, 20055	Soil.....	0.5	2.6	2.5	5.4	4.5	55.6	29.1
17069, 20054, 20056	Subsoil.....	1.4	2.7	1.7	4.3	5.6	44.6	39.9

DEKALB SILT LOAM.

The surface soil of the Dekalb silt loam, to an average depth of 6 inches, is a light, friable silt loam, gray to light brown in color on the immediate surface, changing to pale yellowish beneath and passing into the subsoil without any distinct line of demarcation. The subsoil consists of a pale-yellowish silt loam slightly deeper in tone than the soil, occasionally becoming heavier with depth and generally somewhat close and compact. It, however, contains a considerable proportion of the finer grades of sand which tend to make it friable. Often the sand content in the surface soil is sufficient to give a gritty

feel, and in places the type might be classed as a silty fine sandy loam. Fragments of sandy shale and of shaly sandstone are found on the surface and in the soil mass in quantities varying from a few scattered pieces to a relatively high percentage. In some areas the shale content is so high as to make the soil almost a shale loam. The underlying shaly rocks are often found at less than 36 inches below the surface, though on the whole they occur at a greater depth.

The Dekalb silt loam is found only in the western part of the county upon the Allegheny Plateau. It occurs in a number of areas somewhat separated from each other. The principal areas lie in the vicinity of Philipsburg and Snow Shoe, the latter being quite extensive and covering that section known as the Snow Shoe coal basin. Another area is at the head of Little Moshannon Creek in what is called a subbasin of the Snow Shoe. These areas are developed on the top of the plateau, largely on stream divides, yet not confined entirely to this position.

The surface is rolling and smooth, with some quite steep slopes near some of the streams. The drainage as a rule is excellent.

The Dekalb silt loam is residual in origin, being derived through weathering from the shales and fine-grained sandstones of Carboniferous age. The formation is correlated with the lower productive Coal Measures in which there are a number of included bituminous coal veins. The texture of the shale rock varies from clayey to gritty or sandy. The sandstone beds are thin and the rock fine grained. In past geologic time this formation was covered by another formation known as the unproductive or Barren Measures. Removal of these upper beds in part has exposed the productive measures and given rise to the type of soil here described.

Under much of the area of this type mining operations have been carried on extensively and so much material has been removed that large areas have caved in and are now in a condition unsuited for cultivation. The greater part of the Dekalb silt loam is cleared. Originally it was covered with a heavy growth of timber, in fact, the heaviest on the Dekalb series of soils. In the vicinity of Philipsburg this soil is under cultivation and gives fair yields of the general farm crops. It has also been utilized here for market gardening, especially in the production of strawberries and the heavy truck crops, such as cabbage, cauliflower, and potatoes. The elevation is a little high for tomatoes. The strawberries are of excellent quality and give good yields. Peaches do quite well, the Elberta being best adapted to this soil and elevation. The Crawfords are said to be too tender. Between Snow Shoe and Pine Glen the land is quite generally cleared and farmed, several good farms being seen. Cereals, hay, and potatoes are the principal crops. Of the cereals oats do the best. Timothy and clover do exceptionally well, giving an average yield of

1 ton or more per acre. Where manures and fertilizers are applied much larger yields are obtained. Potatoes are of good quality and yield an average of more than 100 bushels per acre.

For some years past heavy losses have been sustained from the potato rot and this has reduced the profits and tended to discourage growers. Much of the potato seed is obtained from Maine. The varieties most commonly planted are the Green Mountain, Snow, and Norcross. The Sir Walter Raleigh is also a favorite variety.

Being well adapted to the grasses for hay and pasturage, the Dekalb silt loam is desirable for dairying and stock raising. Where good markets are convenient the former would prove more profitable.

Improvement of the areas of this kind of soil can best be accomplished by turning under green manuring crops in addition to applications of barnyard manure. With such treatment the land can be made much more productive. Lime is always beneficial, but should not be applied immediately preceding the potato crop.

Because of the presence of coal veins, or their probable occurrence, this land has a higher value than would be warranted on a basis of its agricultural worth. Where sold in fee simple it brings $100 an acre. Without mineral rights it brings $25 an acre.

The following table gives the average results of mechanical analyses of fine-earth samples of the soil and subsoil of the Dekalb silt loam.

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.*	*Per cent.*
17540, 20045	Soil	1.8	4.2	2.1	7.2	9.3	56.2	18.9
17541, 20046	Subsoil	2.0	5.2	2.3	8.4	9.5	48.9	23.5

DEKALB STONY SILT LOAM.

The surface soil of the Dekalb stony silt loam to a depth of 6 inches consists of light-brown to pale-yellowish heavy silt loam. The subsoil consists of a pale-yellow heavy silt loam changing with depth into a plastic silty clay loam or clay. In some places, as on the lower parts of slopes, the subsoil is often mottled yellow and drab, the yellow color predominating. Generally on the top and upper slopes of the ridges it is difficult to get the soil auger deeper than 2 feet on account of the great amount of broken stone. There is, however, some interstitial soil material down to the solid rock which lies at no great depth below the surface. These underlying rocks consist of thick-bedded shale and thin-bedded sandstone, the strata in the latter case ranging from one-half inch to 3 or 4 inches only. The quantity of rock fragments in the soil varies greatly. Along the boundary between the type and the Dekalb shale loam there is a greater pro-

portion of shale, and the two types blend so that the line separating them had to be arbitrarily drawn. Back from the boundary the stones are more numerous and larger, the quantity being sufficient to interfere with cultivation. These stones are removed from the fields and used in building fences.

The rock fragments in the soil have an important influence on the moisture conditions, assisting drainage when there is an excess of water, on the one hand, and preventing too rapid evaporation on the other. Aside from the presence of stones and the hilly character of the surface, the Dekalb stony silt loam is fairly easy to cultivate. Areas of Dekalb stony silt loam occur as a continuous belt from 1 to 2 miles wide in the Bald Eagle Valley adjacent to the Dekalb shale loam areas. The topography consists of high rounded hills and irregular shaped ridges, with steep slopes. These hills are much higher than those covered by the shale loam and some of the country is rather mountainous in character. The slopes are generally quite steep and erosion is more or less active, shallow gullies being formed. Some small streams originate in this belt, but the larger streams have cut through it from the foot of the Allegheny Mountains.

The soil is residual, being derived from interbedded shale and sandstone. To the resistance of the latter to weathering is due the higher elevation of this type as compared with the shale loam. The rocks belong to the Chemung formation of the Devonian era. A large part of this land is occupied by forests of pine, oak, and chestnut, with hemlock in the ravines. In some places, however, considerable areas are cleared and farmed, and though the slopes are steep and difficult to cultivate, the yields of the general farm crops are fair. Corn does better than on the adjoining Dekalb shale loam. The yields of buckwheat are also larger. Of the small grains oats are most important. Clover does exceptionally well, the land being limed once in 6 to 10 years. Crop rotation is followed, the succession usually being corn, wheat, oats, and grass. A few apples, said to be of fair quality, are produced, and it is probable that the soil would make desirable orchard land.

Farms composed in whole or mainly of the Dekalb stony silt loam bring from $15 to $25 an acre.

Average results of mechanical analyses of fine-earth samples of the soil and subsoil are given in the following table:

Mechanical analyses of Dekalb stony 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.*	*Per cent.*
20047, 20049.....	Soil.....	1.9	3.8	2.0	5.6	14.1	51.7	20.8
20048, 20050.....	Subsoil.....	4.3	5.6	2.0	7.3	10.6	48.4	21.7

DEKALB SHALE LOAM.

The surface soil of the Dekalb shale loam consists of from 6 to 10 inches of a friable yellow-brown silt loam, rather heavy, but so filled with small shale fragments as to be very loose and easily tilled. The subsoil consists of a heavy loam or silt loam grading into a heavy clay loam of a yellow or grayish-yellow color. It is rare that the soil section extends more than 24 inches in depth, broken shale fragments being so numerous below this as to constitute almost a rock condition. The surface soil contains from 30 to 60 per cent of shale fragments of very small size, varying from one-eighth to one-half inch in thickness and from one-fourth to 1 inch in length. The shale fragments are locally known as "gravel," and the type is known as "gravel land." In some sections the type is known as "shoepeg" land, on account of the shape and size of the shale particles. The subsoil contains 50 per cent or more of shale fragments, in fact in most cases is simply a mass of broken shale rock. The underlying shales usually lie at a steep angle and are readily disintegrated by the agencies of weathering.

In the shale belt in the Bald Eagle Valley, where the Dekalb shale loam is known as "slate" or "shale" land, the type departs somewhat from the foregoing description. The color of the soil is lighter, a pale-yellowish color, and the texture is possibly a little heavier, though this may be due to the smaller quantity of shale fragments present in the soil. The subsoil here becomes somewhat heavier with depth and is often plastic. The character of the shale formation differs from that of the Nittany and other valleys in the eastern part of the county. The rocks do not, as a rule, break up into such small fragments, and toward the Allegheny Mountains the blocks become thicker and the texture more gritty.

The most important development of the Dekalb shale loam occurs in the Bald Eagle Valley, where the soil forms a continuous belt from one-half mile to 1½ miles wide, extending the entire length of the valley north of Bald Eagle Creek.

In the Nittany and other valleys in the eastern part of the county the soil is found in narrow bands along the lower slopes of the mountains. Here it is most extensively developed northwest of Penn Cave, on a continuation of the Brush Mountain syncline; near Colyer and around Egg Hill, on the extension of the Egg Hill synclines. In these latter-named localities the soil is derived from the thin-bedded, hard shales of the Utica and Hudson River formations and the larger areas exist where the overlying sandstone material has been eroded away and the shales exposed. Topographically, the soil occupies rounded spurs along the mountain sides, or rounded steep-sided hills, where it exists in large bodies. On the shoulders of the ridges on each side of the numerous gaps, where there is not so much overwash from the

higher sandstone areas, small irregular areas of this type are also found. These are noticeable from a considerable distance, as they are usually cleared, while the adjoining stony loam or rough stony land is forested.

In the Bald Eagle Valley the Dekalb shale loam is derived from shale rocks of a more recent geologic time, the Devonian. There are a number of formations, among them the Hamilton, the Genesee, and the Nunda or Portage. These are clay shales with interbedded gritty shales and thin-bedded sandstones. Toward the Allegheny Front the strata become thicker and harder. The topography consists of rounded hills and irregular-shaped ridges, with smooth steep slopes and narrow V-shaped stream valleys. Near Bald Eagle Creek the shale beds were softer, and this has resulted in a low range of hills with an elevation of about 100 feet, or possibly a little more, above the main valley floor. Back of this range the hills and ridges gradually become much more prominent, the rock formations becoming harder and more resistant to weathering.

Drainage in the Dekalb shale loam is thorough and rapid. In some cases the surface "run-off" is swift and considerable damage is caused by erosion.

The native vegetation was largely chestnut, oak, hickory, pine, and hemlock, and some very good stands of timber are still left.

On account of the shallow depth to rock the soil is apt to be droughty, and does not give high yields. Potatoes do well, however, and are of very good quality. One hundred to 150 bushels per acre represents the range of yields. In the eastern valleys grass does poorly, as do the grain crops, but in the Bald Eagle Valley buckwheat and oats are successfully produced. Here clover gives satisfactory growths on limed fields. The soil as a whole is not well adapted to corn, though this crop is included in the rotation. Some apples of fair quality are grown, but there are no commercial orchards. The soil responds readily to applications of manure and lime, but on account of its leachy nature small applications made frequently are preferable to large applications. Considerable care must be used in order to prevent erosion and loss of the valuable surface soil.

Farms of the Dekalb shale loam probably have an average value of $15 to $25 an acre.

The average results of mechanical analyses of fine-earth samples of the soil and subsoil from the different localities are given below:

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.*	*Per cent.*
17080, 20059, 20061.	Soil.....	3.9	8.5	2.1	2.6	1.7	58.7	22.6
17081, 20060, 20062.	Subsoil.....	4.8	9.2	2.9	3.3	2.5	49.5	27.7

DEKALB LOAM.

The surface soil of the Dekalb loam consists of about 10 inches of friable loam, yellow brown when wet and yellowish to grayish in color when dry. The subsoil is a yellowish to reddish yellow heavy silt loam grading through clay loam to clay at about 30 inches. Some variations occur, as in the areas east of Aaronsburg on the flank of Brush Mountain, where the surface soil is somewhat sandy and the subsoil also of lighter texture. In the Bald Eagle Valley the soil ranges from 6 to 10 inches in depth and consists of a grayish-brown to yellowish fine-textured loam. In places a slightly sandy texture predominates and in others the soil is more silty. The latter variation is especially noticeable on the lower part of the slope which it occupies. In the Bald Eagle Valley more or less rounded sandstone gravel occurs on the surface and scattered through the soil.

The Dekalb loam is found in the valley section of the county, occurring as long, narrow areas at the foot of mountain slopes. Important areas extend along the Nittany Valley side of Bald Eagle Mountain, and along both sides of Nittany Mountain. In the Bald Eagle Valley a number of small areas are found extending from the confluence of Beech and Bald Eagle creeks up the latter to beyond Milesburg.

The surface configuration of these areas is gently rolling or sloping. That in the Bald Eagle Valley is a low, smooth ridge cut in a number of places by streams. The drainage is good. In some cases the run-off is rapid and the land is subject to erosion.

From its position and character this soil evidently represents the wash from the upper slopes spread over and intermingled with the material derived from the underlying shales and limestones; in other words, colluvial matter spread over residual. The colluvial material has been largely derived from the weathering of sandstones. In the Nittany and other valleys, with exception of Bald Eagle Valley, the underlying rock is mostly shale; in the last-named locality the Helderburg limestone is the underlying formation. Here the wash material has come from the Oriskany standstone and the whole has been reworked by water, as is evidenced by the rounded gravel found on the surface and in the soil mass.

This type of soil is easily cultivated and, lying well, it is almost all cleared and in farms. It formerly supported a growth of hardwoods, but now only occasional woodlots or forests exist. It is farmed to the usual crops of the region—corn, oats, wheat, and grass. These crops give excellent yields.

Potatoes are also grown quite extensively, the yield being good and the quality much better than in case of potatoes produced on the limestone soils. Corn yields from 60 to 70 bushels, oats from 35 to

40 bushels, wheat from 15 to 20 bushels, and potatoes from 100 to 150 bushels per acre. With applications of lime this soil produces good crops of clover. In addition to the crops mentioned tomatoes and other heavy truck and canning crops would doubtless do exceptionally well. The value of farms on the Dekalb loam is much above the average for the county.

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

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.*	*Per cent.*
17076, 20065, 20067.	Soil.....	1.2	7.2	7.6	13.7	6.3	48.9	15.3
17077, 20066, 20068.	Subsoil.....	.7	3.9	6.9	12.3	6.1	38.2	31.6

DEKALB STONY LOAM.

The interstitial material of the surface soil of the Dekalb stony loam varies from a heavy sandy loam to a clay loam, with the predominating texture a medium loam. The color is brown or yellow brown. The subsoil is heavier, ranging from a clay loam to a clay, at depths of from 8 to 10 inches. It is generally impossible to bore over 15 inches into the soil, on account of the quantity of sandstone fragments, which form 15 to 60 per cent of the soil mass. These fragments are of all sizes and more or less subangular to rounded in shape.

Areas of the Dekalb stony loam are generally in forest. Where cultivated the stones have generally been picked off and piled. Bands of this soil are found along the slopes of the mountain ridges in the valley sections. The areas lie between the loam and clay loam types of the lower slopes and the Rough stony land of the crests and steep upper slopes. The surface varies from steep to gently sloping. There are practically continuous strips of this soil on both slopes of Bald Eagle Mountain and on the Nittany and other mountainous ridges. It also occurs on the north slope of Tussey Mountains. A few small scattered areas also occur in the plateau section of the county.

On the sides of the mountains its formation is due to the talus from the upper slopes mingling with the material derived from the lower lying shales, to which is due the fine texture of the soil. The talus consists mainly of sandstone which has become more or less broken and rounded in its progress down the slopes. The type may be considered largely a stony phase of the Dekalb clay loam. The upper portions of the areas, however, are to a great extent, if not entirely, of residual origin, derived from the disintegration of sandstones and sandy shales. These small areas in the plateau sections

are also largely residual. Owing to its prominent topographic position and inclined surface the surface drainage is complete and in some localities so rapid as to result in damaging erosion.

Most of the Dekalb stony loam is covered with forest composed of a good growth of oak, hickory, chestnut, pine, and other valuable trees. But little of the type is cleared, and where it is, the land is devoted chiefly to pasture or meadow. It is best adapted to forestry and should be used for this purpose.

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

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.*	*Per cent.*
17092	Soil	0.5	10.2	11.7	21.5	10.5	35.3	10.2
17093	Subsoil	1.4	11.2	11.1	21.6	10.9	29.5	14.1

DEKALB FINE SANDY LOAM.

The surface soil of the Dekalb fine sandy loam to an average depth of 6 inches consists of a light-brown fine sandy loam. The subsoil has about the same texture as the soil, but is yellow or reddish yellow in color. Though of generally fine texture both the soil and subsoil carry some coarse grains, giving them a gritty feel. When moistened the subsoil shows the presence of considerable clay. Upon the surface and to some extent in the soil mass are found small weathered fragments of sandstone and some shaly flakes. In places, as on crests of the ridges, larger stones and bowlders occur and there are some outcrops of the underlying sandstone formation. Included in this type are narrow bands and small areas where the soil consists of 6 inches of light-brown to yellowish loamy fine sand, underlain by the same material, in places exceeding depths of 36 inches. These bands or areas occur on the crest of the ridge close to the disintegrating sandstone rock from which they have been derived. They were too small to be shown as a separate type in the map, and for that resaon were not differentiated.

The Dekalb fine sandy loam is of small extent and is found only in the Bald Eagle Valley, where it occurs as a few small narrow areas occupying the crest of a ridge. It is residual in origin, being derived from the Oriskany sandstone. The fine sandy loam is devoted to the general farm crops of the country and makes fair yields. It would no doubt be an excellent soil for truck crops. Potatoes do well, making fair yields of excellent quality.

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

Mechanical analyses of Dekalb 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.*	*Per cent.*
20057	Soil	1.7	6.9	13.3	39.2	10.4	22.5	6.2
20058	Subsoil	1.5	6.4	10.5	31.3	10.4	27.7	12.0

DEKALB STONY SAND.

The fine-earth material of the Dekalb stony sand consists for the larger part of medium-textured sand or loamy sand, though there is a range in texture from rather coarse to fine. The immediate surface is dark colored, owing to a shallow covering of organic material. Beneath this the color becomes light gray to pale yellowish, the latter usually continuing through the subsoil, though in places the subsoil is a reddish yellow. The average depth of the soil is about 5 inches. There is practically no line of demarcation between soil and subsoil. There is usually enough clay and silt in the soil to make it slightly sticky, and in places the proportion is sufficient to give a heavy loam. On the other hand the soil in places is merely a partially disintegrated conglomerate rock, and it then has the texture of a coarse sand. These departures from the typical soil occur only in small areas. In both soil and subsoil are found more or less weathered and disintegrating sandstone and sandstone conglomerate. Here and there small outcropping ledges of these rocks also appear. The quantity of rock fragments increases with depth and there is very little fine sandy material below 2 feet from the surface. The stones, bowlders, and outcrops are always sufficient to interfere with cultivation. Where the stones are not too large and numerous they may be removed, and fairly cultivable fields are obtained in this way.

The Dekalb stony sand is the most extensive of the mountain and plateau soils. It occurs in the western part of the county in large bodies throughout the length of the plateau. A few small areas occur on Bald Eagle Mountain and on the other mountainous ridges of sandstone found in the valley portion of the county. It occupies the broad tops and gentle slopes of the ridges or stream divides of the plateau section. In some places it extends down the slopes to the stream banks, but here it is often displaced by Rough stony land. The Dekalb stony sand has been derived through weathering from the Pottsville and Pocono formations, the former largely a sandstone conglomerate and the latter a coarse-grained sandstone. The

Pocono, however, does not enter to any great extent into this soil, as it usually gives rise to Rough stony land. These formations are of Carboniferous age. The Oneida and gray Medina sandstones also give rise to small areas of the Dekalb stony sand. As with most soils derived from sandstone the structure is open and porous and the natural drainage free, much of the rainfall passing into the soil.

Nearly all the area of this soil is still uncleared, although most of the merchantable timber has been removed. The forests consisted of white pine, jack pine, and hemlock; in the ravines, oak, chestnut, and some maple. At present it supports a scattering second growth of chestnut and oak, with some pine, where fires have not extended. An undergrowth of huckleberry, ferns, and bracken furnish browse for cattle.

Land of this character has a low agricultural value. It is limited in crop adaptation by texture and structure and by altitude, which confines its use to hardy plants and those that mature quickly. Low yields of wheat, rye, and oats are obtained on the few small areas cultivated. Buckwheat and potatoes can also be produced. The type should be used for pasture and forestry.

The results of mechanical analyses of the fine earth of a sample of the soil and subsoil are given in the following table:

Mechanical analyses of Dekalb stony 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.*	*Per cent.*
20051	Soil	9.5	38.5	13.8	11.6	4.2	17.7	4.7
20052	Subsoil	9.3	41.2	12.9	10.5	4.1	15.7	6.5

DEKALB SAND.

The surface soil of the Dekalb sand to an average depth of 5 inches consists for the most part of a medium loamy textured sand of light-gray to pale-yellowish color. Beneath this is found similar material slightly heavier in texture and more compact. The color of the subsoil is generally a deeper yellow than the soil and now and then becomes a reddish yellow. The immediate surface of most areas, these still being in forest, has a shallow covering of vegetable mold, giving it a darker color and greater loaminess than the material a short distance below. There is usually enough clay present to make the soil somewhat coherent when wet. When moderately dry and loose the soil is often slightly fluffy, especially when the texture of the sand is finer than usual. Variations in texture occur as in the Dekalb stony sand, a loose sand of almost any texture and from fine to coarse being found in some places and in others material of a texture approximating a light sandy loam. In depressions the soil is

often quite silty. In the heavier phases the subsoil is also somewhat heavier and more sticky or plastic. A few sandstones and conglomerate fragments are found on the surface and in the upper part of the soil, and the quantity is often quite large even near the surface. Usually the underlying broken or weathered rock is found within 36 inches of the surface. The stone content, however, is rarely sufficient to interfere with cultivation, though occasional small stony areas, which, on account of their limited extent could not be shown as Dekalb stony sand, are included.

Only limited areas of the Dekalb sand occur in Center County. These are scattered over the western part and usually occupy level to gently rolling tops of broad ridges in the Allegheny Plateau section. The elevation of these areas averages close to 2,000 feet above sea level. Both position and character of soil promote ready drainage and the type is dry, warm, and, compared with the other soils of the section, early. It is residual and derived from the same sandstones and sandstone conglomerates as the Dekalb stony sand—the Pottsville formation.

Agriculturally the Dekalb sand has very little value. Practically none is cleared or under cultivation. In original forest growth and present condition it is very similar to the Dekalb stony sand. It can be purchased for a few dollars an acre. It is best for it to remain in forest, but some means must be found to check forest fires if practical forestry is to be made successful.

The average results of mechanical analyses of fine-earth samples of the soil and subsoil are as follows:

Mechanical analyses of Dekalb 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.*	*Per cent.*
20041, 20043.....	Soil.....	1.9	18.5	24.3	21.7	8.9	19.1	5.0
20042, 20044.....	Subsoil.....	1.4	4.9	22.4	19.0	7.6	23.4	11.1

UPSHUR STONY LOAM.

The surface soil of the Upshur stony loam, to a depth of 5 to 8 inches, consists of a fine loam, ranging in texture from silty to sandy. While the color is variable, the characteristic color is Indian red. Sometimes the immediate surface is brownish red and in places reddish brown. On the mountain slopes where affected by the wash from the gray sandstones above, the top soil is a more pronounced shade of brown or in places it is a yellowish color. The subsoil has quite uniformly the characteristic deep Indian red color, but it varies in texture from a silty to sandy loam, grading with depth into clay loam, or, as in the Bald Eagle Valley, is most often a clay loam grading

into clay. When moistened and rubbed in the fingers, it has a smooth, shiny appearance and greasy feel, which is true to some extent of the soil, particularly the heavier phases. Upon the surface and in the soil there occurs from 15 to fully 40 per cent of shale and sandstone fragments, the content varying with the position. In the Bald Eagle Valley some of the slopes are exceedingly stony, and in general the proportion of coarse material is sufficient to necessitate removal before the land is cultivated. The stone consists of small chips, not flakes, of red shale and blocks of sandstone, the latter gray, brown, or red in color. In some areas the larger stones are lacking, in which case there may be a much larger quantity of small pieces with very little interstitial material. Such spots are most common on knolls in the areas on Bald Eagle Mountain and in the mountains of the eastern and southern parts of the county. The subsoil also contains stone, sometimes in larger quantities than the soil, but there is also much of it that has very little stone.

The Upshur stony loam is on the whole a friable easily cultivated soil, where the stone content is not so high as to interfere. The type is extensive. Its greatest development is in the Bald Eagle Valley, where it occurs as an unbroken belt of varying width extending the length of the valley. The other areas occur as long, narrow strips in the depressions or high valleys on the tops of mountainous sandstone ridges in the eastern part of the county. There are areas of this character on Bald Eagle Mountain, on Nittany Mountain, and on the Tussey Mountains. In the Bald Eagle Valley the topography consists of hills and ridges with steep slopes, rising in the highest parts fully 1,500 feet above sea level. As a whole the surface configuration is such that good drainage is afforded, but some slopes particularly on the Allegheny Mountain are wet and seepy.

The Upshur stony loam is of residual origin. It has been derived chiefly from two geological formations. In the Bald Eagle Valley it results from the Catskill consisting of red shale and red and brown sandstone of Devonian age. Here the Chemung formations of the same age enter into the material to a slight extent. The Catskill shale is mainly argillaceous, and the sandstone is medium to fine grained and interbedded with the shale. The red sandstone weathers to gray or dull brown. The areas outside of Bald Eagle Valley are derived from the Medina formation, also composed of red sandstone and shale.

With the exception of the limestone soils of the valleys the Upshur stony loam is the most productive and strongest of the residual soils of the county. It is retentive of fertilizers, easily improved, and is adapted to a wide range of crops. Wheat yields 10 to 20 bushels per acre. Oats give correspondingly good returns. From 30 to 60 bushels of corn per acre is secured. Timothy and clover do well, and potatoes

yield as high as 250 bushels to the acre. It is considered the best fruit soil in the county, particularly for apples. The trees are thrifty, bear abundantly, and the fruit is of excellent quality, both as regards coloring and flavor. Every farm has its small orchard, but there are no large commercial orchards. The further development of fruit growing on this soil would seem to be one of its best uses. Though this land is some distance from the railroad, it brings the highest prices outside of the limestone districts for strictly agricultural land. The price seldom falls below $25 an acre and may be several times that amount.

The following table gives the average results of the mechanical analyses of fine-earth samples of the Upshur stony loam:

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.*	*Per cent.*
20075, 20077.....	Soil.....	1.3	2.6	1.6	17.4	25.9	38.0	12.7
20076, 20078.....	Subsoil.....	2.2	5.9	3.0	14.3	19.6	36.3	18.3

UPSHUR LOAM.

Occurring in troughlike locations between ridges of the Upshur stony loam are small areas of land lacking stone or carrying a relatively small quantity that have been mapped as the Upshur loam. This soil consists of 6 inches of a silty Indian red or brownish-red loam, underlain to depths exceeding 36 inches by a dark Indian red loam, grading through clay loam into clay.

Areas of this soil are found in the Bald Eagle Valley belt of the Upshur stony loam. Their total extent is small. In origin the type is residual, derived from the same class of rocks as the Upshur stony loam, though in places it has probably been influenced by wash from the surrounding slopes.

The areas have good drainage and are productive, giving good yields of the general farm crops.

The results of mechanical analyses of a typical sample of the soil and subsoil are given in the following table:

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.*	*Per cent.*
20079.....	Soil.....	0.4	2.1	1.3	4.9	12.7	58.3	20.1
20080.....	Subsoil.....	.9	2.7	1.5	4.9	10.6	47.9	31.3

HUNTINGTON CLAY LOAM.

The surface soil of the Huntington clay loam has a depth of 8 to 10 inches and varies from heavy silt loam to silty clay loam of dark-gray, drab, dark-brown, or blackish color. This material rests on a subsoil of yellow or drab more or less plastic silty clay loam or clay; yellow and drab mottling of the subsoil is quite common, especially in the areas lying along Marsh and Bald Eagle creeks. Both the soil and subsoil are quite variable in color and texture, as is apt to be the case with soils of alluvial origin. The character depends upon the class of material of the watershed feeding the stream forming the deposits, the conditions under which the depositions were made and reworked, the drainage conditions, and in the amounts of organic matter contained. In the Nittany Valley it is the wash from both limestone and shale formations, while along Bald Eagle and Marsh creeks it is largely from shales.

This type occurs as narrow bands along the larger streams of the county, the largest and most important areas being found along Bald Eagle and Marsh creeks, in the Bald Eagle Valley, and along Spring and Sinking creeks in the Nittany Valley. The type occupies the low, level first bottoms and is subject to overflow. In the Bald Eagle Valley it is associated with the Moshannon loam and Moshannon fine sandy loam, these latter types occurring along the stream banks, while the Huntington clay loam lies next to the upland and is generally a little lower and is more or less wet. In these areas the soil mass has been largely derived from the contiguous slopes of the Devonian shale formations, while in the Nittany Valley the type owes in part its origin to wash from limestone soils.

Owing to moist conditions, the soil is best adapted to grasses for hay and pasturage, to which it is generally devoted, maintaining a good growth of pasture grasses during the whole season. Corn, oats, and wheat are grown to some extent on the areas where the drainage conditions are better.

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

Mechanical analyses of Huntington 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.*	*Per cent.*
17072, 20069.....	Soil.....	0.5	2.6	2.9	8.1	8.3	52.4	24.4
17073, 20070.....	Subsoil.....	.1	1.1	2.4	11.5	14.1	45.5	24.6

HUNTINGTON GRAVELLY LOAM.

The surface soil of the Huntington gravelly loam to an average depth of 8 inches varies from a light to heavy loam, pale to dark-brown in

color, as the drainage is good or imperfect. The subsoil consists of a yellow loam or clay loam usually resting on a bed of gravel within 24 inches of the surface. Gravel is also intermingled in the soil and subsoil and strewn over the surface. This coarse material consists of rounded sandstone pebbles and flat waterworn pieces of shale.

Only a small area of the Huntington gravelly loam is developed, a few areas being found along Bald Eagle Creek. They occur mostly on delta fans of streams entering Bald Eagle Creek. The material is transported from the surrounding areas by the streams and the soil is alluvial and closely associated with the Huntington clay loam. Because of its gravel content, the soil drains readily and is suitable for growing corn, of which good yields are secured. It also produces the other cereal crops.

MOSHANNON LOAM.

The Moshannon loam has a surface soil of brownish Indian red loam, 8 inches in depth, resting on a subsoil of texture and color similar to the soil, the texture becoming more sandy with depth. At 30 inches the material often changes to a compact fine sandy loam, though in places it becomes a heavy loam or clay loam. Some rounded gravel is found upon the surface and in the soil and subsoil in scattered areas, especially at the confluence of streams. Areas of the Moshannon loam occur associated with the Moshannon fine sandy loam along some of the streams of the county. It is typically developed between the Moshannon fine sandy loam and the Huntington clay loam, and where the latter is absent it lies between the former and the foot of the upland slopes. The areas are all small and not continuous along the streams. The largest areas are on the lower courses of Bald Eagle and Marsh creeks.

The Moshannon loam, like the Moshannon fine sandy loam, is of alluvial origin, representing the finer sediments deposited at a little distance from the stream. These sediments have been derived through erosion of the Upshur types of soil.

Of the bottom-land types the Moshannon loam is the most desirable in the sections in which it occurs. It is adapted to a wider range of crops than the Huntington soils and is fully as productive and as easily maintained in a high state of cultivation.

It produces the largest yields of corn, as much as 125 bushels of ears per acre being reported. This, however, may be regarded as exceptional, and a yield of something less than 100 bushels may be considered a fair average. Next to corn, the grasses and clover probably give the best results. Large yields of hay are harvested and exceptionally good pasturage afforded. Wheat and oats also make good yields, but the straw is liable to be heavy and lodging sometimes occurs. Areas not too wet give good yields of potatoes.

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

Mechanical analyses of Moshannon 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.*	*Per cent.*
20073	Soil	0.0	0.5	0.6	17.9	26.6	38.8	15.7
20074	Subsoil	.0	.7	1.0	18.5	27.2	34.0	18.7

MOSHANNON FINE SANDY LOAM.

The surface soil of the Moshannon fine sandy loam consists of 6 to 8 inches of reddish or reddish-brown light to heavy fine sandy loam. The texture varies, and is sometimes a fine loamy sand and again it is of medium instead of fine texture. Even the fine-textured samples show considerable medium sand. Next to the streams the areas consist largely of bars of loose sand, while farther back the material becomes heavier. The subsoil is similar to the soil, except that it is sometimes more compact. It varies like the soil and is apt to be sandy or a sand or loamy sand in more cases than the soil. Gravel beds are usually encountered within the soil profile and there is often more or less rounded waterworn gravel on the surface. The color is the characteristic feature of this type, the Indian red distinguishing it at once from the Huntington series. The material has been washed from the Upshur types, derived from the red Catskill formation. Along Moshannon Creek, however, the color of the soil has a yellowish shade, the color being due to discolored water from coal mines.

Areas of the Moshannon fine sandy loam occur along streams, usually in narrow strips adjacent to the stream courses. In places the strips are so narrow that they could not be shown on the map without too great exaggeration and in such cases they were included in the heavier Moshannon loam. The aggregate area is small. Its greatest occurrence is along Bald Eagle and Marsh creeks and the small runs tributary to these streams. A few narrow strips occur along Beech Creek, and there are also some areas along Moshannon Creek, on the western boundary of the county. The soil is of alluvial origin. Occurring in the bottoms the areas are all more or less subject to overflow, but otherwise the drainage is good, except in the local depressions. The moisture conditions thus in the main are favorable to crop growth, but the soil is too sandy and gravelly to be a productive type except in the better parts. It produces fair crops of corn where manured and fair yields of potatoes. It is naturally suited to the production of garden vegetables.

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

Mechanical analyses of Moshannon 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.*	*Per cent.*
20071	Soil	0.0	0.9	3.1	25.2	24.4	32.5	14.1
20072	Subsoil	.0	1.3	28.4	21.6	22.8	15.3	10.6

HUNTINGTON SANDY LOAM.

The surface soil of the Huntington sandy loam consists of 6 to 8 inches of a dark-brown to black heavy loam, rather sandy in places, and mixed with varying amounts of gravel and rounded stone fragments. The subsoil consists of a drab to black heavy silt loam to clay loam also containing gravel. In many places masses of rounded waterworn stones are encountered at 15 to 20 inches below the surface.

The soil occurs as first bottoms along the streams in the limestone valleys of the county and is generally level and often poorly drained. The soil is alluvial and is formed from the materials washed from the surrounding hills, reworked and deposited by the water. It has some of the characteristics of soil derived from the rocks of the immediate region, being usually the product of local erosion.

In places the type is utilized for the general farm crops, but usually it is in mowing land or pasture. Owing to its wet condition it is excellent for the pasture grasses, giving good grazing throughout the growing season.

The results of mechanical analyses of the soil and subsoil of this type are given in the following table:

Mechanical analyses of Huntington 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.*	*Per cent.*
17078	Soil	4.2	14.3	11.6	24.7	8.1	25.4	12.2
17079	Subsoil	.7	3.6	3.3	10.3	8.2	47.9	25.6

MEADOW.

Meadow includes the areas of low bottom lands that are too wet to be of use for tilled crops.

In some cases this land would be of value for cultivated crops if properly drained, but usually it is of such a character that reclamation is impracticable. It should be devoted to pasture where possible

or left in forest growth. The extent of Meadow in Center County is small, and the type is therefore quite unimportant.

SWAMP.

Swamp, as mapped in Center County, comprises areas covered by water for the greater part of the year and supporting a growth of water-loving trees, shrubs, grasses, and rushes. Such areas are practically of no agricultural value, though in the driest part of the season cattle can be pastured on them. Swamp is found in three localities—along Moshannon Creek, on the western boundary of the county; at the head of Little Moshannon Creek in Rush Township, in the plateau section; and in the Tussey Mountains, in the southern part of the county.

ROUGH STONY LAND.

Throughout the mountain regions of the county occur many steep, tree-covered slopes that have been mapped as Rough stony land. The agencies of erosion have been so active in these areas as to remove practically all of the surface soil and to preclude the possibility of ever using this land for tilled crops. In some cases it can be used as pasture, some grass growing between the stones, but most of the type is covered by forests of hardwood, pine, hemlock, and trees of lesser value. Much of this land, notably on Nittany and the Tussey Mountains, is held as a state forest reserve. The balance is largely in the hands of lumber companies who are cutting off the merchantable timber. With a proper system of forestry this land should give good returns per acre in timber cut. It is worthless for general agricultural purposes, and all "cut-over" tracts should be reforested as rapidly as possible.

MADELAND.

A few very small areas in Center County are designated on the accompanying soil map as Madeland. These are places where mining has been done, excavations made, or lands dug over so as to change their position and topography, and at present have no agricultural value.

SUMMARY.

Center County is situated in the geographical center of the State. It is irregular in shape and one of the largest counties in the State, comprising an area of 715,520 acres, or 1,118 square miles. The western part of the county lies in the Allegheny Plateau, with an average elevation of about 2,000 feet above sea level. The remainder of the county consists of rolling limestone valleys, separated by narrow, sharp, mountainous ridges of sandstone.

Center County lies in the drainage basin of the Susquehanna River, the western and central parts being drained by Moshannon, Bald Eagle, and Fishing creeks and their tributaries into the West Branch of the Susquehanna, which river forms the northern part of the western boundary of the county. Penn Creek drains the eastern part of the county into the Susquehanna itself. A little drainage in the south-central part of the county is effected by small streams that empty into the Juniata, another tributary of the Susquehanna. A feature of the drainage in most of the limestone valleys is the lack of surface streams, the run-off passing into sink holes and then into subterranean streams.

Settlement of the county was begun only a few years prior to the beginning of the Revolutionary war. The agricultural development of the county was slow for nearly half a century after settlement. The winters are cold with considerable snow, while the summers are comparatively cool. The growing season in the Allegheny Plateau section is so short that cultivated crops like corn do not always mature, and the tenderer vegetables can not be grown with safety. In the valleys, however, the season is long enough to mature all crops. The mean annual temperature at State College is 49° and the mean annual precipitation 40.2 inches.

General farming, consisting of the growing of cereals and grasses, supplemented on a small scale by dairying and stock raising, is the characteristic agriculture. The soils are suited to the production of these crops and practices and make comparatively good yields. The grain crops in order of acreage are wheat, corn, and oats, with barley, rye, and buckwheat of minor importance. A large acreage is devoted to the grasses for hay and pasturage. A little less than one-half the acreage of the county is in farms, of which about two-thirds is improved. The average size of the farms is 127.2 acres.

A little over one-half, or 56.3 per cent, of the farms are operated by the owners, the remainder are leased either on a share or cash basis.

With the exception of the alluvial soils found in the bottoms which comprise members of two soil series, the soils are closely related or associated with the underlying rock formations. The rocks underlying Center County are of sedimentary origin, ranging in geological age from Cambro-Silurian to Carboniferous, and consist of limestones, sandstones, and shales. The limestones have given rise to the Hagerstown series with five soil types represented. The sandstones and shales have formed the Dekalb and Upshur series. Another series occurs in the Barrens, the geological history of which is little known. These are poor, unproductive soils. The sandstones and conglomerates, besides giving a number of soil types, form considerable areas of Rough stony land, which are of no

use agriculturally except for pasturage. Two other miscellaneous types having descriptive names are Swamp and Meadow. The bottom land soils represent two series, viz, Huntington and Moshannon. In all 30 types of soil, including as types Rough stony land, Meadow, and Swamp, were recognized.

The limestone or Hagerstown soils are recognized as the strongest and most productive soils of the county. The soils of the Upshur series are next in favor, and, besides being productive of the same general field crops as the limestone soils, are considered especially well adapted to fruit growing. The Dekalb soils as a class are considered poor soils. They are devoted to the same crops as the soils of the other series. The soils of the Morrison series are not extensive and are of little farming value.

Crop rotation is followed quite generally throughout the county. It consists of corn, wheat, oats, and grass cut for hay two seasons and then pastured for a year or two. Commercial fertilizers are used, supplementing barnyard manure and the clover crop. Liming is quite generally practiced.

The farming class in Center County is in a fairly prosperous condition. The wagon roads are good and railroad facilities excellent. There is a strong demand for all the products of the farms in the nearby towns. Modern means of communication, rural free delivery of mail, and rural telephone lines are available throughout the county. The section affords exceptional educational advantages.

Some improvement could be made in the dairy business by weeding out the unprofitable cows and by making more use of soiling crops. In general, the practice of green manuring to improve the soils should be extended. There is room for the extension of special forms of farming and horticulture. Fruit growing and the production of truck are perhaps the most profitable lines awaiting development.

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