U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE MARYLAND GEOLOGICAL SURVEY, EDWARD BENNETT MATHEWS, STATE GEOLOGIST; MARYLAND AGRICULTURAL EXPERIMENT STATION, H. J. PATTERSON, DIRECTOR.

SOIL SURVEY OF FREDERICK COUNTY, MARYLAND.

BY

W. J. LATIMER, IN CHARGE, AND R. T. AVON BURKE, OF THE U. S. DEPARTMENT OF AGRICULTURE, AND O. C. BRUCE, OF THE MARYLAND AGRICULTURAL EXPERIMENT STATION.

W. EDWARD HEARN, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1919.]

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., January 11, 1922.

SIR: I have the honor to transmit herewith the manuscript report and map covering the survey of Frederick County, Maryland, and to recommend that they be published as advance sheets of Field Operations of the Bureau of Soils, 1919, as authorized by law.

This work was carried on in cooperation with the Maryland Geological Survey, Edward Bennett Mathews, State Geologist; Maryland Agricultural Experiment Station, H. J. Patterson, Director.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. H. C. WALLACE,
Secretary of Agriculture.

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SOIL SURVEY OF FREDERICK COUNTY, MARYLAND.

By W. J. LATIMER, In Charge, and R. T. AVON BURKE, of the U. S. Department of Agriculture, and O. C. BRUCE, of the Maryland Agricultural Experiment Station.—Area Inspected by W. EDWARD HEARN.

DESCRIPTION OF THE AREA.

Frederick County is located in the north-central part of the State of Maryland, 42 miles west of Baltimore and 52 miles northwest of Washington, D. C. It joins the State of Pennsylvania on the north and is separated from the State of Virginia by the Potomac River on the southwest. It is irregular in shape and is 35 miles in its greatest length north and south and 25 miles east and west. The included area is 663 square miles, or 424,320 acres.

The area lies in both the Appalachian region and the Piedmont Plateau region. The former occupies the country lying west of a general northeast-southwest line passing through the center of the county and a small detached area in the extreme southeastern corner of the county. The Appalachian region is characterized by high parallel mountain ranges and intervening valleys. The mountains stand out abruptly from the surrounding country and represent the most prominent physiographic features of the county. The Piedmont Plateau region includes a broad, smooth valley, flanked on the south and east by the plateau proper, which comprises an extensive area of low ridges and irregular-shaped hills.

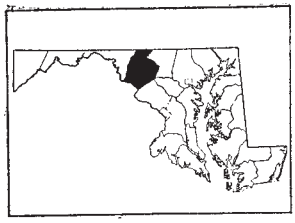

FIG. 1.—Sketch map showing location of the Frederick County area, Maryland.

The principal mountains are South Mountain, which extends along the entire western boundary of the county, and Catoctin Mountain, which, paralleling South Mountain at a distance of about 8 miles, extends from the Potomac River to the Pennsylvania line. Between these mountains lies the Middletown Valley, which is 500 to 1,000 feet below their crests. This valley is 15 miles long, beginning at the Potomac River and extending northward. It averages 7 miles wide, converging to a point at the northern end. The surface is fairly smooth and is cut by shallow V-shaped stream valleys. Near the northern end the topography is more rolling, the swells rising

gradually and merging into the broken mountain country which unites South Mountain with Catoctin Mountain. This region is known as the intermountain country. While these mountains rise higher, their sides are fairly smooth and less steep than those of either of the bordering ranges. This region is interspersed with a number of small valleys of fairly smooth topography. Harbaugh Valley, the largest of these, lies about 800 feet below the surrounding mountains. Its average width is three-fourths mile and its length 3 miles.

South Mountain is comparatively narrow and ridgelike throughout its entire length. The sides are steep and the comb fairly regular in its southern half, while the northern half has an irregular-shaped crest and the sides are less steeply sloping. Catoctin Mountain, throughout its southern reaches, is a low ridge which is fairly smooth on its western side but has a number of short spur knobs extending from the eastern side which have a steep and broken topography. The mountain broadens out and becomes much higher north of Braddock Heights, with steep sides but a fairly smooth top. North of Five Forks the mountain takes the form of a double range, the back mountain being known as Second Mountain. The extreme northern end of the Catoctin range is broken by stream gorges which have steep sides, and the range ends in a series of semidetached knobs.

A well-defined range of foothills about 1 mile wide extends along the eastern base of Catoctin Mountain south from Yellow Springs. These hills lie about 600 to 1,200 feet below the mountains behind them. The topography is rolling to hilly and the slopes are comparatively smooth.

East of these foothills lies the Monocacy Valley, which is 150 to 200 feet lower than the Middletown Valley. It extends from the Potomac River to the Pennsylvania line and has an average width of 5 miles, broadening to 7 miles near the center of the county. The valley is divided into two parts. The lower part, or Frederick Valley, is separated from the upper part by a well-defined escarpment and lies about 100 feet lower than the latter. The Frederick Valley is about 3 miles wide and extends from the Potomac River to just north of Woodsboro. It has a uniformly smooth surface, with broad, shallow stream valleys. The surface of the northern part of this valley, while comparatively smooth, is more strongly rolling than the lower end, and is somewhat hilly along the escarpment. The streams have shallow valleys. The surface of the valley is broken only by a few low, narrow ridges north and east of Emmitsburg. Rocky Ridge extends south from these hills through Woodsboro and merges with the Linganore Hills. Minor ridges of the same character are found paralleling Rocky Ridge on the east. These ridges are

narrow, averaging less than one-fourth mile in width, and stand 50 to 100 feet above the valley floor.

Bordering the Frederick Valley on the east is a well-defined series of closely parallel ridges, extending from its northern end to the Potomac River. The ridges stand about 150 to 200 feet above the valley, have comparatively steep sides, and only in a few places slope gently to the valley. The ridges are separated by narrow valleys about one-fourth mile wide.

Back of these ridges stretch the Linganore Hills, extending to the county line on the east. They represent an irregular hilly country, with fairly smooth slopes, and a uniform crest line that rises gently to the east. The hilltops stand about 200 to 300 feet above the level of the Monocacy Valley. Sugarloaf Mountain, in the southeastern corner of the county, stands about 500 to 800 feet above the surrounding country and is the most prominent physiographic feature of this section.

The mountain ridges in general have steeply sloping sides and a decidedly uneven crest line, broken by low gaps and in places by stream gorges. Several peaks stand out prominently. Of these Lambs Knoll and Monument Knob, of the South Mountain Range, and Pine Rock, High Knob, Salamander Rock, Eagle Mountain, and Carrick Knob, of the Catoctin Mountain Range, are the most noticeable.

The areas of bottom land along even the larger streams are narrow, nowhere exceeding one-half mile in width. The terrace development is limited. A few small sinks are found in the limestone valley (Frederick Valley) and in the Monocacy Valley where it is underlain by limestone.

The elevations vary between wide limits, ranging from 200 feet above sea level at the junction of the Potomac and Monocacy Rivers, at the extreme southern point of the county, to 1,890 feet at the highest point on Second Mountain in the northwestern part of the county. Middletown Valley ranges from 450 to 500 feet above sea level in the southern end to 600 to 700 feet in the northern end. The average elevation of the Monocacy Valley ranges from 300 to 350 feet in the southern part to 400 to 500 feet in the northern part. These elevations show the general slope to be to the south with the direction of the main drainage.

The area is drained by two stream systems—the Monocacy River and Catoctin Creek. Both of these streams flow in a southerly direction into the Potomac River. A small area in the southern part of the Frederick Valley is drained directly into the Potomac River through Tuscarora Creek. Catoctin Creek drains the Middletown Valley. The remainder of the county is drained by the Monocacy River and its tributaries. This stream flows through the center of

the county. Its largest tributaries entering from the east are Bennett, Bush, Linganore, and Israel Creeks, and from the west Ballenger, Carroll, Tuscarora, Fishing, Hunting, Owens, and Toms Creeks.

Practically all the county is well drained, only a few spots in the vicinity of Lewistown and Thurmont being poorly drained. Along the smaller streams swamp conditions may exist for short distances. Streams ramify all parts of the upland except the mountains, where steep rocky gulches serve as drainage ways. Numerous springs are found in the valleys along the base of the mountains.

Over most of the county the streams have cut well down to base level. In some of the mountain regions the streams are still actively engaged in deepening their channels. The streams of the Middletown Valley have cut down 150 to 200 feet below the level of the valley, those of the upper Monocacy Valley flow in channels 50 to 150 feet, and those of the Frederick Valley, 50 to 100 feet below the general level of the valley floors. The streams in the Linganore Hills also flow in channels, 150 to 250 feet below the level of the plateau.

The Potomac River has a drop of about 2 feet per mile, and the Monocacy River of about 3 feet per mile throughout its course of 60 miles through the area. The streams of the Monocacy Valley have sluggish currents, while those of the Middletown Valley are fairly swift. There are very few shoals or rapids and no abrupt drops in the main streams. Only where the streams break from the intermountain region to the Monocacy Valley are abrupt waterfalls encountered. These occur on small streams that have not sufficient volume for power development.

No large water-power plants are located in the county; a few small plants furnish electric current locally. A number of mills are found along the smaller streams where they descend from the general level of the valleys to the main streams. The fall is not great and the volume of water small, so the power developed is small. Most of these mills are used for grinding grain and have been in operation for over a century.

Frederick County was established in 1748, and at that time comprised much more territory than now. It was finally reduced to its present boundaries in 1836, when a part was taken to form Carroll County.

Frederick County is part of the grant to Lord Baltimore. In 1730 the lord proprietor offered special inducements to attract settlers to this region. Many English from the tidewater country of Maryland, taking advantage of this opportunity, obtained large tracts of land in the Monocacy Valley. Much of this land was later sold to German settlers. In 1733 a party of Germans from Pennsylvania settled on the Monocacy River. During the next

15 years many more Germans came from Pennsylvania. Although the majority of the early settlers were German, many English and Scotch-Irish also settled in the county. The English came mostly from Maryland and Virginia by way of the Potomac River and took up lands in the southern part of the county. The Scotch-Irish came from Pennsylvania. Later German and Irish immigrants came direct from Europe. The early settlers were industrious and soon brought a large area of land under cultivation and built a number of towns. Frederick was laid out in 1745.

The population of Frederick County, according to the 1920 census, is 52,541. It consists largely of the descendants of the original settlers. The negro population comprises only 9.1 per cent, and the foreign-born population is very small. Of the total population 71.5 per cent is classed as rural. The urban population lives in Brunswick and Frederick. The greater part of the population is engaged in agricultural pursuits. The density of population of the rural districts is 56.7 persons per square mile. The Monocacy Valley is the most thickly populated and the mountain districts in the northwestern part of the county are the most thinly populated parts of the county.

Frederick, the county seat, is located in the south-central part of the county. It has a population of 11,066 and is the largest and most important town in the county. It has a number of manufacturing enterprises and good banks, and is the center of a well-developed farming section.

Emmitsburg, situated in the northern end of the Monocacy Valley, has a population of 940. Thurmont, situated at the eastern base of Catoctin Mountain, on the Western Maryland Railroad, has a population of 1,074, Brunswick, on the Baltimore & Ohio Railroad in the southwestern corner of the county, has a population of 3,905. The Baltimore & Ohio Railroad shops are located here. Middletown, with a population of 749, is located near the center of the Middletown Valley. Each of these towns provides a market for a prosperous farming region.

Walkersville and Woodsboro are located in the Frederick Valley and Myersville and Jefferson in the Middletown Valley. These are small incorporated towns that are the centers of thriving agricultural communities. Other smaller towns are Libertytown, New Market, Adamstown, Buckeystown, Point of Rocks, and Burkittsville.

Frederick County is well supplied with transportation facilities. The Baltimore & Ohio Railroad extends east and west through the southern end of the county. A branch line extends from Frederick Junction to Frederick, a distance of about 3 miles. The Metropolitan Branch of this system runs from Washington Junction to Washington, D. C. The Western Maryland Railroad crosses the north-

central part of the county, with a branch line from Rocky Ridge to Emmitsburg. A branch of the Pennsylvania Railroad comes in from the northeast and runs to Frederick.

The Hagerstown & Frederick Electric Railroad extends west from Frederick to Middletown and across South Mountain to Hagerstown. A branch line runs from Braddock Heights to Jefferson, another branch line extends north from Frederick to Thurmont, where it connects with the Western Maryland Railroad. The Chesapeake & Ohio Canal passes through the southern end of the county along the north bank of the Potomac River. It was an important freight carrier at one time and is still used to a limited extent in transporting farm products.

Frederick County has an excellent system of highways. There are aproximately 100 miles of hard-surfaced State roads, and over 100 miles of macadam county roads and pikes. The dirt roads are in good condition most of the year. All sections of the county are reached by rural mail delivery routes. Telephones are in general use in all but the mountain districts. Good schools and churches are found in all parts of the county.

Frederick is the principal local market for farm products, especially wheat, sweet corn, and truck crops. The smaller towns handle their share of this traffic. Baltimore and Washington are the principal outside markets for dairy products, poultry, eggs, pork, beef, lambs, sheep, and orchard fruits. Baltimore is the chief market for purchasing supplies.

CLIMATE.

Frederick County has a temperate humid climate. The winters are cold but not severe, and the summers are warm but seldom marked by protracted hot spells.

The mean annual temperature of the area is 53° F., taking the average as shown by the records of the Weather Bureau stations at Frederick and Emmitsburg. The absolute maximum temperatures, as recorded by these stations, respectively, are 104° F. and 102° F.; and the absolute minimum, —21° F. and —23° F.

The mean annual rainfall of 42.06 inches is well distributed throughout the year. The heaviest precipitation is during the summer months, when needed by the growing crops. The rainfall in the driest seasons is adequate for crop production if favorably distributed, but crops sometimes are damaged to some extent by droughts.

The average dates of the latest killing frost in the spring at Frederick and Emmitsburg are, respectively, April 22 and April 6, and the average dates of the earliest in the fall are October 19 and November 7. The active growing season, which is the period between

the last killing frost in spring and the first in fall, averages 180 days at the Frederick station and 215 days at the Emmitsburg station. The Frederick station is located 275 feet above sea level and is fairly representative of the Monocacy Valley. The Emmitsburg station is located 720 feet above sea level, 250 feet above the valley on the base of Carrick Knob. The frost data would indicate that there is a thermal belt along the base of the mountains which is immune from frost for about a month longer than the valley region. The season in the Middletown Valley and Harbaugh Valley is conceded to be about one week later than in the Monocacy Valley. This is noticeable in the planting time in spring and in the wheat harvest. The mountain region lies much higher, and there is evidence that the climatic conditions differ to some extent from those of the valleys, but no definite data bearing on this question are available.

The climatic conditions of the county make it well suited to general farming, stock raising, and orcharding. The following tables give detailed climatic data for the area:

Normal monthly, seasonal, and annual temperature and precipitation at Frederick.

[Elevation, 275 feet.]

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1856).	Total amount for the wettest year (1889).	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	34.5	70	−12	3.18	2.48	0.66	4.7
January	32.1	73	−21	3.20	4.79	3.87	7.8
February	32.6	72	−12	2.98	1.16	2.18	10.8
Winter	33.0	73	−21	9.36	8.43	6.71	23.3
March	41.7	90	8	3.23	1.78	5.16	4.1
April	49.0	98	22	3.35	2.90	3.41	0.4
May	63.6	97	30	3.79	3.09	9.51	T.
Spring	51.4	98	8	10.37	7.77	18.08	4.5
June	71.6	100	38	4.41	2.15	3.43	.0
July	76.2	104	49	4.04	2.83	7.60	.0
August	73.8	104	45	3.63	3.74	1.11	.0
Summer	73.8	104	38	12.08	8.72	12.14	.0
September	67.0	97	31	3.22	1.44	4.06	.0
October	55.5	91	23	2.67	1.85	4.51	T.
November	43.9	80	7	2.51	2.44	6.33	1.2
Fall	55.4	97	7	8.40	5.73	14.90	1.2
Year	53.4	104	−21	40.21	30.65	51.83	29.0

Normal monthly, seasonal, and annual temperature and precipitation at Emmitsburg.

[Elevation, 720 feet.]

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year (1879).	Total amount for the wettest year (1889).	Snow, average depth.
	°F.	°F.	°F.	*Inches.*	*Inches.*	*Inches.*	*Inches.*
December	33.1	75	0	3.23	4.72	1.82	5.8
January	32.6	70	−23	3.36	1.77	4.84	9.5
February	31.7	64	−15	3.20	1.63	1.24	11.5
Winter	32.4	75	−23	9.79	8.12	7.90	26.8
March	39.9	89	2	4.12	3.08	6.04	7.0
April	51.8	92	20	3.36	2.88	4.17	0.5
May	62.0	97	32	4.10	4.26	10.20	.0
Spring	51.2	97	2	11.58	10.22	20.41	7.5
June	69.7	97	42	4.10	2.16	5.10	.0
July	75.5	102	50	3.96	1.57	9.50	.0
August	72.7	101	50	4.08	4.39	2.00	.0
Summer	72.6	102	42	12.14	8.12	16.60	.0
September	65.6	96	36	3.57	2.17	6.45	.0
October	54.7	90	24	3.64	0.77	3.38	T.
November	42.9	77	12	3.20	2.43	6.63	1.4
Fall	54.4	96	12	10.41	5.37	16.46	1.4
Year	52.6	102	−23	43.92	31.83	61.37	35.7

AGRICULTURE.

Frederick County has been essentially an agricultural county from its early settlement. The Frederick Valley was the first part of the county cleared and put under cultivation, and was the first to reach its full agricultural development. The Upper Monocacy Valley was next, followed by the Middletown Valley. The early chronicles state that the yields were good, especially in the Frederick Valley. The chief crops of this early period were wheat, corn, rye, and tobacco. Tobacco was introduced from Virginia and grown mostly in the southern part of the county. New land was put in tobacco or corn, and followed by wheat. The native grasses furnished good grazing, but little hay was cut. The German farmers held that corn was exhaustive to land, and grew mostly wheat, which soon became the leading crop. In 1790 Frederick County was the leading wheat-producing county in the State. The crop was milled in the county and the flour shipped down the Potomac River to Georgetown and to

Baltimore. In 1800 about 80 new flour mills were in operation on the Monocacy River and its tributaries. Wheat continued to be the leading crop and was not abandoned even after the opening of the wheat lands of the Western States. The Linganore Hills region was later in developing than the valleys, and was backward until the introduction of the practice of liming and the use of commercial fertilizers some 40 years ago, when this region began to develop rapidly.

According to the census of 1880, wheat was grown in 1879 on 83,767 acres; corn, 52,002 acres; hay, 38,416 acres; oats, 5,651 acres; rye, 4,013 acres. There has been little change in the acreage of these crops since that time, the decennial census reports showing minor fluctuations in most of them.

Cattle were raised for beef, and fattening beef cattle for market was developed to some extent at one time, especially in the Middletown Valley. This has given way in recent years to dairying.

Frederick County is the best developed agricultural county in the State and ranks among the best of the Eastern States. It is essentially a wheat and corn country, these two crops occupying an acreage double that of all other crops. Hay is another crop of importance. Rye, oats, buckwheat, tobacco, potatoes, and vegetables are the minor crops. Dairying is highly developed, with other branches of the live-stock industry subordinated. Orcharding and trucking are relatively important.

About 50 per cent of the farm income is derived from crops, 45 per cent from live stock, and 5 per cent from other sources, including orchard products. The income from crops is divided as follows: 8 per cent corn, 12 per cent sweet corn, 27 per cent wheat, 2.5 per cent hay, 0.5 per cent potatoes. From live stock: Cattle 35 per cent, poultry 5.6 per cent; hogs 2.3 per cent, sheep 0.3 per cent, and horses 1.8 per cent.[1]

Wheat, the largest and most important crop, is also the main cash crop. In 1919, 94,591 acres were in this crop, yielding 1,445,072 bushels. Most of the crop is sold to local mills. Bearded varieties are most commonly grown. Wheat is more extensively grown in the Frederick and Monocacy Valleys than in other parts of the county.

Corn, the next crop in importance, was grown upon 57,659 acres in 1919, yielding 1,738,891 bushels. A small part of this crop is sold in the local markets, the remainder is fed to work stock and hogs. A considerable area of corn is grown for ensilage, which is used in feeding dairy cows and in wintering beef cattle. White and yellow dent corns are the common varieties. Most of the corn grown for grain is yellow dent. Corn occupies a part of every farm in the county. Sweet corn is grown upon a large acreage in the Frederick

[1] Data supplied by the county agent.

Valley and to some extent in the Middletown Valley. Tne product is sold to canneries and is one of the main cash crops. The stalks are fed to stock.

The hay crop stands third in importance. Tame grasses in 1919 occupied 44,959 acres, from which 51,708 tons of hay were harvested. Timothy and clover mixed occupied almost two-thirds of the total acreage—to be exact, 28,596 acres—timothy alone 10,361 acres and clover alone 4,945 acres. Small acreages of alfalfa, millet, and other tame or cultivated grasses make up the remainder. The bulk of the clover is red clover, but there is some crimson clover and alsike clover. Cowpeas and soy beans are grown to a small extent. At the present time alfalfa occupies a larger acreage than cowpeas or soy beans. It is planted mostly on the soils of the limestone valleys, and to a lesser extent in the Middletown Valley. Corn was cut for forage on 47,116 acres in 1919. This shows a remarkable increase in the last 10 years; there were 3,101 acres in all coarse forage, including corn, in 1909.

Practically all the hay is fed to work stock and cattle upon the farms, a small part being disposed of in local markets.

Rye was grown in 1919 on 2,795 acres, producing 34,947 bushels. Oats were grown on 3,024 acres, producing 56,179 bushels. Most of the oat crop is grown in the mountain region. This part of the county is too cold for winter oats, and the valley region is considered too warm for spring oats.

Potatoes were grown in 1919 upon 2,440 acres, and yielded 331,593 bushels. The crop is sold mainly in the local markets. All other vegetables, including sweet potatoes, occupied 6,545 acres in 1919.

There are in the county only a few farms engaged exclusively in trucking. These are in the vicinity of Frederick. Nearly every farm raises enough vegetables for home use, and on some there is a surplus which is sold in the local markets and to canneries. There are 10 canneries in the county which pack sweet corn, tomatoes, and pumpkins.

A little tobacco is grown in the country immediately bordering Montgomery County. The census reports 108 acres in this crop in 1919, yielding 88,695 pounds. The leaf is suitable for use in the manufacture of smoking tobacco and with the product of southern Maryland counties goes into the export trade.

Dairying is one of the most important industries in the county, and has developed rapidly in recent years. It is given most attention upon the farms of the Monocacy Valley and in the vicinity of convenient shipping points. Whole milk, the principal product, is shipped to Washington and Baltimore. In the Middletown Valley, and in more level parts of the intermountain country, there are cream routes, and a creamery is located at Middletown. Nearly all

the farms have a few dairy cows, which produce enough dairy products for home use and a surplus for the local markets. Frederick furnishes a fairly good local market for milk, cream, and butter. Most of the dairy stock is grade Holstein, Guernsey, and Jersey, but there are many purebred herds. According to the 1920 census there are 31,157 dairy cattle in Frederick County, of which 21,710 are milk cows.

Many beef cattle are raised in the county and a still larger number fattened for market. The industry has given way to some extent to dairying, but is still practiced in the Middletown Valley, the lower part of Frederick Valley, the Linganore Hills, and the intermountain country. The number of beef cattle in the county is reported by the 1920 census as 4,276. Improved strains were introduced many years ago, and the native stock consists largely of purebreds or grades of the Hereford and Aberdeen Angus breeds. Many cattle are brought in from adjoining States and fattened for market. Some of the beef cattle are disposed of upon the local market or to the packing house at Frederick. Most of it is shipped to Baltimore.

Hogs are kept on every farm. The principal breeds represented are Chester White, Duroc-Jersey, Berkshire, and Poland-China. They are used to supply home needs or sold in the local markets. The 1920 census reports 33,994 hogs on the farms in 1919.

In 1920 there were 4,441 sheep in the county. Most of these are in the intermountain region and on the farms that have considerable bottom land. Sheep are mainly of the mutton breeds. They are sold locally and in Baltimore.

The work stock consists almost entirely of horses. These are raised upon the farms in sufficient numbers to supply local demands and a small number for sale. Percheron or Belgian stallions are used. The brood mares are used for work, and horse raising is merely an adjunct to general farming. The number of horses upon the farms, according to 1920 census, is 16,514.

Relatively little land is in permanent pasture. It consists of marshy areas along the smaller streams and of poorly drained flats or glade lands along the base of Catoctin Mountain, where native swamp grasses flourish, and of areas in the intermountain region where bluegrass comes in naturally. Pasturage is supplied mainly by hay land which is used for pasture after the timothy begins to fail.

Poultry is kept on nearly every farm, and much attention is given to poultry raising, especially upon the smaller farms, where the sale of poultry and eggs is one of the principal sources of income. White Leghorn, Rhode Island Red, Buff Orpington, and Plymouth Rock are the chief breeds of chickens. A few turkeys, guinea fowls, and ducks are kept.

Fruit growing is carried on in connection with general farming, nearly every farm having a small orchard. Commercial orcharding is not developed and only a few orchards are large enough or receive the attention to warrant their being classed as commercial. Most of the orchards of any size are found in the Linganore Hills, upon the ridges on each side of the Frederick Valley, along the base or foothills of the eastern slope of the Catoctin Mountain, and in the intermountain region. According to the census, 133,762 apple trees yielded 129,536 bushels in 1919, 90,274 peach trees yielded 21,925 bushels, 8,002 pear trees yielded 10,207 bushels, 6,201 cherry trees yielded 2,842 bushels, and 5,202 plum trees yielded 3,023 bushels. Apples and peaches are about the only fruit grown in sufficient quantity to ship. Among the varieties of apples are York Imperial, Ben Davis, Grimes, Yellow Transparent, Oldenburg, Jonathan, Delicious, Gano, and Stayman Winesap. The leading varieties of peaches are Elberta, Heath, Crawford, Carman, Champion, and Smock. Most of the fruit is marketed fresh. Grapes are not grown commercially. The census reports 10,560 vines for 1919, which produced 250,388 pounds of grapes.

The following table gives the value of farm products of Frederick County for the year 1919:

Value of farm products in 1919.

Products by classes.	Value.	Products by classes.	Value.
Cereals	$6,040,498	Live stock and products—Contd.	
Other grains and seeds	83,721	Poultry and eggs	$1,220,482
Hay and forage	2,365,670	Wool	12,138
Vegetables	1,420,396	Honey and wax	6,182
Fruits and nuts	320,730		
All other crops	29,894	Total	15,418,035
Live stock and products:			
Animals sold or slaughtered	[1] 1,647,361		
Dairy products (excluding home use)	2,270,963		

[1] Income from this source is not reported in the 1920 census. These figures are only approximate. They are based upon the assumption that the income from this source in 1919 had the same relation to the total value of domestic animals as it had in 1909.

The general farm crops do not differ much in different parts of the county; only the proportional acreage of the important crops and the minor crops vary. This variation shows relations with differences in physiography, topography, or soils. Wheat is grown upon a larger acreage in the Frederick Valley than in any other part of the county. More hay is grown in the upper Monocacy Valley. Corn occupies a relatively larger acreage in the Middletown Valley than in the Frederick Valley, and less corn is grown in the Linganore Hills than in the Frederick Valley. Oats are grown more extensively upon

the mountain ridges and in the intermountain region. Buckwheat is grown almost exclusively upon the mountain land. Orchard development has been mainly upon the ridges in the Linganore Hills, in the foothills along the eastern base of Catoctin Mountain, and in the intermountain region. Much of the mountain land, owing to its steep and broken topography, is unsuited for crop production.

These general differences are usually recognized by the farmer, but the difference in the adaptability of individual soils is not so readily conceded. The limestone valley land (Hagerstown and Frankstown) is recognized as strong land, well suited to general farm crops, especially wheat and corn. The soils of the Middletown Valley (Ashe loam and silt loam) are considered strong land, especially by the residents of this section, and this valley is usually considered better for corn and clover than the other sections of the county. The Linganore Hills region (Manor and Chester soils predominating), locally called "chestnut land," is recognized as being light, and not as productive as the heavier valley soils, unless heavily fertilized. The soils of the intermountain region (Ashe gravelly loam, stony loam, and Porters silt loam and stony loam) are considered the best for apples. The Cardiff slate loam ridges and the Murrill and Dekalb soils along the base of Catoctin Mountain are the best for peaches. Crops are not restricted to the soils to which they are best adapted, but as a rule the various crops have their best development on such soils.

The methods or farm practices do not differ very much throughout the county. The larger farms have a greater proportion of land in crops. This is due in a measure to the fact that many of the large farms in the southern part of the county are rented and the rented farms invariably have a larger acreage in crops. The medium-sized farms are devoted more to dairying and the smaller farms to truck crops, hogs, poultry, and fruit.

Sod land is usually turned for corn in the fall, 7 to 9 inches deep, and left during the winter; in the early spring it is harrowed to check evaporation. When plowing is done in the spring, the fields are dragged with a plank drag and harrowed at least twice before planting. Planting is done with a 2-row planter, in rows 40 to 42 inches apart. A smoothing harrow is used before or soon after the plants come up. Cultivations are made with 1-row walking or 2-row sulky cultivators. The crop is usually cut by hand and set up in shocks in the field in rows, about 32 shocks to the acre. Wheat is planted between these rows. The corn is husked later and the shocks removed when convenient. The strips occupied by the corn shocks are seeded to oats in the spring, and clover is seeded at the same time. The corn used for ensilage is often cut with a corn

cutter and binder. This machine is used to some extent upon mature corn during labor shortages. The extensive production of sweet corn is made possible by the fact that it is pulled green and is out of the way before the corn harvest begins. The shucks are hauled from the canneries and fed to cattle.

Winter wheat is grown exclusively. When wheat follows corn the land is usually disked; when it follows wheat the land is plowed 5 or 6 inches deep, harrowed until in good tilth, and usually rolled to secure a firm seed bed. The crop is planted with 11-foot drills. It is rolled in the spring to pack around the roots the soil loosened by freezing. It is harvested in late June with reaper and binder and set in shocks in the field. Wheat is threshed from stacks in the open by itinerant threshing outfits.

Timothy is sown with wheat when it is to be followed by grass, and red clover is sown broadcast over the wheat field in spring. In some cases the timothy is omitted in the fall and clover is sown in the spring. In these cases the rotation is shortened by turning the clover stubble in the late fall and starting the rotation again by planting corn in the spring. When the timothy and clover are sown with the wheat, the clover is cut the first season and dies out by the second season, when the timothy comes in strong enough to cut for hay. The mowings are used until the timothy begins to fail or the percentage of weeds gets too great for good hay, when the field is used for pasture or plowed and planted to corn. Bluegrass is seeded with the timothy when permanent pasture is desired, which is seldom done in the valley region, but is sometimes done in the mountain region or upon the bottom land. The hay, which usually consists of good clover or timothy, is harvested with a mower, cured in the field, and stored in barns. Very little hay is stacked in the fields. Millet is often grown when the hay crop is short.

This section is too cold for winter oats, and all but the mountain sections are considered too hot for oats to reach their best development. Spring oats are grown. Rye is sometimes sown in the late fall. Cowpeas, vetch, or buckwheat sometimes follow rye.

A 5-year rotation, corn 1 year, wheat 2 years, hay (timothy and clover) 2 years, is in general use upon the farms of the county. This is sometimes extended to 7 years by using the field for pasture. A 4-year rotation is practiced by some farmers, especially on dairy farms, where the second year of wheat is omitted. Upon some of the farms, especially in the Middletown Valley, a 3-year rotation is used consisting of corn, wheat, and clover. There seems to be a tendency toward the shorter rotations, usually by growing wheat only one season and allowing the mowings to stand only two seasons.

The farm buildings are good, and adequate for the type of farming. The dwellings are large, many of them built of brick or stone.

The barns are large, usually having stone basements for stock and a superstructure for storing hay and other farm crops, machinery, and supplies. The other outbuildings are usually large. Silos are numerous throughout the county, and many of these are of hollow-tile construction. Improved labor-saving machinery is in common use. There are many tractors in use, and the number is increasing. Most of the farms have reapers and binders, mowers, corn cutters, manure spreaders, hay tedders, hay rakes, turning plows, grain drills, corn planters, cultivators, disk plows, disk harrows, spike-tooth and spring-tooth harrows, double-disk plows, drags, rollers, and disk rollers. Large wagons with broad tires are in common use.

The work stock consists of medium-sized draft horses. Three to five are generally used with wagons. Two to four are used with turning plows, and four to six with binders and reapers.

The available manure is usually applied to sod land before it is turned. Commercial fertilizer is not in general use for corn, only about one farmer in twenty adhering to the practice of fertilizing for corn. Practically all the fertilizer bought is used for wheat. Uusually 250 to 350 pounds per acre is applied. Less is used for wheat when it is to be followed by wheat and more when grass is to follow. Acid phosphate (14 per cent) and bone meal (analyzing about 10 per cent phosphoric acid and 2 per cent nitrogen) are in common use. A special mixture of fertilizer is used for tobacco. Some acid phosphate of a higher grade (16 per cent) is used on wheat preceding grass. Fertilizers have been in use for 40 years or longer. The census of 1880 reports $305,038 spent for fertilizer in 1879. The census of 1920 reports 84.9 per cent of the farms using fertilizer, with a total expenditure of $417,504. Liming has been in general practice for 25 or 30 years. At the present time burnt lime is applied at the rate of 25 to 75 bushels per acre, with an average of about 35 or 45 bushels, once during each rotation. A number of lime quarries furnish limestone, which is burnt upon the farms, and several large plants are producing agricultural lime.

According to the census, 74.7 per cent of the farms reported an expenditure for labor in 1919 of $1,613,023. This is considerably more than double the amount expended in 1909. At the present time (1919) farm labor is scarce and high, much of the efficient labor being attracted by the high wages paid in other industries. The prices range from $2.50 to $3 a day, with two meals, $45 to $60 per month without board, $30 to $45 with board. Higher wages are paid in harvest season. As much as $5 a day or 10 to 12 cents per shock was paid for cutting corn during the last season. High wages have resulted in much of the farm work being performed by the farmer and his family, in the purchase of more improved machinery, and in a slight curtailment of some forms of agriculture. The laborers

are mostly native-born whites, with a number of negro laborers upon the farms in the southern part of the county. The farm labor is fairly efficient.

The average size of farms, as given in the last five decennial census reports, show a gradual decrease; from 105 acres in 1880 to 95.5 in 1919. Very few farms in the county contain more than 500 acres. The greater number in the valley sections range in size from 50 to 250 acres. The manor farms in the southern part of Frederick County are fairly large and represent the only large farms found in the well developed part of the county. There are some large holdings in the mountain section, and many very small farms along the base of the mountains.

In the Frederick Valley many of the farms are rented, but over the remainder of the county most of the farms are operated by the owners. According to the census, 27.7 per cent of the farms are operated by tenants. This is more than in 1880 but less than in 1910. Nearly all the manor farms are rented.

There is very little land rented for cash, as this system gives the owner little control or supervision of the farm. Most of the farms are rented on the crop-share plan. The terms of the leases vary, but they usually provide for an equal division of the proceeds. The owner furnishes land, half the fertilizer and half the seed, and receives half the corn and wheat, and half the increase of cattle where they are kept. Hay is fed to work stock and cattle and the manure is returned to the farm. In case of cash rent the owner furnishes lime. Cash rents vary from 3 to 5 per cent of the farm value. A number of the better class of tenants lease for a term of 4 or 5 years.

As reported by the census, there are 3,817 farms in the county. These occupy 85.9 per cent of the area of the county, and 80.5 per cent of the land in farms is classed as improved. The value of all farm property is placed at $10,880 per farm. Of this valuation, 53.2 per cent is represented by the land, 27.5 per cent by the buildings, 6.4 per cent by machinery, 12.9 per cent by domestic animals.

The selling price of farm land in the Frederick Valley at the present time (1919) is $200 to $350 an acre, with an average for the better farms of $250 an acre; in the upper Monocacy Valley, $100 to $250 an acre; in the Middletown Valley, $150 to $250; in the Linganore Hills, $50 to $65 for the poorer grades of land and $75 to $150 for the better land, with an average of $100 an acre for the better farm land. In the intermountain region the price of land ranges from $100 an acre downward. The price of mountain land with cleared patches is $25 to $35 an acre. The rougher mountain land is valued around $10 an acre.

There has been very little land upon the market, until the recent advance in farm land values. During this year (1919) a large num-

ber of the best farms in the county changed hands at prices 25 to 50 per cent higher than those at which they were formerly held.

SOILS.[2]

The soils of Frederick County are prevailingly light in color, ranging from light brown or yellowish brown to red or reddish brown. All of the mature soils of the county are low in organic matter. This region was forested with hardwoods until reclaimed for agricultural purposes, and the conditions did not favor the accumulation of any great amount of organic matter in the virgin soil, except for an inch or two of leaf mold on the surface, thoroughly incorporated with the mineral constituents of the soil.

A common characteristic of the soils of this county is the absence of free carbonates. In the soil-forming processes lime and other carbonates have not accumulated, and there are no calcareous soils in the county, although the Hagerstown and Frankstown soils are derived from limestone. On the other hand, the soils of the county are not strongly acid in character, though they respond to liberal applications of lime. The absence of free carbonates in the soil is due in a large measure to the climatic conditions, particularly the rainfall and temperature, together with good drainage. The rocks from which many of these soils are derived contain carbonates and all of them contain calcium which under favorable climatic conditions would be converted into carbonates, but under the prevailing process of decay and soil formation the carbonates have not accumulated in the soil.

All the soils of the county respond readily to the application of commercial fertilizers and to the addition of liberal quantities of organic matter, which increases their water-holding capacity and improves their structure. Practically all the soils possess a mellow friable structure and are capable of absorbing considerable quantities of water and storing it for the crops.

In chemical composition the soils of Frederick County are quite similar to those of this general region of the State of Maryland. Many of these soils, particularly the Ashe and Chester, run high

[2] Frederick County joins Montgomery County on the southeast. The soils do not join exactly in a few places along the boundary line. The Penn silt loam in Frederick County is mapped against the Penn sandy loam and Penn loam in Montgomery County, and the Manor slate loam is mapped against the Lehigh loam and the Manor loam. With one exception, these soils that fail to join are of the same series but differ slightly in texture or stone content. The western boundary of Frederick County follows the crest of South Mountain. Along this boundary Rough stony land is mapped in Frederick County against Ashe stony loam in Washington County. This is accounted for by the fact that the eastern slopes of South Mountain are steeper and contain more rock outcrop than the western slopes. The Ashe soils are mapped in Frederick County on the lower slopes of the mountain. The soils of Frederick County do not join those of Adams County, Pa. This is accounted for largely by the fact that the soils in this survey are mapped in greater detail and separated on the basis of finer distinctions than the soils in Adams County, which was surveyed in 1904.

in potash, and there is also a high percentage of potash in the Murrill gravelly loam. Some question may be raised as to the correlation of an area of red soils in the vicinity of Urbana with the Chester loam. This was done because the chemical analysis of this particular soil shows it to contain a much higher percentage of potash than the red soils of the Piedmont region farther south, which have been classed as the Cecil. The Chester loam, red phase, is quite similar in chemical composition to the Ashe loam of the Middletown Valley.

There is a close similarity between the limestone soils of the county, namely, the Hagerstown and Frankstown soils. The Penn soils are developed in the northeastern corner of the county and have a distinct color characteristic—Indian red. The Chester and Manor types, which occupy all of the Piedmont region not occupied by the Penn, are closely related in color, but differ considerably in structure; the Chester types have a fairly compact but friable subsoil, whereas the subsoil of the Manor is distinctly friable and highly micaceous, with a greasy, soft feel. In the Middletown Valley the Ashe soils bear a close resemblance to the well-developed areas of the Chester, while the Porters soils differ from the Ashe in that they are brown to reddish brown in both soil and subsoil. The Chandler and Talladega soils are quite similar and differ chiefly in color. The Dekalb soils occupy mountainous regions and have a structure somewhat different from the other soils of the county. The Montalto and Iredell soils are derived from practically the same kinds of rock, but the Montalto represents a more advanced stage of disintegration, decomposition, and oxidation of the parent material, thus giving it a reddish-brown color as contrasted with the grayish-brown color of the Iredell, while the subsoil of the Montalto is a smooth, friable clay and that of the Iredell is a sticky, impervious clay.

The soils of Frederick County belong to four general divisions—the Appalachian Mountain,[3] the Limestone Valley, and the Piedmont Plateau, the soils of which are residual in origin, being derived from the weathering in place of the rock formations, and the River Flood Plains, which are alluvial in origin. The soils of the Appalachian Mountain region are developed in the western part of the county, and those of the Piedmont Plateau cover the eastern part of the county with the exception of the relatively small area occupied by the Limestone Valley soils in the south-central part of the county. The River Flood Plain soils occupy the overflow land and second bottoms along all the streams in the area. Colluvial

[3] While the mountain ranges in this area are uplifts of the Piedmont region, their soils, because of topographic similarity, are classed with those of the Appalachian Province.

soils are not extensive, occupying small areas in the north-central part of the county. Rough stony land includes rough and stony mountain areas without distinction as to the kind of soil material.

The rocks from which the soils are derived are sedimentary and volcanic in origin. The original rocks have been much altered through folding, pressure, and heat. Some of the formations have been so highly metamorphosed that the original structure has been destroyed and the mineral composition changed. Most of the basic volcanic rocks have assumed a schistose structure, and the acid volcanic rocks are in the form of fissile slates. Only in a few places is the original rock preserved unaltered. The sedimentary rocks have been much altered in places. Sandstones have been changed to quartzites and shales to slates and schists. The limestone in places has been changed to marble. The strata of the sedimentary rocks were originally horizontal, but because of changes due to folding, the rocks outcrop at varying angles. Trap-rock dikes are common in the younger sedimentary formations in the eastern part of the county.

The surface relief varies, depending largely upon the resistance offered by the rocks to erosion. The sandstones and quartzites, being the hardest, are found in the mountain ridges. Most of the schists are soft and break down readily under weathering, permitting the formation of valleys by erosion. The harder schists form hills and fairly smooth, low mountains.

The phyllites, slates, and semicrystalline rocks of the Piedmont Plateau are comparatively soft, giving the fairly smooth topography of the Linganore Hills. Occasionally harder quartzite beds form ridges that stand slightly above the other hills. The red sandstones of the Monocacy Valley are soft and occupy a smooth lowland belt. The limestones, while hard, are partly soluble in water, and the associated shales are very soft. Surface and internal weathering has reduced these formations to the lowest level of any of the upland, and the soils derived from them have a smooth topography. Where a ridgy topography is developed the trend of the ridges is northeast-southwest, with the general direction of the anticlines and synclines of the Appalachian Mountains.

The rocks of the area differ widely in lithological and chemical composition and give rise to soils that differ in physical and chemical properties.

For convenience of mapping and classification the soils having the same origin, color, structure, mode of formation, and general topography, and to some extent a related agricultural value, are grouped in series. The series are divided into soil types—the unit of soil mapping—on the basis of texture, or the proportion of soil particles of various sizes, as gravel, sand, silt, and clay, which compose the type

The soils of the Appalachian Mountain section are derived from two groups of rocks, (1) those on the mountains, represented by sandstones, slates, quartzite, and mica schist, and (2) those between the mountains, represented by schist and granite schist, and by diorite and other basic volcanic rocks.

The soils derived from the first group are developed upon South Mountain, Catoctin Mountain, and Sugar Loaf Mountain. These formations, as a rule, are not deeply weathered; ledges of the parent rock outcrop and fragments appear in the soil and subsoil in the form of stone, gravel, and platy chips. Four soil series are derived from these rocks, the Dekalb, Hanceville, Talladega, and Chandler.

The types of the Dekalb series have gray surface soils and a yellow to yellowish-brown friable subsoil. The stony loam is derived largely from the Antietam and Weaverton sandstone, which in places has been changed into quartzite. The loam is derived from sandstones and Harpers shale. The shale loam is derived from the Harpers shale where it is practically unaltered except by weathering. The soil material is filled with shale chips.

The Hanceville series has types with brown surface soils and a red friable subsoil. The gravelly loam is the only type of this series in the county. It is derived from the Harpers shale, and is found scattered throughout the Dekalb soils.

The types of the Talladega series have grayish-brown or brown to reddish-brown surface soils and a red friable, greasy subsoil. They are derived from metamorphosed shale or mica schist. The silt loam is deeply weathered, having very few fragments of the parent rock, while the slate loam is filled with small soft slate fragments.

The types of the Chandler series have gray to grayish-brown soils and a yellowish-brown to yellow subsoil. The soil is inclined to be fluffy and the subsoil is very friable and has a greasy feel. They are derived from a mica slate in which the mica is finely divided.

The soils weathered from schist, granitic schist, and granite are found in the region lying between South Mountain and Catoctin Mountain, occupying the Middletown Valley and the intermountain region. These soils are usually deeply weathered, but in places the partly disintegrated parent rock is found in the soil section. Fragments of quartz and schist are found scattered upon its surface and throughout the soil mass. Bowlders of diabase and acid volcanic rock are found upon the surface and masses of the original magma protrude in places. These rocks give rise to the soils of the Ashe and Porters series.

The types of the Ashe series have grayish-brown to brown surface soils and a yellow to yellowish-brown friable subsoil. The loam is derived from the granitic schist, and contains some gritty material. The silt loam is derived from the softer schist, and the gravelly loam

is derived from the harder or epidotic schist. The surface contains an abundance of fragments that show the schistose structure, and also fragments of a greenish rock common to the region. The stony loam contains a quantity of bowlders of both diabase and acid volcanic rocks.

The types of the Porters series have brown to yellowish-brown or reddish-brown surface soils and a yellowish-red to reddish-brown friable, but heavy subsoil. These soils are derived from schist containing a relatively high percentage of iron, which imparts the red color. The silt loam is derived from comparatively soft schist. The gravelly areas contain schist fragments and are derived from slightly harder rock. The stony loam is derived from the harder, more resistant diabase rocks, which have been little altered by the forces that have changed most of this formation. Bowlders of the material are commonly found upon the type.

The Limestone Valley soils are located mainly in the Frederick Valley. They are derived from crystalline limestone and calcareous shale. Small detached areas are found along the eastern base of Catoctin Mountain between Lewistown and Mount St. Marys. Still smaller areas derived from crystalline limestone and marble are found scattered between New Market and Union Bridge.

The limestone soils are the residue of the limestone formations after the calcium and magnesium carbonates have been removed by the action of water. The soil accumulations over the limestone bed rock vary considerably in depth even in the same field. As a rule they average deeper than in case of soils derived from sandstone and quartzite, but are shallower than in the soils derived from schist. Three soil series are derived from limestone, the Hagerstown, Frankstown, and Colbert.

The types of the Hagerstown series have brown surface soils and a yellowish-brown to reddish-brown or red compact but friable subsoil. They are derived from limestone containing less chert and shale material than that giving rise to the Frankstown soils. The loam is derived from blue-and-white crystalline limestone and marble. The stony areas are derived from the harder, less soluble limestones, and the gravelly areas from cherty limestone. The sandy loam is derived from a sandy limestone or oolitic limestone.

The Frankstown series consists of types with yellowish-brown or brown surface soils and a yellow or yellowish-red friable subsoil. These soils are derived from highly siliceous limestones interbedded with soft, yellow, calcareous shales. The silt loam is the only type of this series in the county.

The types of the Colbert series have dark yellowish brown surface soils and a yellow, mottled with drab, heavy subsoil. They are derived, under conditions of poor drainage, from siliceous limestone

and calcareous shales. The silt loam is the only type found in this area.

The soils of the Piedmont Plateau region occupy all of the county east of the base of Catoctin Mountain except the relatively small areas occupied by the Limestone Valley soils. The soils may be divided into three groups in point of origin, those derived from the Triassic sandstones and conglomerate; those from phyllites, slates, and schist; and those from trap rock.

The Triassic formation occupies the western part of the Piedmont Plateau region. It covers the upper Monocacy Valley and extends in a narrow strip southward between the Frederick Valley and Catoctin Mountain, with the exception of a break in the formation west of Frederick. The Triassic rocks give rise to four soil series, the Penn, Lansdale, Lehigh, and Athol.

The Penn series includes types with red or Indian-red to reddish-brown soils and a red to Indian-red subsoil. They are derived from a soft red sandstone, blocky fragments of which are scattered throughout the soil and subsoil. In places the partly weathered sandstone comes within the 3-foot section. The loam and silt loam of the series occur in Frederick County.

The types of the Lansdale series have gray to grayish-brown surface soils and a drab-gray to yellow subsoil in places mottled with drab or red. These soils are derived from sandstones and shales and are associated with the Penn soils. The pale color of the subsoil is probably due to poor drainage and a deoxidized condition of the iron. The silt loam is the only type of this series mapped in the present survey.

The Lehigh soils have grayish-brown surface soils and a grayish-brown to yellowish-brown subsoil. They are derived from Triassic sandstone that has been metamorphosed by heat and pressure. The material contains numerous blocky gray sandstone fragments. The gravelly loam is the only type in the county.

The types of the Athol series have brown surface soils and a yellowish-red to red, and in some places a yellow, heavy subsoil. They are derived from the basal conglomerate of the Triassic formation, which consists of a mass of quartz and cherty limestone pebbles embedded in a red calcareous matrix containing some sand. Quartz pebbles are present in large quantities in the soil and subsoil, and here and there the parent rock protrudes from the surface. The gravelly loam is the only type found in this county.

The Piedmont Plateau proper lies south and east of the Monocacy and Frederick Valleys. The rocks outcropping over this region are phyllite, slate, schist, and other semicrystalline rocks. These rocks give rise to the Chester, Manor, Cardiff, and Conowingo series of soils.

The types of the Chester series have grayish-brown to brown surface soils and a firm yellow to yellowish-red subsoil. They are derived from igneous and metamorphic rocks, principally gneiss, granite, and schist. These soils are more deeply weathered than the associated soils. In places, however, they are shallow. A stony loam, gravelly loam, and loam are mapped.

The types of the Manor series have yellowish to grayish-brown to reddish-brown surface soils and a yellow to yellowish-red to red greasy subsoil, which is very friable owing to the presence of finely divided mica. These soils are derived from phyllites, and are the most extensive soils of this region. The slate loam, gravelly loam, and loam of this series occur in the present survey.

The types of the Cardiff series are characterized by the yellowish-brown color of the surface soil, the yellow color of the subsoil, and the substratum of slate. The soil material is derived from a gray slate, which in places resembles an arenaceous sandstone that has assumed a schistose structure through pressure. The slate loam is the only type mapped in Frederick County.

The Conowingo series consists of types with grayish-brown surface soils, a yellow impervious and tough subsoil, and a slate or serpentine substratum. They are derived from acid volcanic rocks that have been metamorphosed into fissile slates. The gravelly silt loam is the only type mapped in this area.

Narrow dikes of trap rock extend through the central part of the Piedmont region, north and south from the Pennsylvania State line in the vicinity of Emmitsburg to the Montgomery County line near Sugar Loaf Mountain. These dikes occur as low, narrow ridges, which are numerous and more or less parallel in the northern part of the area but extend south in a single outcrop. The dikes consist of diabasic rock, which has weathered to a great depth. Rounded bowlders of the parent rock are numerous upon the surface. They show a characteristic concentric weathering and contain a high percentage of magnetite. They are known locally as ironstone ridges. The Montalto and Iredell series are developed upon these ridges.

The types of the Montalto series have reddish-brown or rusty-brown surface soils, with a yellowish-red to red heavy subsoil. The stony clay loam is the only type mapped. It is developed where the dike separates the Frederick Valley from the Linganore Hills.

The Iredell soils are characterized by gray to yellowish-brown surface soils and a yellow to greenish-yellow, extremely plastic, waxy subsoil. The stony clay loam is the only type represented in the county.

The colluvial soils represent material that has been transported from a higher level either by gravity or wash and deposited upon the valley floor. The Murrill and Allen series include the soils derived in this manner.

The types of the Murrill series have yellowish-brown to light-brown surface soils and a yellowish-brown subsoil. They consist of material derived largely from Dekalb and Ashe soils.

The Allen series is represented by the gravelly loam, which has a reddish-brown or brown surface soil and a red, friable, heavy subsoil. It is derived largely from wash from the Porters soils.

The soils of the River Flood Plains occur along streams, and consist of old-alluvial deposits, or second bottoms, and recent-alluvial deposits, or the present flood plains.

The terrace soils in the county are developed along the larger streams and belong to the Elk series. The Elk soils include types with light-brown to brown surface soils, and a yellow to yellowish-red or red subsoil. They are derived largely from wash from limestone soils or are deposited upon limestone. The Elk loam, the only type of this series mapped in this survey, is developed along the Potomac River and lower Monocacy River.

The first-bottom soils occupy the present flood plains of the streams. They consist of material brought down in times of flood and their grouping into series is determined largely by the upland soils from which the material is derived. Members of the Huntington, Bermudian, Congaree, Wehadkee, and Pope series are mapped.

The Huntington soils have brown to chocolate-brown surface soils and a brown to a yellowish-brown subsoil. They are derived from material washed largely from limestone soils. The silt loam is the only type in this county.

The types of the Bermudian series have brown to Indian-red surface soils and an Indian-red subsoil. They are derived from material washed largely from the Penn soils. The silt loam is the only soil mapped.

The Congaree types have dark-brown surface soils and a light-brown subsoil. They are derived from the wash of the Catoctin schist soils and those of the Piedmont Plateau proper. The silt loam is the only soil type of the series mapped in this county.

The Wehadkee series includes types with dark-gray surface soils and a mottled gray, drab, and yellow, sticky subsoil. They are derived from the same material as the Congaree soils, but have been subjected to poor drainage conditions. The silt loam is the only type mapped.

The types of the Pope series have grayish to yellowish-brown surface soils and a yellowish-brown subsoil. They are derived largely from material washed from the Dekalb soils and Rough stony land. The sandy loam is the only type mapped.

The following table gives the actual and relative area of the soil types mapped in Frederick County:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Penn silt loam	44,992	10.6	Huntington silt loam	5,696	1.3
Rough stony land	35,328	8.3	Wehadkee silt loam	5,376	1.3
Manor slate loam	35,008	8.3	Dekalb loam	5,312	1.3
Frankstown silt loam	26,368	6.5	Murrill gravelly loam	4,288	1.0
Colluvial phase	1,216		Talladega slate loam	3,968	.9
Ashe loam	26,496	6.3	Porters stony loam	3,136	.7
Porters silt loam	20,544	4.9	Chester stony loam	2,880	.7
Chester gravelly loam	20,032	4.7	Lansdale silt loam	2,176	.5
Manor loam	19,456	4.6	Iredell stony clay loam	1,984	.5
Congaree silt loam	18,880	4.4	Dekalb shale loam	1,728	.4
Manor gravelly loam	16,384	3.9	Montalto stony clay loam	1,664	.4
Dekalb stony loam	14,208	3.3	Chandler slate loam	1,664	.4
Ashe stony loam	12,864	3.0	Allen gravelly loam	1,536	.4
Ashe gravelly loam	12,160	2.9	Lehigh gravelly loam	1,408	.3
Chester loam	7,936	2.7	Hagerstown sandy loam	1,216	.3
Red phase	3,520		Chandler silt loam	1,088	.3
Ashe silt loam	10,624	2.5	Elk loam	896	.2
Penn gravelly loam	10,496	2.5	Colbert silt loam	832	.2
Bermudian silt loam	10,304	2.4	Pope sandy loam	768	.2
Hagerstown loam	7,808	1.8	Hanceville gravelly loam	576	.1
Athol gravelly loam	5,568	1.8	Talladega silt loam	576	.1
Yellow subsoil phase	2,176				
Cardiff slate loam	6,656	1.6	Total	424,320	.....
Conowingo gravelly silt loam	6,528	1.5			

Appalachian Mountain Province.

DEKALB STONY LOAM.

The interstitial material of the Dekalb stony loam to the depth of a few inches is dark gray to dark yellowish brown. This grades quickly into a pale-yellow or yellowish-brown mellow loam to silt loam, about 8 to 10 inches deep. The subsoil consists of a yellow or light yellowish brown silt loam to silty clay loam, only slightly compact and friable. Both soil and subsoil contain a small percentage of small sandstone fragments and quartz gravel, both rounded and angular. Scattered upon the surface and embedded in the soil are numerous rocks and bowlders from several inches to several feet in diameter.

The Dekalb stony loam is developed extensively along the lower slopes on the eastern side of Catoctin Mountain, upon the somewhat flattened tops of the mountains above High Knob, upon the lower slopes of Sugar Loaf Mountain, and along the base of South Mountain from the Potomac River to Turners Gap. It is developed intermittently along the top of South Mountain, from Monument Knob to Sensenbaugh School. Most of the type occupies mountain sides that are fairly steep. Where it is found upon the caps of the moun-

tains the topography is fairly smooth. The run-off is rapid and the drainage thorough.

Small areas have been cleared of timber and stones, and are used for pasture, orchards, or cultivated crops. Corn, oats, and buckwheat are the main crops, corn occupying the largest area. A few cattle are grazed upon the pasture and run in the forested area. There are a number of small orchards, mainly of apples and peaches. The type is not important and only a small percentage of it is cultivated. The wooded areas consist of white oak, red oak, chestnut oak, poplar, and pine. Land of this type sells for about $15 to $25 an acre.

The steep topography and stony surface are the chief drawbacks to the improvement of this land. The smooth areas could be utilized to advantage for orcharding. The remainder could be grazed or left in forest. If the land is cleared and the stones are removed, results similar to those obtained upon the gravelly areas of the Dekalb loam may be expected. The soil may be improved by the methods recommended for the Dekalb loam.

DEKALB SHALE LOAM.

The interstitial material of the soil of the Dekalb shale loam is a dark grayish brown or yellowish-brown mellow loam to silt loam, about 6 to 8 inches deep, and of the subsoil a yellow to yellowish-brown friable silty clay loam. The soil contains a large percentage of gray to yellow thin shale fragments and the subsoil is completely filled with yellow shale fragments. The parent rock is usually encountered at 3 to 5 feet below the surface.

The Dekalb shale loam is developed in rather small, narrow strips along the eastern base of Catoctin Mountain, at intervals from the base of Carrick Knob to Fishing Creek 1¼ miles west of Lewistown. Smaller areas occur on the west side of Catoctin Mountain in the vicinity of Philips Delight School, and upon South Mountain between Pine Knob and Black Rock Gap. The type occurs on long, narrow, low ridges, or on the sloping base of a mountain, or upon the top of a mountain such as the area developed upon South Mountain. The topography is gently sloping to steep, but the surface is generally smooth. The drainage is excessive and erosion is active in places. In spots the surface soil has been removed and the partly disintegrated shale is exposed. The soil is droughty, and crops usually suffer for want of moisture even during moderately dry seasons.

The Dekalb shale loam is inextensive and unimportant. Probably 65 per cent is cleared. A fair acreage is in pasture, and some is in orchards. About half of the cleared area is devoted to cultivated crops, mainly corn, wheat, oats, and hay (clover and timothy, or cowpeas). Vegetables are grown in gardens for home use. Tomatoes

are grown for canning. The crop yields are considerably below the average for the county. Corn yields 15 to 35 bushels; wheat, 10 to 20 bushels; oats, 15 to 25 bushels; hay one-half to three-fourths ton per acre.

The suggestions for the improvement of the Dekalb loam will apply equally well to this type. More fertilizer should be used upon this land than on the "valley" soils. The growing of tomatoes could well be extended where the soil is located near a cannery. This soil is fairly well suited to the growing of legumes, such as cowpeas, crimson clover, soy beans, and vetch, and these crops should be in more general use. The character and topography of this land make it well suited to orcharding, for which it should be more extensively utilized.

DEKALB LOAM.

The surface soil of the Dekalb loam is dark gray in the surface few inches, passing into a pale-yellow mellow loam which extends to 6 or 8 inches below the surface. The subsoil consists of a yellow to brownish-yellow, fairly compact, friable clay loam. The partly disintegrated parent rock is encountered at 4 to 6 feet. A few small fragments of sandstone and quartz are scattered upon the surface and through the soil.

This type is prominently developed upon Catoctin Mountain, south of Five Forks and upon Sand Flat, and around the eastern base of Sugarloaf Mountain. The latter areas contain a high percentage of silt. Upon Sand Flat the soil carries a relatively large proportion of medium to fine sand. In fairly extensive areas this soil approximates a gravelly loam, the gravel content constituting 20 to 30 per cent of the soil mass in most places. The gravel consists of small blocky or angular sandstone fragments, angular and rounded quartz fragments, and gray shale fragments. The areas of this gravelly variation are widely developed. They lie along the base of South Mountain at Mount Hope Church, extend from near Reno School to the top of the ridge at Foxes Gap, and also occur at Turners Gap and at Wolfsville Crossing. Other areas are scattered along the eastern base of Catoctin Mountain from the mouth of Hampton Valley, south to the Hagerstown and Frederick pike.

The topography of the Dekalb loam varies from fairly level to strongly sloping. The typical areas occupy the smoother parts, while the gravelly areas are commonly found upon the steeply sloping mountain sides. The runoff is rapid, but erosion is not active. Even the more level areas are for the most part well drained, owing to the porous nature of the subsoil and substratum. On Sand Flat the drainage is retarded by the closeness of the underlying sandstone.

This soil is relatively unimportant. About 30 to 40 per cent is cleared and under cultivation. The forested areas are mainly in oak, chestnut, poplar, and pine. A fair acreage is in permanent pasture and supports an indifferent sod of native grasses. Corn, wheat, oats, buckwheat, and hay (timothy, clover, and cowpeas) are the crops grown. There are a number of apple and peach orchards in a thriving condition and producing fruit of good quality. Some cattle and hogs and a few sheep are kept upon this land and run mostly in the forested areas.

The soil is naturally light, and the farms are not handled as well as the valley farms, so the yields of general farm crops do not run very high. Corn yields 15 to 35 bushels, wheat 8 to 15 bushels, hay one-half to 1 ton per acre. Vegetables and fruit produce better than the staple crops.

Lime is used to a small extent in farming this land. The little available manure is applied to corn land. Phosphate fertilizers are used by some farmers upon wheat and oats. The rotations in common use on the valley farms are not followed.

This land sells for $25 to $100 an acre, according to location, topography, and improvements.

Most of this soil is deficient in organic matter. This can be added by turning under heavy sod land, or turning under cover crops or the stubble from leguminous crops. This will increase the moisture-holding capacity. Complete fertilizers should be used upon practically all crops, except where legumes are grown in the rotation, in which case the nitrogen can be omitted or the proportion reduced. Cowpeas, crimson clover, soy beans, and vetch are well suited to this soil. A good grade of tobacco is grown upon this soil in adjoining States with the use of heavy applications of fertilizer. This land is well suited to fruit growing. Much of it lies in a thermal belt that is free from killing frost a month earlier in the spring than some other localities. It is well suited to peaches, apples, and practically all the tree fruits grown in this section. It is also well suited to small fruits, including the brambles, and to grapes. The type offers opportunities for commercial orcharding.

HANCEVILLE GRAVELLY LOAM.

The surface soil of the Hanceville gravelly loam, to a depth of 6 or 8 inches, is a grayish to yellowish-brown mellow gravelly loam, which passes into a layer of a few inches of yellowish-red, fairly compact, but friable heavy loam. The subsoil proper is a red, compact but friable, gravelly clay loam, which contains small mottlings or streaks of gray and yellow. The type is rather deeply weathered, the partly disintegrated shale being encountered at depths of 4 to 6 feet. The gravel consists of small blocky pieces of buff-colored shale,

platy pieces of gray shale, angular pieces of sandstone, and angular and rounded quartz fragments. The gravel constitutes 20 to 30 per cent of the soil mass.

The Hanceville gravelly loam is developed in several small oval-shaped areas in the vicinity of Edgewood near the base of the eastern slope of Catoctin Mountain and in small irregular-shaped areas around the northwestern base of Sugarloaf Mountain. The surface is fairly smooth, with a gently undulating to sloping topography. The drainage is well established and aeration is thorough. The gravel content makes both soil and subsoil somewhat open. However the soil is more retentive of moisture than the Dekalb soils.

Practically all of this land is cleared and under cultivation. The few remaining trees are oak, chestnut, poplar, and pine. Corn, wheat, and hay (clover and timothy) are the principal crops. A few small orchards are found, in which apples and peaches predominate. The soil is well farmed and the yields are good. Corn yields 20 to 40 bushels per acre, wheat 10 to 20 bushels, and hay about 1 ton per acre. A few cattle are fattened for market, and hog raising is engaged in. This soil is handled in much the same manner as the Chester loam and gravelly loam.

This land is valued at $65 to $100 an acre. The suggestions offered for the improvement of the Chester soils may be followed upon this land. It is well suited to legumes, such as cowpeas, soy beans, crimson closer, and vetch, and these crops should be used more freely. It is also well suited to peaches, apples, and small fruits.

TALLADEGA SLATE LOAM.

The surface soil of the Talladega slate loam is a grayish-brown to yellowish-brown or reddish-brown mellow silt loam to loam, 6 to 10 inches deep, containing an abundance of thin, soft, yellow shale or slate fragments and some angular quartz fragments. The subsoil is a red, micaceous, heavy, greasy loam to silty clay loam, containing soft fissile slate, much of it weathered but still holding its form. The parent rock is encountered at 3 to 4 feet and consists of partly weathered metamorphosed shale or slate varying in color from gray to buff, greenish yellow, or reddish yellow, and containing a noticeable amount of finely divided mica.

The Talladega slate loam occurs in a belt about three-fourths mile wide extending from Yellow Springs nearly to Point of Rocks and occupies all of this strip except for the small areas occupied by the Talladega silt loam. This belt represents the low rolling foothills of Catoctin Mountain. The slate loam lies on sloping hillsides and narrow spur ridges, the topography being sloping, steeply sloping or hilly. The drainage is thorough to the extent that the soil is

droughty. Erosion is fairly active upon the exposed steeper slopes, but in the main the surface is fairly smooth.

Only about 30 or 40 per cent of the type is cleared and under cultivation. The forested areas support mainly oak, chestnut, poplar, and pine. The type is not important agriculturally. About half of the cleared area is in pasture which supports only a fair sod of native grass. A number of cattle, sheep, and hogs are grazed upon this pasture land and range in the wooded areas. A number of peach orchards on this type seem to be doing fairly well. Corn, wheat, oats, buckwheat, and hay (timothy and clover) are the principal crops. Each of these is grown upon a small acreage. Corn yields 15 to 35 bushels per acre, wheat 10 to 15 bushels, oats 15 to 25 bushels, and hay one-half to three-fourths ton per acre.

The soil is not very well farmed, being handled about like the gravelly areas of the Dekalb loam. Little fertilizer, lime, or manure is used.

The Talladega slate loam sells for $35 to $100 an acre, according to topography, location, and improvement. A few farms on the State roads would command a higher price.

The steeper slopes should be protected to prevent erosion. They can be kept in pasture or orchards, or protected by cover crops. Suggestions given for the Dekalb loam may be followed for improvement of this land. The extension of the orchard industry would seem to be a promising use for parts of this soil.

TALLADEGA SILT LOAM.

The Talladega silt loam has a grayish-brown, yellowish-brown to reddish-brown, mellow silt loam surface soil, about 6 to 10 inches deep, which grades into a subsoil of red, heavy, friable silt loam to silty clay loam. The subsoil contains a high percentage of finely divided mica that gives it a smooth, greasy feel. Some quartz gravel is scattered upon the surface and throughout the soil mass, and also a small quantity of thin, platy, soft, reddish-yellow slate fragments. The underlying rock is weathered to considerable depths, the unweathered rock being encountered 10 to 20 feet below the surface.

The Talladega silt loam occupies small oval or irregular-shaped areas on the fairly smooth or more level hilltops throughout the region occupied by the Talladega slate loam.

The soil is not very important. About 60 or 70 per cent is cleared and cultivated. The forest growth includes mainly chestnut and oak, with a scattering of other hardwood trees. Corn, wheat, and hay (timothy and clover) are the leading crops, and oats, buckwheat, and cowpeas are minor crops. A small acreage is in permanent pastures, in which there is only a fair sod of native grasses.

A few peach orchards are situated on the type. The soil is not naturally strong and the crop yields are moderate as compared with those on the valley soils. Corn yields 20 to 45 bushels; wheat, 10 to 20 bushels; hay, one-half to 1 ton per acre. The yields vary widely with the fertilizer used and the condition of the land. Upon some farms essentially the same methods are used as are used upon the Chester and Manor soils, and upon other farms the methods are those used upon the Dekalb soils. The soil is easy to cultivate and breaks down readily into a good tilth.

This land is valued at $75 to $150 an acre, according to location and improvements. The soil is fairly well suited to the production of fruit, especially peaches and small fruits. This industry should be extended. For the improvement of this soil the recommendations for the Chester loam and the Dekalb loam should be followed.

CHANDLER SLATE LOAM.

The surface soil of the Chandler slate loam, 7 to 10 inches deep, is a grayish-brown to yellowish-brown fluffy silt loam containing a quantity of thin gray chips of soft slate, some gritty material, and angular quartz fragments. The subsoil is a yellow to yellowish-brown heavy silt loam to silty clay loam filled with gray slate fragments. It also contains a noticeable amount of finely divided mica, which gives it a smooth and greasy feel. The surface soil contains less mica than the subsoil. The partly disintegrated parent rock—a gray slate—is encountered at 3 to 5 feet.

The Chandler slate loam occupies most of the belt of Chandler soils which extends from Braddock to 1 mile north of Point of Rocks. Within this belt it occupies the steeper hillsides and areas that have a broken topography. The surface in detail is fairly smooth. The drainage is good, the run-off being rapid. The porous condition of the substratum permits of thorough underdrainage, so that the type is droughty. Erosion is active upon the exposed hillsides.

This soil is not important, probably less than 40 per cent being cleared and used for crop production or pasture. The undrained areas support a forest consisting largely of chestnut, chestnut oak, and white oak, with a scattering of other hardwood trees. The same crops are grown as upon the silt loam. The yields range slightly lower and about equal to those of the Talladega slate loam.

The Chandler slate loam forms part of the same farms with the silt loam and the same methods are used in handling the two soils, except that less attention is given to the slate loam areas. A few peach and apple orchards are located on this type. A number of cattle, sheep, and hogs are kept upon the pasture and ranged in the woods. The Chandler slate loam sells for $35 to $100 an acre.

The steeper slopes should be seeded to grass to protect them from washing. Cover crops should be grown to give winter protection to land that is cultivated. Suggestions given for the improvement of the silt loam may be followed upon this land.

CHANDLER SILT LOAM.

The surface soil of the Chandler silt loam is a grayish-brown to yellowish-brown, mellow, fluffy silt loam, about 6 to 10 inches deep, underlain by a layer of several inches of yellow silt loam of the same structure. The subsoil consists of a light grayish brown, pale yellowish brown, or yellow heavy silt loam or silty clay loam, only slightly compact. Finely divided mica gives the soil material a greasy feel and a smooth and friable structure. In places angular quartz fragments are scattered upon the surface and throughout the soil. A few thin, soft, gray and yellow slate chips are present in both the soil and subsoil material.

The type is developed upon the fairly level hilltops and more gently sloping hillsides of the Chandler soils belt mentioned under the preceding type. The silt loam lies from 400 to 500 feet above sea level, and about 100 feet higher than the adjacent valley. The topography is fairly level to gently sloping. The drainage is thoroughly established and the soil is droughty. Erosion is not active.

This soil is inextensive and unimportant. About 65 or 75 per cent is cleared and used for farming. In the forested areas chestnut predominates, with a scattering of white oak and chestnut oak. Locust is abundant in the second growth. Part of the cleared area is used for pasture. It furnishes a poor sod, as grass does not make a good stand. Corn, wheat, oats, buckwheat, potatoes, cowpeas, and hay (timothy and clover) are the crops grown. Corn, wheat, and oats are the most important, covering the largest acreage. A few peach orchards are located upon the land, and a few home orchards that have a mixture of fruit trees. Corn yields 15 to 45 bushels; wheat 10 to 20; oats 15 to 30 bushels; hay one-half to three-fourths ton per acre. This soil is fairly well farmed, but it is leachy and is not readily maintained in a high state of production. The rotations followed upon the "valley" soils are followed on this land. The available manure is used. Lime is applied to a limited extent. Fertilizers (acid phosphate or bone meal) are used by most farmers in growing wheat or oats. The soil is easily tilled, and it requires only ordinary effort to keep the fields in good tilth; there is practically no tendency to clod or bake upon drying.

The Chandler silt loam sells for $75 to $125 an acre, with a few more favorably located areas held at a higher price. This soil is adapted to the production of Irish and sweet potatoes, and the

acreage in these crops should be extended. It is fairly well suited to orcharding. Peaches seem to do better than other fruits. It needs humus in the form of green manures or barnyard manure. Leguminous crops can be grown advantageously.

ASHE STONY LOAM.

The interstitial material of the Ashe stony loam is a dark yellowish brown silt loam to loam, about 6 to 8 inches deep, underlain by a yellowish-brown to greenish-yellow silty clay loam, fairly compact but friable. Large and small bowlders of greenstone are found strewn upon the surface and embedded in the soil and in places narrow ledges of this rock outcrop. Small fragments of schist and quartz are scattered throughout the soil mass, giving it a more or less porous character. The main part of the type is derived from basic volcanic rock which has been metamorphosed into a schist. Some of the original magma remains in the form of black rock protrusions. Small areas north of Wolfsville are derived from acid volcanic rock which has been highly metamorphosed. The soil is grayish brown to yellowish brown and the subsoil is yellow, resembling the Dekalb subsoil in color. The stones occur as slabs of hard, fine-grained, bluish-gray rock. The tree growth upon the soil derived from the acid volcanic rock is predominantly chestnut, with some chestnut oak, white oak, beech, and poplar.

The Ashe stony loam is found in disconnected areas on the west side of Catoctin Mountain and the east side of South Mountain, and is extensively developed in the intermountain region between Myersville and the Pennsylvania line. It occupies fairly smooth to steep mountain sides and in places passes over the mountain tops. This gives in general a somewhat rough and broken topography, but many areas are fairly smooth. The drainage is effected through surface gulches and is usually excessive. Owing to the presence of the stones, erosion is not active.

The Ashe stony loam is not an important soil type, as only small areas are cleared. The forest consists of a variety of hardwood trees, mainly white oak, hickory, walnut, maple, poplar, ash, chestnut, and locust, with a heavy undergrowth of briers, grape vine, hazel, and sumac. Most of the cleared areas are grazed, being covered with a good bluegrass sod. The stones have been removed from a few small fields and piled in fences. In these fields the same crops are grown as upon the gravelly loam, with about the same results. Usually some bowlders or rock protrusions are left that interfere with cultivation and cut down the yields. The type is used to a small extent for orcharding. Most of the wooded areas are used as a range for cattle, horses, sheep, and hogs. Bluegrass comes in naturally.

The Ashe stony loam has a comparatively low agricultural value. It sells for $20 to $40 an acre, according to location and improvement.

This land is difficult to bring under cultivation, owing to the work required in removing the stones. The type can best be utilized for grazing. The smoother areas could be used for orcharding; the steeper stonier areas should be left in forest.

ASHE GRAVELLY LOAM.

The soil of the Ashe gravelly loam is a yellowish-brown mellow silt loam to loam, passing at 6 to 10 inches into a yellow or yellowish-brown friable silty clay loam, which in places has a greenish cast or is greenish yellow below 24 inches. Quantities of yellowish-brown schist fragments, small pieces of greenstone or "copper stone," and quartz fragments are scattered upon the surface and throughout the soil section, forming about 30 to 40 per cent of the soil mass. Although the soil is weathered to a great depth in places, the partly disintegrated parent rock is encountered within the soil profile over much of the type. The type is derived from the weathering in place of the Catoctin schist, which for the most part is derived from basic volcanic rock that has been metamorphosed in varying degrees, most of it assuming a schistose structure.

Near the center of the intermountain region a belt of acid volcanic rock outcrops and gives rise to areas of this soil in the vicinity of Middlepoint, from there northward and around Foxville. This rock has been highly metamorphosed and has a schistose or laminated structure. The derived soil is grayish brown to dark yellowish brown, and the subsoil is yellow to yellowish brown. The gravel content consists of bluish-gray, hard schist fragments, gray slate, and a small amount of yellowish-brown or buff-colored schist. Greenstone is absent.

The Ashe gravelly loam is fairly extensive. It is found upon the western side of Catoctin Mountain south of High Knob, at intervals upon South Mountain north of Turners Gap, and in the intermountain region and Harbaugh Valley. The type occurs on smooth ridge tops and sides, the base of mountains, and to a lesser extent in the smooth valleys. It is found on the caps of the mountains and in mountain gaps. It has a wide range in elevation, occurring from 500 feet to 1,800 feet above sea level.

The Ashe gravelly loam is only moderately important in the agriculture of the county. About 65 per cent is cleared and cultivated. The forested areas have a variety of trees, including practically all the hardwood trees of this region, with oak, hickory, poplar, walnut, chestnut, chestnut oak, and beech predominating. Nearly half of the cleared area is in permanent pasture with a good bluegrass sod. Corn, wheat, oats, buckwheat, timothy, and clover are some of the

crops grown. Late Irish potatoes are grown for market in many places near transportation. Corn yields 20 to 50 bushels, wheat 10 to 20 bushels; oats 20 to 40 bushels, and hay about 1 ton per acre. Buckwheat and Irish potatoes make fairly good yields. Many apple and peach orchards are established on this type in the intermountain region, especially near Wolfsville. The trees seem to be healthy, and an excellent grade of fruit is grown.

Most of this land is operated by the owners. Some of it is well farmed, and the cultural practices and methods used are the same as upon the other soils of the Middletown Valley. In some cases the regular 4 or 5 year rotation common in the rest of the county is followed, but the diversity of crops on most of the farms precludes the use of this rotation and there is no standard system. This soil is easily tilled. The gravel does not interfere seriously with cultivation and in a way forms a mulch that helps conserve moisture. Little fertilizer or lime is used. The available manure is applied on corn land. Spring-tooth harrows, which are effective in gravel soils, are in common use.

This land sells for $50 to $150 an acre, according to location and improvements.

Much of this land is deficient in organic matter. This can be supplied by turning under cover crops or sod. This soil, like the other Ashe soils, is well suited to legumes, and these should be included in the crop plans. This type is better suited to orcharding than to any other form of specialized industry and contains numerous good orchard sites. The same suggestions for improvement may be followed as given for the Ashe loam and Porters silt loam.

ASHE LOAM.

The Ashe loam consists of a brown to yellowish-brown mellow loam, about 6 to 10 inches deep, underlain by a subsoil of yellow heavy loam to clay loam of a smooth, friable structure. Locally small angular fragments of white quartz are scattered upon the surface and throughout the soil and to a less extent in the subsoil. The soil ranges from a silt loam carrying some gritty material to a soil that approaches a heavy sandy loam. Most of the type is deeply weathered; however, spots are found where the greenish-yellow, partly disintegrated parent rock is found within the 3-foot section. In spots the subsoil is yellowish red. A few rock outcrops are found along the steeper slopes to the streams. The type is known locally as "flint land."

The Ashe loam occurs in a large body in the southwestern corner of the county, occupying most of the southern part of the Middletown Valley. The topography of the type is fairly level, with the surface cut by narrow, shallow, -shaped valleys. This gives an un-

dulating to gently rolling surface which becomes more rolling and somewhat broken near the streams. The general level of the valley is about 100 to 150 feet above stream level. The drainage is thorough and is accomplished through surface channels. Erosion is mildly active upon the slopes.

The Ashe loam is one of the important soil types. Probably 85 to 90 per cent is cleared and used for farming. The remaining forest, which is confined to woodlots and some of the steeper slopes along streams, consists of hardwood, oak predominating. The soil is well developed from an agricultural standpoint, and crop yields are good. Corn, wheat, and hay (timothy and clover) are the principal crops. Corn yields 40 to 70 bushels per acre, with an average of about 45 to 50 bushels; wheat 20 to 25 bushels; hay 1½ to 2½ tons per acre. Raising and fattening beef cattle is the chief form of stock industry. Dairying is developed only to a limited extent. There are a few home orchards, mainly apples and peaches, but commercial orcharding is not developed. Corn is grown more extensively than any other crop. Oats, buckwheat, cowpeas, crimson clover, and millet are minor crops. Irish potatoes are grown to some extent in the vicinity of Brunswick. Quite an area is in permanent pastures, usually the steeper slopes near streams. The sod is composed of bluegrass and other native grasses. Temporary meadows are utilized for pasture from the time the hay is cut until fall each year while retained in sod, which may be for a period of 1 to 3 years.

The Ashe loam as a rule is well farmed. However, many large farms located in the southern part of the valley are rented, with the usual deteriorating results. Sod land is turned 7 to 9 inches deep; other plowing is shallower. The soil is easy to plow, and it requires comparatively little effort to bring about good tilth. A regular 5-year rotation is followed; but there is a growing tendency to shorten this to 4 years. Wheat is grown only one year by many farmers. Some commercial fertilizer is used; this is applied to wheat. A customary application is 200 to 250 pounds of acid phosphate or bone meal per acre. The available manure is applied to sod land before plowing. Lime is used on most farms, but only small quantities are applied, little of the land receiving more than 35 bushels per acre every 7 years. This land sells for $150 to $200 an acre, but very little of it is on the market.

A considerable proportion of the type is deficient in organic matter. This can be increased by turning under a heavy sod. Leguminous crops are well suited to this soil, and should be included in the rotation, or grown upon patches that are not included with the regular rotations. As this soil is well suited to corn production, and clover does well, a 3-year rotation, (1) corn, (2) wheat, (3) clover, should prove satisfactory. This would give a clover stubble every three

years to enrich the soil. This soil is used successfully in other sections for the production of tobacco. It is not in need of potash for general crops; and, where clover is grown, there is little need of nitrogen fertilizers. Liberal applications of acid phosphate should be made for both corn and wheat. This land is well suited to the production of Irish potatoes on a commercial scale.

ASHE SILT LOAM.

The Ashe silt loam has a surface soil of yellowish-brown mellow silt loam about 7 to 10 inches deep, which passes into a yellow to golden-yellow or light yellowish brown silty clay loam to silty clay, somewhat compact but friable. A few fragments of white quartz are scattered upon the surface and throughout the soil and subsoil. In places a few blocky schist fragments occur. Most of the type is thoroughly weathered to depths below 3 feet, but in places the buff-colored schist rock, which is usually partly disintegrated and soft, is encountered. Only upon the steeper slopes along streams is there any rock outcrop.

Areas of the Ashe silt loam are scattered over the Middletown Valley. The largest lie in a belt which averages about 1 mile wide, and extends south from Myersville through Middletown to a point just north of Jefferson. The topography is slightly more broken than that of the loam type, as this soil occurs farther up in the Middletown Valley where the streams have cut deeper channels. The surface varies from gently undulating to hilly, and steeply sloping along the streams. The drainage water is removed largely through surface channels. The drainage is thorough, but the soil is retentive of moisture, and crops rarely suffer even during continued droughts.

This is one of the important soils of the Middletown Valley. About 90 to 95 per cent is cleared and under cultivation. The few remaining trees attest to the sturdy hardwood growth the type at one time supported. A number of locust and walnut trees are found in the fields and fence rows. The crops grown and yields obtained are practically the same as upon the loam. More of this land is operated by owners, and if it were not for the steeper topography, it would produce better than the loam. The same general methods of cropping and the same cultural methods and fertilizer practices are followed as upon the loam. It also has about the same distribution of live stock, though the farms are generally smaller, and more hogs and poultry are kept. Dairying is somewhat better developed, as this type is well located with respect to transportation. Cream is shipped to Middletown and is the chief source of income upon some of the farms. Sweet corn is grown to some extent in the vicinity of Middletown and Jefferson. The yields compare favorably with those of the Limestone Valley

soils. This land sells for $150 to $250 an acre, but very little is on the market.

The same recommendations for improvement can be followed as given for the Ashe loam. This soil has a greater tendency to clod than the loam and the incorporation of organic matter is more important.

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

Mechanical analyses of Ashe 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.*
201606	Soil	0.6	1.9	0.9	4.4	18.0	56.3	17.7
201607	Subsoil	.6	1.7	.8	3.7	16.6	51.8	24.7

PORTERS STONY LOAM.

The interstitial material of the Porters stony loam is a dark-brown or dark reddish brown mellow loam to a depth of about 6 to 12 inches, where it grades into a few inches of a yellowish-brown or yellowish-red heavy loam or clay loam. The subsoil proper consists of a red compact but friable clay loam to clay. The material is generally deeply weathered, but there are rock outcrops in places. Most of the stones are detached, resting upon the surface or embedded in the soil mass. They consist of dark diorite or the original magma containing considerable iron, greenstone, or quartz, and vary in diameter from a few inches to several feet. The outcrops usually consist of the original basic volcanic rock which has not been altered. Considerable gravel, consisting of large and small pieces of buff-colored schist, greenstone, magnetite, and quartz, is found upon the surface and throughout the soil mass. The gravel gives a porous structure to the soil and substratum. The type is derived from the weathering in place of the Catoctin schist, part of which has not been changed materially from the original basic volcanic rock.

The Porters stony loam is developed chiefly north from Hampton, Eyler, and Harbaugh Valleys to the Pennsylvania line, and in small bodies southeast of Wolfsville to Grossnickle School, from Paintrock Mill to Jerusalem; along the base of South Mountain from near Reno School to Mount Hope Church, and along the western base of Catoctin Mountain below Pine Rock. The surface features vary from steeply sloping mountain sides to fairly smooth slopes and smooth mountain tops. The drainage is thorough.

Owing to the stone content erosion is not active. A considerable amount of rainfall is absorbed by the gravelly soil and passes out through springs at the base of the mountains.

This land, though not extensive, is fairly important, considering its broken topography. About 30 to 40 per cent of it is cleared and either in cultivated crops or in pasture or orchards. The forested areas are utilized as a range for cattle, sheep, and hogs. The forest consists of a variety of hardwood trees, oak, hickory, ash, walnut, poplar, maple, and locust predominating. The underbrush was probably thick at one time, but the constant tramping of cattle has destroyed or kept down the growth. Bluegrass is found between the rocks even in forested areas. Most of the cleared land is in pasture, which furnishes good grazing. The rocks have been cleared from a fair acreage, which is in cultivated crops. Corn, wheat, oats, buckwheat, and timothy and clover are the principal crops grown. Corn yields 20 to 50 bushels per acre, wheat 10 to 20 bushels, oats 20 to 30 bushels, and hay about 1 ton per acre. Many cattle are grazed upon this land, and a smaller number of sheep and hogs use this range. Some apple and peach orchards have been established. The trees are healthy and the fruit is of good quality.

Little or no fertilizer is used upon the land. Lime is not used. Some stable manure is applied to corn land. Few improved labor-saving implements are used. The cultural methods are practically the same as upon the gravelly areas of the Porters silt loam.

The agricultural value of this soil is not high owing to the steep topography and stony surface, and to the inaccessible positions of the smoother areas. The price varies from $20 to $50 an acre, according to topography and improvements.

Bluegrass comes in naturally upon this soil and furnishes excellent grazing. The natural stand should be improved by seeding. Stock raising should be followed, taking advantage of the natural pastures readily established on this land. The organic content should be increased by turning under sod, and leguminous crops should be grown more often. Acid phosphate or bone meal should be used with wheat, oats, and buckwheat. Apple orchards should be planted, as this soil is well suited to the production of this fruit. The varieties recommended for the gravelly areas of the silt loam are adapted to this land also.

PORTERS SILT LOAM.

The surface soil of the Porters silt loam is a dark reddish brown, mellow, medium to heavy silt loam, about 6 to 12 inches deep. This passes into a layer of a few inches of yellowish-brown or yellowish-red, fairly heavy, friable silty clay loam. The subsoil proper is

encountered below 15 to 18 inches and consists of a red to yellowish-red, heavy, friable silty clay loam to clay. Many white quartz fragments are scattered upon the surface and throughout the soil mass, and locally the soil is known as "red flint land." The soil is deeply weathered and nowhere does the parent rock formation come within the soil section. It is derived from the weathering in place of Catoctin schist. The higher areas contain more quartz and a few pieces of dark diabase rock and some greenstone. Most of these rocks have been removed and made into fences or piled into stone heaps. This formation carries a large amount of potash and the resultant soil is relatively strong in this necessary plant food.

Included with the Porters silt loam are fairly extensive areas that contain gravel. These are shown on the map by gravel symbols. These areas have essentially the same soil, except that it is usually a slightly lighter silt loam and the entire soil profile has a more open structure because of the gravel content. The gravel consists of blocky yellow schist fragments and white quartz. In places small fragments of greenstone are present. It is derived from the harder and less weathered schist. The greenstone and diabasic fragments are more common here than over the rest of the type.

The Porters silt loam is developed over the Middletown Valley more extensively in the northern end between the valley proper and the intermountain region. It also extends south, paralleling the base of the Catoctin Mountain almost to the Potomac River, and lies along the base of South Mountain to Burkittsville. The gravelly areas are developed over the intermountain region and Harbaugh Valley. The type occurs at elevations varying from 800 to 1,800 feet. The topography in general is gently rolling to hilly. The surface features include smooth valley areas and fairly steep mountain sides, but most of the type, even at higher elevations, is fairly smooth. In places it caps the somewhat flattened tops of mountains and is commonly found in mountain gaps. The drainage of the entire type is well established. Erosion is not active even upon the steeper places, owing in part to the protection of the gravel. The soil is retentive of moisture and crops rarely suffer even during excessively dry seasons.

The Porters silt loam is an important soil type, about 80 to 85 per cent of it being cleared and cultivated. The remaining tree growth is hardwood; in woodlots chiefly white oak. The larger forested areas have a variety of trees, including white oak, hickory, walnut, maple, poplar, and ash. The second growth is largely locust. Corn, wheat, and hay (timothy and clover) are the principal crops upon most of the soil. Upon the gravelly areas, besides these crops, oats, buckwheat, millet, and Irish potatoes are grown. Dairying is developed to a limited extent, cream being shipped to Middletown. Raising and fattening cattle is the leading stock industry. Orcharding is devel-

oped to some extent upon the gravelly areas, both peaches and apples being grown. The trees are healthy and the fruit is of good color and quality. Orcharding is developed around Wolfsville and Foxville and in Harbaugh Valley. The varieties most commonly found are York Imperial, Yellow Transparent, Ben Davis, and Grimes. Sweet corn is grown in the vicinity of Middletown and Jefferson.

The Porters silt loam is naturally strong land, and as most of it is well farmed the yields are high. The soil is well suited to corn, wheat, and clover. Bluegrass comes in naturally and furnishes good pasture. The gravelly areas, especially in the higher altitudes, are suited to the production of oats, buckwheat, and apples. Corn is more extensively grown than wheat, as wheat has a tendency to lodge.

Corn yields 30 to 85 bushels per acre; wheat 15 to 30 bushels, with an average of about 20 bushels; oats, 25 to 60 bushels, and hay 1½ to 2½ tons per acre.

Sod land is usually plowed 7 to 9 inches deep, as a rule in late fall or early winter, and disked or harrowed in the spring before planting time. The other cultivations are essentially the same as upon the Limestone Valley soils. The organic content of this soil is kept up on most farms, which makes cultivation comparatively easy. The following 5-year rotation is followed: (1) Corn, (2) wheat, (3) and (4) hay (timothy and clover), (5) pasture. This is sometimes grazed for two years or more. The tendency is toward a shorter rotation. Very little fertilizer is used. Lime is in general use and is applied at the rate of about 25 to 35 bushels once during each rotation.

The Porters silt loam is very desirable land for farming and very little is upon the market. The land sells for $150 to $250 an acre, according to location. The gravelly areas sell for $75 to $150 an acre, with a few of the better located areas going higher.

The best method of keeping up the fertility of this land is to turn under sod frequently and a cover crop occasionally. It should be heavily limed at least once in every 5 years. More stock should be kept so as to increase the amount of manure to be applied to the land. Acid phosphate or bone meal should be used for both corn and wheat, about 250 pounds for corn and 350 pounds for wheat. Where legumes are used in rotations there appears to be little need of fertilizers containing nitrogen. This land is well suited to corn and clover, and the rotations could well be shortened to (1) corn, (2) wheat, (3) clover and timothy. The gravelly areas are best suited to orcharding, especially the production of apples. Several excellent commercial varieties are well suited to this soil, under the existing climatic conditions, including the York Imperial, Grimes, Winesap, Yellow Newtown (Albemarle Pippin), and Delicious.

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

Mechanical analyses of Porters 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.*
201614	Soil	0.9	2.0	0.9	4.2	11.4	62.0	18.3
201615	Subsoil	.1	1.1	1.0	7.2	10.5	54.4	25.7

LIMESTONE VALLEY PROVINCE.

HAGERSTOWN SANDY LOAM.

The Hagerstown sandy loam is fairly uniform in character throughout its occurrence in this county. It has a dark-brown to yellowish-brown, mellow, light sandy loam soil, which passes at about 8 inches into a light yellowish brown, slightly compact sandy loam. The subsoil proper is encountered at 12 to 18 inches below the surface and consists of red to reddish-brown, and in some places yellowish-brown, friable sandy clay. The sandy material consists of well-rounded quartz particles medium to fine in texture. Very few fragments of rock are upon the surface. Rock outcrops, in the form of toothlike protrusions, are numerous in places, particularly upon the breaks near streams where erosion has exposed the bedrock.

This soil is developed near the center of the limestone belt, in close association with the Hagerstown loam. Its largest single occurrence is a strip varying from one-fourth to one-half mile in width and extending from about one mile north of Limekiln to a point one mile east of Frederick. Other detached areas are found west of Buckeystown and Limekiln and in the big bend of the Monocacy River two miles northeast of Frederick. Most of these strips extend in a general northeast and southwest direction.

The surface is gently rolling to undulating, with some fairly level areas. A number of depressions, sink holes, are scattered over the type, and the drainage is largely internal. Although many streams traverse the type, there are practically no stream heads or surface drainage ways originating in it. The drainage is good owing to the character of the soil and substratum.

The Hagerstown sandy loam is not very extensive and not an important agricultural soil. About 90 per cent is cleared and under cultivation. The remaining forest growth is hardwood, the same as on the other limestone soils.

Corn, wheat, and oats are the most important crops, with rye, cowpeas, clover, and potatoes as minor crops. Sweet corn is the most important special crop and probably occupies a larger acreage than

any other single crop. All the vegetables common to this section are grown in the gardens. A fair acreage is devoted to orchards, apples and peaches predominating. A considerable acreage, including much of the stony areas, is used for pasture. The soil supports a fair sod of bluegrass, and some of the type is included in farms devoted mainly to dairying.

The crop yields are slightly less than upon the other limestone soils. Corn yields 30 to 50 bushels per acre; wheat, 12 to 20 bushels; oats, 20 to 30 bushels; and sweet corn, 2 to $2\frac{1}{2}$ tons per acre.

This soil is cropped in practically the same manner as the Hagerstown loam, except that less hay is grown, and consequently corn follows corn in the rotations more often. The cultural practices and the fertilizers used are essentially the same on both types.

The price of this land is usually $100 to $150 an acre. Some of the better developed areas bring higher prices, while the stony areas, if separated, would bring a lower price.

The recommendations for general improvement are the same as for the Hagerstown loam. The soil is rather light and needs organic matter and commercial fertilizers for the best results in crop production. Manure should be used when possible. Sod or a cover crop, preferably a legume, should be turned under when manure can not be obtained. A complete fertilizer of a grade suitable to the crop grown should be used. This soil is adapted to a wide range of crops besides the staple crops grown. Irish and sweet potatoes do well, especially the latter. It is well suited to such legumes as cowpeas, soy beans, crimson clover, and vetch. Alfalfa would succeed where the land is limed and inoculated. Melons succeed upon this class of soils. The type is well suited to truck crops, as the warm nature of the soil favors early development. Peaches do exceptionally well, as do small fruits and brier fruits, and stony areas could be utilized for these crops.

HAGERSTOWN LOAM.

The surface soil of the Hagerstown loam is a brown or dark yellowish brown mellow loam, 8 to 12 inches deep, passing into a yellowish-brown, heavy, fairly compact but friable loam. The subsoil proper, encountered at depths of 15 to 20 inches, consists of a red or reddish-brown clay loam to clay, compact but friable. Most of the soil is deeply weathered, but in many places narrow ledges of the parent rock (crystalline limestone) are encountered at varying depths below the surface and outcrop in ledges projecting from a few inches to 3 feet above the surface. In a few places these outcrops occur in sufficient numbers to interfere seriously with cultivation or to form a stony loam. These spots are indicated upon the map by stone

symbols. Fragments of limestone are found scattered upon the surface and embedded in the soil over most of the type, but these do not interfere with cultivation to an appreciable extent.

In places where the soil is closely associated with the Hagerstown sandy loam it carries a noticeable amount of sand. Gravelly areas are quite common in the central part of the belt in the vicinity of Ceresville and Walkersville. These gravelly areas occupy the higher, more rolling parts of the type. The soil is a brown to reddish-brown loam over the typical subsoil. The gravel content comprises about 20 per cent or less of the soil mass, being most abundant in the upper part and almost entirely absent in the subsoil. The gravel consists of waterworn quartz pebbles from one-fourth inch to 1 inch in diameter, with a few as large as 2 inches.

In the vicinity of Creagerstown Station the gravel upon this type consists of small blocky chert fragments scattered upon the surface and throughout the entire soil mass. Some spots, however, are entirely free from gravel. The surface soil in this locality is dark brown and carries a higher content of silt, and the subsoil is reddish yellow and somewhat heavier than in the rest of the type, more nearly representing the Hagerstown subsoil as mapped in Washington County.

Northeast of New Market and east of New London are long, narrow valleys or depressions in which the type consists of a dark-brown mellow loam or silt loam, about 10 to 12 inches deep, underlain by a dark yellowish brown, fairly compact silty clay loam to clay.

Another variation of this type is found south from Union Bridge in the vicinity of Clemsonville and Oldfield. The soil is a brown mellow loam 10 to 15 inches deep passing into a reddish-brown heavy loam subsoil. Both surface soil and subsoil are lighter in structure than the typical soil. Small platy fragments of slate are present in the soil and subsoil. Fragments of variegated marble also occur.

The Hagerstown loam is developed near the center of the limestone formation of the Frederick Valley. It extends in a strip about 1-mile wide from Buckeystown northeast to the Monocacy River 2 miles northeast of Frederick, and in a broader strip from west of Walkersville to the foot of Chestnut Hill 2 miles west of Woodsboro. These areas have fairly regular lines following the outcrop of the formation. The topography is undulating to gently rolling, with some fairly level stretches. The gravelly areas occur in irregular shaped areas following fairly well the contour or outline of the hills upon which the type occurs. The other variations of the type are found in rather low, level, or valley positions. The drainage of this type, although largely internal, is well established. The

surface drainage ways are poorly developed. A number of streams cut across the soil, and quite a few head along its edges, but very few head back into this type.

The Hagerstown loam is one of the best farming soils in the county. Practically all of it is cleared and under cultivation. Judging from the remaining timber and from early chronicles, the land supported a heavy growth of hardwood trees, oak, hickory, walnut, elm, maple, and ash predominating. Locust trees are important in the second growth. Only a few woodlots, hedge rows, and scattering trees remain.

Corn, wheat, and hay (timothy and clover) are the most important crops grown, with small acreages of oats, rye, alfalfa, Irish potatoes, and vegetables. Dairying has been developed into one of the most important industries upon this soil. Nearly all the farms have home orchards, in which apples predominate. Raspberries are grown on many farms. Sweet corn is the most important special crop and is grown upon nearly all the farms over the main part of this soil.

This soil is one of the most productive in the area. Corn yields 40 to 75 bushels per acre, with an average of about 50 bushels; sweet corn, 2 to 4 tons per acre, with an average of about 2½ tons; wheat 18 to 25 bushels, with an average of about 20 bushels, but 35 bushels per acre is not uncommon in good years. Hay (timothy and clover) yields 1½ to 2½ tons per acre, with an average of about 2 tons per acre. Alfalfa cuts about 3 to 4 tons per acre per season. Irish potatoes yield 150 to 250 bushels per acre.

Wheat and sweet corn are the principal cash crops. The ensilage is fed to milk cows, and the sale of the milk constitutes the chief source of income on many of the farms. The surplus hogs, chickens, eggs, butter, and vegetables sold upon the local markets constitute an important source of income on a number of farms. A few small commercial apple orchards are found southwest of Walkersville and about 4 miles south of Frederick. Much of this land is rented and consequently is not kept in the highest state of productiveness.

The soil of the Hagerstown loam if plowed at the proper time, is easy to till, making a mellow seed bed, but it has a tendency to clod when plowed too wet. This land is usually broken to the depth of 7 to 9 inches and disked and harrowed. All the available manure is placed upon the land during the fall or winter preceding spring plowing. The crop rotation followed is (1) corn, (2) wheat, (3) wheat, with timothy and clover, (4) hay, followed by pasture for 2 years and sometimes longer. Commercial fertilizer is not used with corn, but 250 to 300 pounds of acid phosphate is used with wheat. Lime at the rate of 25 to 30 bushels per acre is usually applied once

during each rotation period. The fertility is easily maintained upon this land as the soil holds improvement.

Practically all of the Hagerstown loam is advantageously located and highly desirable for farming. Very little is upon the market. The selling price varies from $150 to $300 an acre, according to improvements.

The methods followed by the best farmers are admirably suited to this soil. They give good crop yields and at the same time maintain the fertility of the land. Upon many of the rented farms, however, the organic content of the soils is much lower than it should be. This condition can be improved by following a shorter rotation, (1) corn, (2) wheat, (3) hay (clover). This gives a clover stubble to turn under each third year and, with the use of lime and commercial fertilizer, will increase the productiveness of the land in a comparatively short time. If the land should seem too rich and wheat have a tendency to lodge, the use of fairly heavy applications of phosphate, 300 to 500 pounds, and 50 pounds of potash fertilizer will have a tendency to stiffen the straw and increase the grain yield. Seed beds should be thoroughly prepared.

Alfalfa is a crop that is adapted to this soil and should prove a profitable crop where stock raising is followed. A good stand should be obtained by liming, inoculation, and proper preparation of the seed bed.

This land is well suited to apples, and commercial orcharding should be fostered, especially upon the stony areas. The York Imperial, Stayman Winesap, Delicious, and Grimes are excellent varieties for the soil and climate. Vegetables, strawberries, and bramble berries should be grown when a market can be had, for these crops make excellent yields when properly handled. Tobacco is successfully grown upon this land in adjoining counties in Pennsylvania.

FRANKSTOWN SILT LOAM.

The surface soil of the Frankstown silt loam is a yellowish-brown or grayish-brown mellow silt loam, about 8 to 10 inches deep, passing into a subsoil of yellowish-brown, yellow, golden-yellow, and in places reddish-yellow, slightly compact, firm, friable silty clay loam to silty clay.

Both soil and subsoil contain small platy fragments of soft yellow shale. A few quartz fragments are scattered upon the surface and are encountered locally in the soil. Flat slatelike pieces of limestone are found in places, but are usually absent from the surface as they have been picked up and placed in stone fences, which are common upon the limestone valley farms.

This soil is usually deeply weathered and comparatively free from rock outcrop. In places thin protrusions of the parent rock are found, but not in sufficient numbers to interfere with cultivation. Rock outcrops are found mostly along stream edges, where erosion has been active.

Small rounded knolls occur scattered over the type, upon which the shale fragments common to this soil are numerous enough to form a shale loam. These areas also carry a quantity of quartz fragments and are indicated upon the map by gravel symbols.

The Frankstown silt loam is derived from weathering in place of gray, highly siliceous limestones containing interbedded strata of soft, yellow, calcareous shale. This formation has been altered by high pressure, so that it is banded, the quartz having separated out into thin layers. The rocks have many parallel cleavage planes and upon weathering break up into slabs from 1 to 3 inches thick.

The Frankstown silt loam occupies practically all the upland of the Frederick Valley except the comparatively small area occupied by the Hagerstown soils. It occurs in an extensive belt beginning at the bottom land of the Potomac River, about 2½ miles southeast from Washington Junction, and extending in a general northeast direction to 1 mile north of Woodsboro. It is approximately 1 mile wide at the base but quickly widens out to an average width of 3 miles and finally comes to a point at its northern extremity where the formation pinches out. Several small detached areas occur as a narrow valley between the chains of hills that parallel each other from Laurel Hill to Greenfield Mills on the Monocacy River.

The topography is gently undulating and the surface fairly smooth. Although the land lies lower than the surrounding soils the drainage is well established. The drainage is partly internal, but not to the same extent as in the Hagerstown soils. Much of the water is carried off through the shallow basin streams that head back into the body of the type, usually in the colluvial phase. Erosion is not active upon this land.

The Frankstown silt loam is not quite so productive as the Hagerstown soils, but owing to its freedom from rock and the ease with which it is cultivated it is a desirable soil for farming. It is one of the most important soils in the county. About 90 per cent is cultivated and about 5 per cent is utilized for town sites. The remaining tree growth is confined to woodlots and scattered trees. The trees are hardwood, mainly oak, ash, hickory, walnut, elm, maple, and locust.

Wheat, corn, and hay (timothy) are the most important crops. Wheat occupies the largest acreage and is the principal cash crop. Rye, oats, alfalfa, potatoes, and vegetables constitute the minor crops.

Sweet corn, the largest special crop, is extensively grown in the vicinity of Frederick, Walkersville, and Buckeystown. Next to wheat, sweet corn is the cash crop second in importance. Most of the farms have small orchards, in which apples predominate. There are no commercial orchards. Vegetables are grown in abundance in home gardens. Trucking is carried on to a limited extent in the vicinity of Frederick. Only a small area is in permanent pasture. Dairying is developed to some extent upon nearly all parts of the type. The milk is shipped and forms one of the chief sources of income. Beef cattle are raised on some of the larger farms in the lower part of the Frederick Valley. Some of the corn is sold, and the rest, together with the hay, is fed to work stock, cattle, and hogs. Ensilage is fed largely to dairy cows and to some extent to beef cattle.

Corn yields range from 35 to 75 bushels per acre, with an average of about 50 bushels. Wheat yields 12 to 25 bushels per acre, with an average of about 15 bushels. On the better farms the maximum yield is 25 to 35 bushels. Irish potatoes yield 150 to 250 bushels per acre. Sweet corn produces 2 to 4 tons per acre; hay (timothy and clover), 1½ to 2½ tons; alfalfa, 2½ to 3 tons per season.

Much of this land is rented, especially the larger farms in the southern part of the area, known as the "manor farms." Most of the farms upon this soil have good houses, barns, and silos, and adequate outbuildings. Improved machinery is used, and the stock in general is of good quality. Sod land is usually turned about 8 inches deep in the late fall, left through the winter, and prepared and planted to corn in spring. Wheat follows corn. If the land is plowed when in proper condition, only two harrowings are needed before rolling for wheat. Wheat usually follows wheat. Timothy is seeded with the wheat in the fall, and clover is seeded in the spring. This is cut for hay the first and second years and used for pasture for one or two years. Manure is applied to sod land before turning. Almost no commercial fertilizer is used with corn. About 150 pounds of acid phosphate per acre is used for wheat alone, and 300 pounds when grass is seeded with the wheat.

The selling price of this land varies from $150 to $350 an acre, according to location and improvements. The average price is about $250 an acre.

The methods followed upon the better farmed land of this type give splendid results, but the methods used upon many of the rented farms have resulted in a partial depletion of organic matter and a lowering of production. More live stock should be kept, especially dairy cows, thereby increasing the supply of manure. If an increase of stock is not feasible, a shorter rotation could be practiced, such as (1) corn, (2) wheat, (3) clover. This would give a clover stubble

every third year. Alfalfa should be more generally grown, not only for its valuable hay but as a soil renovator. Alfalfa will succeed upon this land where the seed bed is properly prepared, limed, and inoculated.

Lime should be applied in larger quantities or more frequently to give the best results on this soil. However, liming should not be practiced unless the content of organic matter is increased. More acid phosphate could be used to advantage upon wheat. Where wheat precedes grass, 500 pounds can be used. The best results with corn are obtained where 200 or 250 pounds of phosphate is used.

Frankstown silt loam, colluvial phase.—The soil of the colluvial phase is a dark yellowish brown loamy silt loam, about 10 to 12 inches deep, grading imperceptibly into a yellowish-brown to yellow silty clay loam, slightly compact but friable. The soil and subsoil of this phase is fairly uniform throughout.

The areas of this phase are well distributed over the type and are derived from the same formation as the type, but much of the present soil has been washed down and accumulated at the base of slopes and in depressions. The phase occurs in irregular shaped areas, usually oval or following the outline of shallow basins that are really shallow drainage ways, except that there is no stream development. Streams head from many of these basins. The phase usually lies 10 to 20 feet lower than the type. Although this soil is found in depressed areas, the drainage is well established, being largely internal.

This phase is used for practically the same general farm crops as the typical soil and is handled in much the same manner. The yields average a little higher than the average for the type. Corn yields 45 to 85 bushels per acre, with an average of about 60; wheat, 15 to 25 bushels, with an average of about 18; hay, 2 to 3 tons per acre; and sweet corn, 3 to 4 tons per acre.

This phase is a valuable asset of farms located mainly on the typical soil, as it is better adapted to corn and grasses. Crops are usually surer on account of the better moisture conditions. This land, although well drained, is likely to carry more moisture than the higher soils and to remain cold later in the spring. Larger areas of corn could be grown to advantage, or corn could be used two years in the rotation. This soil should be used also for the production of timothy hay. A rotation that would be adapted to this land would be (1) corn (with cowpeas), (2) corn, (3) wheat, (4) and (5) clover and timothy cut for hay. This land furnishes good pasture, but is too valuable for crop production to be utilized for this purpose. Wheat has a tendency to lodge. This phase is better supplied with organic matter than the typical soil. Commercial fertilizers may be used in smaller quantities, as the soil receives some plant food and fertilizer washed from the adjoining fields.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the typical Frankstown silt loam:

Mechanical analyses of Frankstown 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.*
201601	Soil	2.2	3.1	1.2	4.2	13.7	53.4	22.0
201602	Subsoil	.9	2.5	1.2	3.6	10.5	51.7	29.4

COLBERT SILT LOAM.

The surface soil of the Colbert silt loam is a dark-gray heavy silt loam to loam, about 7 to 10 inches deep, passing into a subsoil of yellow mottled with drab, heavy, plastic, sticky, silty clay loam. In spots the subsoil is not quite so heavy and is gray mottled with drab and yellow. Small areas also contain gravel, scattered upon the surface, consisting mainly of rounded quartz. The soil is deeply weathered and only occasional fragments of limestone are found. Outcrops of limestone occur along the upper edges of the type.

This soil occupies low, fairly level positions, usually along the streams that issue from Catoctin Mountain or around stream heads that rise at its base. The type represents areas from which the material that overlies the remainder of the limestone formation has been removed by these streams. The drainage is imperfectly established. The surface is so low that there is little surface drainage, and the type is too near stream level to permit of much internal drainage. This leaves spots that are in a more or less marshy condition when not artificially drained.

The Colbert silt loam is not very extensive, occurring in comparatively small areas. The largest areas are found just south of Mount St. Marys, northeast of Thurmont, and south of Catoctin.

Practically all of the type is cleared and in pasture. Little of it is used for crops. The existing forest consists of hardwoods, oak, water oak, ash, and hickory predominating.

Corn, wheat, and hay (timothy) are grown upon the cultivated areas. These crops give only fair yields. The type furnishes good grazing, being covered with a sod of native grasses. Hay cuts about 1½ to 2 tons per acre and is the most profitable crop grown. There are indications that lime has been used in the past on some of this land. Little manure or fertilizer is used. Not as much attention is given to this soil as is given to the other farm soils.

The selling price of this land is comparatively low, ranging from $60 to $100 an acre, a few better located areas being higher. Much of this land forms parts of farms located upon surfaced roads, and

it is held at prices somewhat higher than its actual farm value would seem to warrant.

If properly drained and limed, this land could be brought up to a high state of productiveness. The soil is best adapted to timothy, and its smooth surface makes mowing easy. Alsike clover would probably succeed where other clovers would fail because of the acid condition of the land.

Piedmont Plateau.

Penn gravelly loam.

The Penn gravelly loam consists of a reddish-brown gravelly loam, underlain at about 6 to 8 inches by a red or Indian-red, slightly more compact subsoil. The gravel consists of small, blocky, red sandstone fragments and comprises about 20 to 40 per cent of the soil mass. The partly disintegrated parent rock is usually encountered at 24 to 36 inches below the surface, or the blocky fragments become so numerous that boring is prevented below that depth.

In small areas of this type the gravel consists in part of rounded quartz pebbles. In other places, usually upon the steeper slopes, pieces of sandstone from 1 to several inches in diameter are found. Spots of sandy stony loam are encountered near Bloomfield. The stone upon some of these spots is gray. These variations were too small to map separately.

The Penn gravelly loam occupies broken or sloping areas along streams or upon well-developed ridges throughout the region occupied by the Penn soils. The largest areas of the type are found 1½ miles west of Frederick, between the National Pike and the Hagerstown & Frederick Railroad extending west nearly to Fuller, and south of Hansonville. The topography is usually steeply sloping to sloping, or rolling to hilly. The drainage is excessive, owing to the slope and to the porous nature of the substratum. Erosion is not as active as might be expected from the topography, as the surface is protected by the gravel mulch. Only in a few places is the type too steep to cultivate successfully, and only in a few places is there sufficient rock to interfere with tillage. However, because of its topography, it is less desirable for farming than the silt loam of the series.

The more gently sloping areas and ridges are utilized for crop production, and the steeper, rougher parts are in forest. Possibly 60 or 70 per cent of the type is cleared and under cultivation. The remaining forest consists of white oak, chestnut, and hickory, with some cedar and pine on the thin, stony places.

As this type usually forms part of farms on the Penn silt loam it is, with a few exceptions, utilized for the same crops. The same

general practices are followed, but the yields are slightly lower. Less attention is given to this soil than to the silt loam. Improved machinery can not be used in many places, although the topography of much of the type will permit of the use of mowers and reapers. Possibly more corn is grown than wheat, on account of the steep surface. Some of this land is used for pasture, being fenced with the bottom land. It does not furnish very good native grass, but this is supplemented by seeding a mixture of tame grasses. Dairy cattle, beef cattle, and hogs are kept. A number of good peach and apple orchards are located upon this land, mostly upon the hill or ridge parts of the type and rarely upon the slopes along the edge of stream bottoms. Some of these are extensive enough to be termed commercial orchards. The trees seem to be in a healthy condition and the fruit is of good quality.

The methods of improvement recommended for the Penn silt loam can be applied to this type. The rougher areas should be kept in forest or, if cleared, they should be kept in sod. Orchards, especially of peaches, should be extended, as the type is well suited to the production of this fruit.

PENN SILT LOAM.

The soil of the Penn silt loam is uniformly an Indian-red to reddish-brown mellow silt loam, underlain at 8 to 10 inches by a red to Indian-red silty clay loam subsoil, fairly compact but smooth and friable. In both soil and subsoil small blocky fragments of sandstone are found. The formation giving rise to this soil is not deeply weathered, and in many places the partly disintegrated rock comes within the 3-foot section, usually below 30 inches. This shallow condition occurs in small spots over most of the type and is prominently developed in the upper Monocacy Valley between Emmitsburg and Creagerstown. These areas are irregular in occurrence, lying mainly along the slopes to the streams in the more level sections, usually in places where shale predominates.

Over a considerable area of this type southeast of Thurmont rounded quartz gravel is scattered over the surface and embedded in the soil. This gravel varies in size from 1 inch to several inches in diameter, and is derived from rock foreign to the formation giving rise to the remainder of the soil material. It is not present in sufficient quantity to interfere with cultivation or materially alter the character of the soil. Small areas have a noticeable amount of fine and medium sand. These sandy areas lie between Doubs and Church Hill and between Furnace Branch and the mouth of the Monocacy River along the Montgomery County line. Finely divided particles of mica also are present in both the parent rock and the soil.

The Penn silt loam is extensively developed over the upper Monocacy Valley, where it occupies most of the upland. The southern limits of this development extend from the Carroll County line near Union Bridge in a sweeping semicircle to where the Pennsylvania Railroad crosses Double Pipe Creek, thence along the line of the railroad to New Midway, and on through Hansonville to Indian Springs. This soil also exists in fairly large areas in the region south from the Hagerstown & Frederick Railroad to the Potomac River bottom land and between the foothills of Catoctin Mountain and the Frederick Valley.

The type has a fairly smooth surface, the topography being almost level to gently undulating or slightly rolling. It occupies the more level areas back of the breaks to the streams. Drainage is well established over most of the type, shallow stream basins ramify nearly all parts of it. There are a few flats or depressions around stream heads and upon level areas, where the soil is shallow and drainage is imperfect, but most of the poorly drained areas have changed color through deoxidation and have been mapped as another soil type. Most of the drainage is accomplished through surface channels. The close structured shale generally prevents the downward movement of water, but there is evidence in places of internal drainage. East of Thurmont a number of sinks are found, which indicate that the soil is closely underlain by limestone at this point. The shallow areas do not hold moisture well, and crops suffer during dry seasons.

The Penn silt loam is one of the important soils. Nearly all of it is cleared and cultivated. The only remaining tree growth is found in woodlots and consists mainly of white oak, ash, and hickory.

Wheat, corn, and hay (timothy and clover) are the most important crops. Small acreages are planted to oats, rye, millet, and Irish potatoes. Dairying is extensively developed over the parts of the type in reach of transportation. Fattening beef cattle is carried on to some extent, especially upon the farms in the northeastern part of the Monocacy Valley. Practically all the farms have a number of hogs and some poultry. Most of the farms have small orchards and nearly all have gardens, which produce the fruits and vegetables common to this region. Sweet corn is grown as a special crop on this land in the central part of the county, where it is in reach of the canneries at Frederick, Buckeystown, and Walkersville. Little permanent pasture is maintained, except upon the poorly drained spots. Most of the pasture is provided by hay land between the time the timothy begins to fail and the time the sod is turned under for corn.

This land is fairly shallow and is known as light land. Where not improved by liming, manure, or turning under of sod, and fertilized, its crop production is low. Most of this land is well farmed, with the

result that the average yields run higher than might be expected from this class of land. Wheat yields range from 10 to 25 bushels per acre, with an average of about 20 bushels. Corn yields 25 to 65 bushels per acre, with an average of about 40 bushels. Hay cuts about 1½ to 2 tons per acre. Most of the hay is timothy, as more of this crop is grown than is usually found on other upland soils.

Most of the farms on this type are of moderate size, ranging from 75 to 125 acres, and are largely operated by the owners. The regular 5-year rotation is commonly followed, (1) corn, (2) wheat, (3) wheat, (4) and (5) hay (clover and timothy). This rotation is often extended to 7 years, permitting the grass land to be grazed. The second year of wheat is often omitted, this practice being more common on the dairy farms. Lime, about 25 to 35 bushels per acre, is applied once during each rotation. Acid phosphate or bone meal, 250 to 300 pounds per acre, is used with wheat. This land is easy to plow and comes into good tilth readily, requiring very little disking or harrowing.

Land of this type, owing to the ease with which it is cultivated, its smooth surface, absence of rock outcrop or other obstacles, and its general desirability for farming, commands a price equal to that of naturally stronger soils. It sells for $50 to $250 an acre, according to location and improvements. The average price is about $150 an acre.

As this soil does not hold moisture very well, it is necessary in its proper management to increase the moisture-holding capacity and conserve the moisture supply. By turning under sod or cover crops, using manure, and plowing deep the retentiveness of the soil is considerably increased. In cultivating the land a soil mulch should be kept by frequent disking or harrowing, or by using a disk-packer. Lime should be applied at the rate of at least 50 or 60 bushels per acre during each rotation. As this is naturally a light soil, suitable commercial fertilizers should be used with practically all crops. Applications as high as 500 pounds per acre will give good results. This land is well suited to timothy. More attention should be given to the selection of timothy seed. The poorly drained spots should be artificially drained unless they are to remain in permanent pasture.

LANSDALE SILT LOAM.

The Lansdale silt loam is a yellowish-brown mellow silt loam, about 7 to 10 inches deep, underlain by a subsoil of mottled yellow, brown, and drab silty clay loam. The subsoil is firm but not as compact or heavy as in most of the valley soils. The color of the soil and subsoil varies with the drainage condition. In poorly drained spots the soil is gray and the subsoil drab mottled with gray, yellow, or yellowish

red. In better drained spots and where the soil grades into the Penn silt loam, the surface soil is brown and the subsoil yellowish brown mottled with red, or red mottled with yellow or gray. Only a few fragments of parent rock are seen, although these rocks are found locally within the 3-foot section.

The type occurs as flat areas in depressions around stream heads, in swales, and in the low areas adjacent to the ridges formed by the dikes of trap rock which traverse the region.

The type occurs in relatively small oval-shaped or oblong areas scattered throughout the Penn soils. It is most prominently developed over the upper Monocacy Valley. The largest areas are found around the headwaters of Cattail Branch in the northeastern part of the county, one-half mile southeast of Fuller in the south-central part, and 1½ miles south of Mountaindale in the central part of the county. The topography is nearly level to gently undulating or gradually sloping. Owing to the flat surface, drainage is poorly established.

The soil is not important because of its small area and poor drainage. Most of it, however, is cleared and used either for pasture or cultivated crops. A number of woodlots are located upon this soil, which consist principally of white oak and hickory with a scattering of swamp oak (pin oak).

Very little of this type is in cultivated crops, it is used for tilled crops only where it forms part of a field largely composed of Penn silt loam. Most of the cleared part is in permanent pasture or meadow. The permanent pasture consists to some extent of native grasses, but is supplemented by pastures of tame grasses. Corn, wheat, and oats are grown a little, but give only fair yields. Hay (timothy) yields 1½ to 2 tons per acre, making the best returns of any crop upon this soil.

Little attention is given this land; since it forms part of Penn silt loam farms which contain plenty of arable land, the poorly drained land is usually included with the woodlot or permanent pasture. Some open ditches have been placed along the low places or natural drainage ways, but very little of this soil has been tile drained. When cultivated it receives about the same treatment as the Penn silt loam. The Lansdale silt loam is commonly included in farms with other soils and sells for $50 to $100 an acre. It does not occur in areas extensive enough to have a separate selling value.

The first step in the improvement of this land is to provide better drainage. A system of tile drains should be installed to give the best results. After being properly drained and heavily limed, it will have about the agricultural value of the Penn silt loam. Alsike clover would probably succeed upon much of this land in its present condition. Until thoroughly drained it is best adapted to grass and should be used for hay or pasture.

LEHIGH GRAVELLY LOAM.

The surface soil of the Lehigh gravelly loam is a grayish-brown to bluish gravelly loam, about 8 to 10 inches deep. The interstitial material is mellow in structure. The subsoil is a grayish-yellow gravelly clay loam, somewhat compact but friable. The gravel content consists of blocky gray to blue sandstone fragments, shale chips, and some angular quartz fragments. These are strewn upon the surface and nearly everywhere comprise about 20 per cent of the soil mass. Weathering is not deep; the partly disintegrated rock comes within the soil section in many places and is rarely more than 4 feet below the surface. The type is derived from Triassic sandstone and shale, metamorphosed by the intrusion dikes of igneous rock. In places these dikes outcrop and in other places they force the overlying Triassic formation into ridgelike position, standing well above the general level of the formation. The metamorphosed rock is a gray sandstone interbedded with strata of bluish-gray shale. Characteristic rounded bluish-colored stones of fine texture are present in the partly disintegrated rock or substratum.

The type is developed in the northern part of the county between Emmitsburg and the Pennsylvania State line. Narrow strips of this soil are found along the edges of the dikes of trap rock that extend southward across the Triassic formation. In most cases these areas were too narrow to map. Yellowish-brown to bluish-gray, fine-grained, blocky stone fragments, ranging from a few inches to a foot in diameter, occur in these positions. These small areas represent a stony loam and are included with the Iredell soils developed upon the dikes. Small spots of loam and silt loam that are comparatively free from gravel are present in the more level upland, upon gentle slopes, or near the base of the ridges. Those last mentioned are included with the Lansdale silt loam. As the Lehigh soils occur closely associated with the Penn soils, there are areas in which the surface soil is brown and the subsoil yellowish brown to reddish brown, and the gravel varies from gray to red sandstone fragments.

The Lehigh gravelly loam has a gently rolling to ridgy topography. Surface drainage is well established. The soil is shallow and has a relatively small storage place for moisture, consequently crops often suffer in dry weather.

Owing to the small extent of this soil it is not important, though most of it is cleared and utilized for cultivated crops. The tree growth consists mainly of white oak and hickory, with some pine and chestnut in places where the soil is extremely shallow. The same crops are grown as upon the Penn silt loam, but the yields are slightly lower. The same farm practices are followed. General farming and stock raising are carried on more than dairying, owing

to the location of the type somewhat distant from railroads. The price of this land varies from $40 to $100 an acre.

The same recommendations may be followed in the improvement of this land as given for the Penn silt loam.

ATHOL GRAVELLY LOAM.

The Athol gravelly loam has a surface soil consisting of 8 to 10 inches of brown loam containing a quantity of rounded and subangular quartz gravel. Below this is a layer, 2 to 5 inches thick, of yellowish-brown to yellow or reddish-yellow light clay loam, also containing quartz fragments. The subsoil proper consists of a somewhat heavy red clay, friable but slightly plastic, and containing gravel. Gravel forms 30 to 40 per cent of the entire soil mass and is composed of rounded or waterworn quartz pebbles, varying from one-half to 2 inches in diameter, with an average of about 1 inch. In general the type is deeply weathered, but in places bowlders of the parent rock protrude. These stony areas are more pronounced near Washington Junction, and are indicated on the map by rock outcrop symbols.

This type is developed along the edge of the Triassic formation. The largest areas lie in a strip about one-half mile wide from Feagaville to Washington Junction, and in intermittent areas from the vicinity of Shookstown to the base of Chestnut Hill west of Woodsboro. A few scattered areas occur in the vicinity of Lewistown between the outcrop of Triassic sandstone and the base of Catoctin Mountain. Narrow strips also commonly occur along the base of the hills upon which the Triassic sandstone outcrops and joining the limestone valley, where the surface material is derived in part by colluvial action from the higher lying Penn soil and the subsoil is derived from the underlying limestone. The soil of these areas is usually reddish brown, very closely resembling the Penn soils, while the subsoil is usually yellowish brown to red and resembles the Hagerstown subsoil in structure and color.

The topography is gently undulating to gently sloping. The drainage is well established, largely through surface channels.

This soil is not very extensive in area, but is a strong soil and fairly important. Most of it is cleared and used for farming. The stony areas are mostly in timber. The existing tree growth consists of hardwood, oak, hickory, walnut, and locust predominating.

The Athol gravelly loam is very closely associated with the Limestone Valley soils and is used for about the same crops. Wheat, corn, and hay (timothy and clover) are the chief crops. Dairying is developed upon this land in the vicinity of Frederick. Beef cattle are raised or fattened in the southern part of the county. Hogs and poultry are kept on nearly every farm. Fruit is not grown in

commercial quantities. Vegetables are grown on every farm, and the surplus upon the farms near Frederick is disposed of in that market. Sweet corn is the only special crop grown. Wheat yields 15 to 30 bushels per acre, with an average of about 20 bushels. Corn yields 25 to 70 bushels per acre, with an average of about 40 bushels. Hay cuts 1½ to 2 tons per acre; sweet corn yields from 2 to 3½ tons per acre. The same system of farming and the same methods and practices are followed as upon the Hagerstown loam.

The selling price ranges from $150 to $350 an acre, with the average about $200.

The same methods for improvement may be followed as recommended for the Hagerstown loam.

Athol gravelly loam, yellow subsoil phase.—The soil of this phase is a dark-brown mellow loam, about 8 to 12 inches deep, underlain by a yellow to yellowish-red, heavy, fairly plastic clay to clay loam. The gravel content is approximately the same in character and amount as found in the typical soil. This phase is less deeply weathered than the typical soil, the parent rock in places lying at 24 to 30 inches below the surface, and ledges occasionally outcropping. This phase occupies a somewhat lower position and has a more level or gently sloping topography than the typical soil. The drainage depends largely on the run-off and is not well established in places.

This phase is practically all cleared and used for crop production. It is used for the same crops as the typical soil, but is not as well farmed, and yields range slightly lower. A larger proportion is in permanent pasture. The price of this phase ranges from $100 to $250 an acre.

In general the methods for improving the main type can be used on this phase. Some of the lower areas might be improved by tile drainage or the clearing out of the main drainage channels. Alsike clover could be used to advantage where red clover will not grow.

CHESTER STONY LOAM.

The soil of the Chester stony loam is a grayish-brown or pale-yellow stony loam to silt loam, about 7 to 10 inches deep, underlain by a yellow, friable, fairly firm silty clay loam subsoil. The rock content consists of bowlders and outcrops of quartz and quartzite and slabs of schist and slate. Small quartz, schist, and slate fragments occur on the surface and in the lower subsoil. Finely divided mica gives a greasy feel to the subsoil in many places. The formation is not deeply weathered, but the parent rock is usually not encountered at depths of less than 4 feet. Here and there ledges of quartzite outcrop.

The type is developed in small circular or oblong areas capping the hills or ridges of the Linganore Hills region. It lies about 50 to 100

feet higher than the surrounding country. The topography is rolling to hilly and the drainage is excessive. The knolls and ridges occupied by this type are for the most part covered with a forest consisting of chestnut and chestnut oak, with a scattering of white oak and other hardwood trees. So little of the type is under cultivation that it might be considered nonagricultural. It invariably forms the woodlot upon the farms where it occurs. Where cleared of trees and rocks it has about the same crop value as the gravelly loam. The Chester stony loam has a very low market value. Favorable areas can be utilized for fruit culture, and it also has value as pasture.

CHESTER GRAVELLY LOAM.

The Chester gravelly loam consists of surface soil of a pale-yellow or grayish-yellow loam to silt loam about 7 to 10 inches deep, passing into a subsoil of yellow to yellowish-brown, friable, fairly firm silty clay loam. The lower subsoil has a greasy feel, owing to the presence of small mica flakes. Scattered upon the surface and throughout the soil are varying quantities of angular quartz fragments, and many small blocky chips of yellow schist, and also thinner platy fragments of slate. The latter two increase in numbers in the lower subsoil. This gravel imparts a porous or open structure to the soil, but does not occur in sufficient quantity to interfere greatly with cultivation. The formation from which this type is derived is not weathered very deeply. Loose disintegrated rock is often encountered at 24 to 30 inches and is generally present within 4 feet of the surface. In places a few small quartz bowlders are scattered over the surface, and at Chestnut Hill there is a quantity of rounded quartz gravel upon the surface and mixed with the soil.

This type occurs on low rolling ridges or hills and along the fairly steep hillsides in the Linganore Hills region. It is developed chiefly in a belt extending south from Ladiesburg, between Libertytown and Mount Pleasant, to Bush Creek, near Ijamsville. A narrow strip extends south from Reels Mill to Park Mills. From here one arm passes north of Sugar Loaf Mountain along Bennett Creek to within about 1 mile of the Montgomery County line. South from Park Mills it extends in a fairly broad belt to the bottom land of the Potomac River. These belts of the soil are intermittent, being broken by areas of Chester loam.

The drainage is through surface channels and is thorough. The hillsides sometimes suffer from erosion where freshly plowed or left exposed during winter.

The Chester gravelly loam is fairly extensive, and is used largely for crop production, but is not an important soil. About two-thirds is cleared and under cultivation. It is locally known as "chestnut

land," as the chestnut is the prevailing tree in the forest growth. In addition there is a scattering of oak, poplar, and hickory.

The same crops are grown as upon the Chester loam, but the yields are slightly less. Corn yields 15 to 50 bushels per acre, depending upon the season, the condition of the land, and the commercial fertilizer used. Wheat yields 8 to 25 bushels per acre, with an average of 10 or 12 bushels.

The same methods of farming are followed as upon the Chester loam. The land is inclined to be more droughty than the loam type, and crops are apt to suffer during a dry season.

This land sells for $75 to $150 an acre. If segregated it would probably sell for less.

The same methods are recommended for improvement as used upon the Chester loam. More care should be taken to keep the surface protected to prevent needless washing.

CHESTER LOAM.

The Chester loam is a brown to yellowish-brown mellow loam to silty loam, about 8 to 10 inches deep, passing into a yellow or yellowish-brown to reddish-yellow, firm, friable clay loam or silty clay loam, which extends to depths of more than 3 feet. Only a few scattered fragments of schist, slate, and angular quartz are present on the surface or mixed with the soil or subsoil. Under forest conditions the immediate surface material is darker and the underlying soil is pale yellow. In plowed fields when dried out the soil is gray. Spots in which the subsoil is yellowish red, brown, or even red occur, but they are small and of little importance.

The Chester loam is not extensive in this area. Areas of it are scattered over the Linganore Hills region, where they occur on somewhat flattened ridge tops, gently rolling hills, or sloping benches. The largest areas lie in the region south from Union Bridge to Clemsonville, south of Ladiesburg, around Centerville, at New Market, and on the Frederick Pike 2 miles west of New Market. Most of the type lies between 400 and 600 feet above sea level. The drainage is through surface channels and is well established.

The Chester loam, while not extensive, is an important soil type. About 85 to 90 per cent is cleared and under cultivation. The uncleared area consists mainly of woodlots, in which the prevailing growth is white oak, chestnut, poplar, and hickory.

The most important crops are wheat, corn, and hay (timothy and clover). Wheat is grown on a larger acreage than corn and is the principal cash crop. Dairying is highly developed upon the farms that are near transportation; on others the chief forms of live-stock industry are hog raising and fattening of steers. Upon the dairy

farms corn is grown on an acreage equal to that of wheat. Fruit is grown to a very limited extent, mainly in home orchards.

The yields upon this type vary between wide limits according to the condition of the farm, that is, whether it has been handled properly or allowed to run down. They vary also with the amount of fertilizer used. Ordinarily corn yields 30 to 60 bushels per acre, wheat 15 to 25, hay 1 to 2 tons, and Irish potatoes 100 to 200 bushels per acre.

The Chester loam is easily plowed and requires relatively little preparation before planting, as it does not clod or bake. When sod land or stubble is turned under, disking a few times brings the field into good tilth. Most of this land is well farmed. The farmers follow a systematic rotation, corn 1 year, wheat 2 years, followed by hay (timothy and clover). The area in grass is utilized for pasture after the second year of hay. The period that the land remains in sod varies considerably, ranging from 1 to 3 or 4 years, according to the needs or inclinations of the farmer. Lime is usually applied once during each rotation at the rate of 20 to 45 bushels per acre. Acid phosphate or bone meal is used upon wheat, 250 to 300 pounds per acre, and is sometimes used upon corn. The available manure is applied to sod land before turning.

The Chester loam sells for $100 to $250 an acre, according to improvements and location.

This soil responds readily to improvement and fertilization, but deteriorates rapidly when neglected. The most important thing to be considered in keeping up the fertility of the land is the supply of organic matter, the supply of which must be maintained to get the best results. This can be done by turning under sod land more often through shortening the rotations, and by planting cover crops, preferably legumes. Manure should be used where available. This can be obtained economically where dairying or stock feeding are followed. Lime should be applied liberally once during each rotation, providing the rotation is not longer than 5 years. Heavy applications of commercial fertilizer can be made profitable with all crops grown. Where manure is used and legumes are grown the nitrogen element of the fertilizer may be omitted. Acid phosphate, at the rate of 250 to 500 pounds, can be used to advantage, the heavier applications upon wheat followed by grass. Special fertilizers should be used for truck crops or tobacco. This soil is used in some sections for growing tobacco. The yield is not as large as on some types, but the grade is usually good.

Chester loam, red phase.—The surface soil of the Chester loam, red phase, is a brown to reddish-brown mellow silt loam, about 7 to 10 inches deep, which passes into a subsoil of red silty clay loam,

firm, fairly compact but friable, extending to 3 feet and deeper. A few fragments of partly rotted schist and slate are scattered on the surface and throughout soil and subsoil. In places there are noticeable quantities of schist and slate fragments in the lower subsoil and substratum. The phase is deeply weathered over most of its area.

Small spots are found in which the surface soil is yellowish brown and the subsoil is yellowish red, with the structure the same as the remainder of the phase. In places there is a noticeable amount of mica, but in no place does the content of mica compare with that in the Manor soils.

The Chester loam, red phase, is developed in a large body covering about 5 square miles, west of Urbana. Small scattered areas are encountered in other parts of the Linganore Hills region. The phase has a fairly level to gently undulating topography. Drainage is well established, shallow stream basins ramifying all parts of the phase.

This is one of the important soils of this section of the county. It is nearly all cleared and under cultivation, and comprises some of the best farms of the Urbana district. The existing forest, confined to woodlots, is hardwood, with white oak predominating. The second growth is largely locust.

General farming and stock raising are followed. Corn, wheat, and hay (timothy and clover) are the leading crops. The yields compare favorably with the other important soils of the county. Corn yields 30 to 60 bushels per acre, wheat 15 to 25 bushels, hay $1\frac{1}{2}$ to 2 tons per acre. Dairying is developed to a small extent. Feeding beef cattle is the leading live-stock industry. Some hogs are kept on every farm.

The same farm practices and methods are used as upon the Chester loam and other soils of the Linganore Hills region. The same rotations are followed, the same practices in the use of lime, manure, and fertilizers. This soil is fairly strong and retains the improvements made upon it. It is moderately retentive of moisture, and crops do not suffer during dry seasons as much as upon most of the soils of the phyllite and slate region. It has, in common with the other soils of this region, including the "slate" and "chestnut" soils, the characteristics of a mellow soil that is easy to till and requires little effort to bring into good tilth.

This land is valued highly for farming, and little of it is upon the market. Its value is estimated at $100 to $150 an acre. This low valuation is probably due to the fact that it is situated at some distance from facilities for transportation.

The same methods may be followed in improving the soil as given for the typical Chester loam. Alfalfa should succeed upon this land if it is limed and inoculated and the seed bed properly prepared.

MANOR SLATE LOAM.

The Manor slate loam as developed in Frederick County has many variations. Most of the type has a surface soil of brown mellow loam, about 7 to 10 inches deep, filled with thin platy gray to brown slate fragments. The subsoil is a red to reddish-brown, smooth, greasy silty clay loam, not very compact, and containing a quantity of brown or reddish slate fragments. These fragments of slate are soft and have a high content of mica. Finely divided mica also is present throughout the soil material. The partly disintegrated parent rock is encountered in the lower subsoil and in places comes near the surface.

Small areas are found where the surface soil is grayish brown or yellowish brown, and the subsoil is yellow to yellowish brown or yellowish red but has the characteristic structure of the Manor material.

Some of the areas derived from black, bluish, and purplish slates were included with this soil. They have a dark-gray surface soil and a steel-gray or purplish-gray subsoil. Both soil and subsoil are filled with dark-gray or steel-gray, thin, platy fragments of the parent rock. These areas also have the characteristic structure of the Manor soils, differing from them only in color.

The topography is gently undulating to rolling or hilly. In many places the type occupies hillsides along streams; in others the slopes of ridges; and in some places it extends over their crests. The drainage is through surface channels and is excessive, erosion being active upon the exposed steeper slopes. In dry seasons crops suffer for want of moisture. The type is extensively developed over the eastern part of the county in the Linganore Hills region.

About 60 to 65 per cent of the type is cleared and under cultivation. The uncleared area supports a forest growth mainly of chestnut, with a scattering of oak and other hardwood trees.

Land of this type is used for the same crops as the Manor loam, but gives slightly lower yields. The same distribution of stock is found. More of this land is used for orcharding than of the Manor loam. Several commercial peach and apple orchards appear to be in thriving condition. The same methods of cropping and fertilization are used as upon the Manor loam.

The Manor slate loam sells for $50 to $100 an acre, with a few of the more favorably located places held at higher prices.

There is more danger from erosion upon this soil than upon the Manor loam or Chester loam, and the hillsides should be protected from washing by growing cover crops or keeping them in sod, planting tilled crops as little as possible. Aside from this the same methods for improvement may be used as recommended for the Manor loam and Chester loam.

MANOR GRAVELLY LOAM.

The Manor gravelly loam is similar to the Manor slate loam, except for the presence of many angular quartz fragments and also a larger quantity of black schist fragments. The subsoil is not predominantly red like that of the slate loam, but otherwise it has the characteristics of the Manor soils. It occupies the same topographic positions and is developed over the same general region as the slate loam, the larger areas being found in the extreme eastern part of the county, north and east of Monrovia.

It is utilized for crop production to about the same extent as the Manor slate loam. The same crops are grown, with about the same yields. It is handled in essentially the same way as the Manor slate loam. There is little difference in the price of the two soils. The methods suggested for the improvement of the Chester loam and other "chestnut land" may be used upon this soil.

MANOR LOAM.

The Manor loam, as typically developed, has a surface soil of a yellowish-brown or brown loam to silty loam, light and fluffy in texture, and 7 to 10 inches deep. The subsoil is a yellow to reddish-yellow or yellowish-red, slightly compact, smooth, light clay loam, containing enough finely divided mica to give it a slick or greasy feel and friable structure. Many small, thin, platy, soft slate fragments are scattered upon the surface and throughout soil and subsoil. These increase in number with depth, until the soil, below 30 to 36 inches, is almost entirely composed of the partly disintegrated rock. Scattered upon the surface and throughout the soil profile are small angular pieces of quartz derived from the thin quartz veins that occur in the slate formation.

This soil is derived from the weathering in place of a gray or buff-colored slate containing beds of steel-gray, purple, and black slate. In places the weathered subsoil is red in color and the surface soil is reddish brown. The areas are usually found upon the better drained or aerated knolls or ridges. The soil in these areas has the characteristic structure of the Manor series.

The Manor loam occurs on ridge tops and upon low rolling hills and gently sloping hillsides. The type has a fairly smooth topography. The drainage is mostly through surface channels and is thorough. Erosion is not so active as upon the Manor types that occupy steeper topography. The type is developed in irregular areas in the extreme eastern part of the county.

The loam is not as extensive as the other Manor soils, but it is a better soil and more important to the agriculture of the county. About 75 per cent of it is cleared and under cultivation. The forest consists

mainly of chestnut and chestnut oak, with a scattering of white oak and other hardwood trees. It is locally known as chestnut land.

Corn, wheat, and hay (timothy and clover) are the principal crops. Corn is not grown as extensively as upon the Limestone Valley soils. The crop yields vary between wide limits, according to the state of fertility of the land and the amount of fertilizers used. Corn yields 25 to 60 bushels per acre; wheat 15 to 25 bushels per acre; hay 1 to 1½ tons per acre. Tobacco is a special crop on the type along the Montgomery County line. It produces 800 to 1,000 pounds per acre, according to the season and effectiveness of the cultural methods employed. Dairying is developed upon this land where it lies near to transportation facilities. Feeding beef cattle is an industry that is given some attention. Hogs and poultry are kept on nearly every farm.

This land is light and requires comparatively little labor to bring it into good tilth. There is little tendency to clod or bake upon drying. Cultivation, except where sod land is turned, is shallow, and land is disked to bring it into condition for seeding. When wheat follows corn, disking is all that is required in preparation of a seed bed. Lime is used at the rate of 20 to 35 bushels per acre. Acid phosphate is used for wheat, about 250 to 350 pounds being applied. Less is used for corn, and manure is applied to sod land before turning. Large quantities of commercial fertilizer are used with tobacco. It has only been since the introduction of commercial fertilizer, some 25 or 30 years ago, that this land and its associated soils have developed agriculturally.

The Manor loam sells for $100 to $150 an acre, with the price of the more favorably located and the better improved farms ranging higher.

Suggestions for improvement of the Chester loam also apply to this land.

CARDIFF SLATE LOAM.

The interstitial soil material of the Cardiff slate loam is a grayish-yellow or dull yellowish brown silt loam to loam, friable in structure, to a depth of about 6 to 8 inches, where it passes into a layer of a few inches of dull yellowish brown to grayish-yellow heavy loam. The subsoil consists of a yellow friable silty clay to clay loam. Both surface soil and subsoil contain quantities of blocky gray slate and schist fragments, which increase below 30 inches to such an extent as to exclude all but a small part of the clay material. The unweathered or partly disintegrated rock is encountered at 4 to 6 feet. In places, especially upon the steep slopes, slablike pieces of slate several feet in length are common. A few pieces of quartz rock are scattered upon the surface. The slate fragments give a porous structure to the soil and subsoil. They do not interfere seriously

with cultivation. Their presence on the surface helps to conserve moisture during dry seasons. The drainage is usually excessive. Erosion is not active, although the slopes are steep.

The Cardiff slate loam occupies well-defined ridges standing 100 to 150 feet above the surrounding country. These ridges are about one-half mile wide, are fairly smooth on top, and usually have fairly steep sides. They extend in a general northeast-southwest direction from New Midway to the Potomac River bottom land at Tuscarora. For most of the distance there are two parallel ridges, about one-fourth to one-half mile apart, separated in most places by a narrow limestone valley and at other places by the Monocacy River. The western edge of this ridge belt forms the escarpment along the eastern edge of the Frederick or Limestone Valley. The more eastern of the ridges merges in many places with the Linganore Hills.

This soil is not one of the important types. Possibly 60 or 65 per cent is cleared and under cultivation. The remainder is wooded, chiefly with chestnut, chestnut oak, white oak, and a scattering of other hardwood trees. Locust occurs in fence rows. This soil has about the same crop value as the Chester gravelly loam. Corn yields 25 to 50 bushels per acre, according to the season and the condition of the land. Wheat yields 10 to 20 bushels, with an average of about 18 bushels. Hay (clover and timothy) yields 1 to 1½ tons per acre. These are the principal crops grown. There are a number of orchards, in which apples and peaches predominate. Dairying is developed to a small extent, and fattening of beef cattle is carried on to some extent. There is a fair acreage in pasture, including the wooded slopes that are utilized as a range for cattle, sheep, and hogs.

The same methods of farming are followed as on other types in the Linganore Hills, and lime and commercial fertilizers are used in about the same quantities.

The selling price of the land varies greatly, according to location, improvements, and topography. The range is from $65 to $150 an acre and the average probably about $100 an acre.

The same methods for improvement can be adopted as upon the Chester and Manor soils. This soil is especially adapted to fruit growing, as the porous nature of the subsoil is well suited to a good root development, and the topography favors good air drainage. The type is probably better suited to orcharding than to any other industry.

CONOWINGO GRAVELLY SILT LOAM.

The Conowingo gravelly silt loam is dark gray in the surface few inches, and a pale-yellow to dull yellowish brown silt loam to a depth of about 5 to 8 inches, where it passes into a yellow, heavy, intractable clay, which may be mottled with drab in places or may contain a

few black streaks or mottlings. The clay is plastic when wet and very hard when dry. It is tenacious and impervious to water. In places the greenish fissile serpentine rock from which the soil is derived is encountered at 24 to 30 inches; this may be dry in many places where the upper subsoil contains considerable moisture. Small iron concretions occur upon the surface and scattered throughout the soil and subsoil in quantities sufficient to form a gravelly silt loam. Fragments of black or dark-brown honey-combed rock, coming from the underlying formation, are scattered upon the surface in places. Peculiarly shaped dark-colored bowlders protrude from the surface in places. Where plentiful these are indicated on the map by rock symbols.

This soil is developed in narrow belts through the central part of the Linganore Hills region, extending from near Clemsonville to Green Valley east of Urbana, the largest developments occurring between New London and New Market. It occupies fairly smooth to gently undulating country, which becomes hilly along the streams. The drainage is dependent entirely on surface streams, and spots in which the drainage is not thorough occur.

The Conowingo gravelly silt loam is not an important soil. Probably about half of it is cleared and under cultivation. The forest growth consists largely of white oak, with a scattering of other hardwood trees. The cleared area is devoted largely to permanent pasture. The cultivated areas are used for wheat, corn, and hay, largely timothy, as clover does not seem to thrive. Corn yields 15 to 40 bushels, wheat 12 to 15 bushels, hay about 1 ton per acre.

The soil is handled in much the same manner as the adjoining Chester loam, except that, in general, it is not as well farmed.

The Conowingo gravelly silt loam sells for $65 to $85 an acre, with a few better located areas held at higher prices.

The soil bakes upon drying and is cultivated with difficulty, which accounts for the small acreage devoted to tilled crops. The soil can be improved by turning under cover crops and sod. It should be heavily limed at least once during each rotation. This land can best be utilized for grass and small grains. Alsike clover would probably succeed where red clover will not catch. Bluegrass does fairly well and should be seeded where pasture is desired. Cattle raising, especially fattening of beef cattle, should succeed upon this land, owing to the good pasture afforded, and could be made a means of bringing run-down fields up to their former productiveness.

MONTALTO STONY CLAY LOAM.

The Montalto stony clay loam, as typically developed in this area, has a surface soil about 5 to 8 inches deep, of brown to rusty-brown, heavy silty clay loam to clay loam, carrying large quantities of stones.

This grades into a subsoil of yellowish-red to red heavy stony clay loam, compact and somewhat plastic, which grades at about 15 to 20 inches into a buff-colored or yellowish-red gritty clay loam, less compact than the upper subsoil. The stones consist of fragments of the parent schist rock and diorite, the former blocky, the latter rounded. Some of the bowlders of diorite, known locally as ironstone, are several feet in diameter. The blocky schist fragments are rarely more than 6 inches in diameter and are less numerous than the diorite bowlders. The bowlders show a characteristic concentric weathering. The hard unweathered rock is usually 4 to 10 feet below the surface, and although partly disintegrated rock in places lies within the 3-foot profile, outcrops of the ledge rock are rare.

Some variations from the typical soil are found. In areas southwest of Sugar Loaf Mountain the surface soil is reddish brown and the subsoil is red, but in other respects the material is characteristic of the series. The stone content varies widely. In places between Urbana and Mount Pleasant the stones are so numerous that cultivation is almost impossible. In the areas north of Emmitsburg along the Pennsylvania line the bowlders are much larger, in some places 5 to 10 feet in diameter, but there are fewer smaller stones.

The Montalto stony clay loam is derived from the weathering in place of intrusive dikes of diabase or trap rock. These dikes are comparatively narrow, averaging about one-eighth to one-fourth mile wide, and extend for several miles without a break. The type is developed in a narrow belt from Le Gore south to the western base of Sugar Loaf Mountain. Southwest of Sugar Loaf Mountain the type extends to the Montgomery County line. Where the dike traverses the Frederick Valley there is a well-defined ridge lying 50 to 100 feet above the general level of the valley. Where the dike merges with the Linganore Hills it loses its ridgelike form. The topography is gently undulating to sloping. Only in a few places are the sides of the ridges steeply sloping. The drainage is effected through surface channels and is adequate. Erosion is not active even on the steeper slopes.

The structure of the soil enables it to hold a quantity of moisture in storage, and crops rarely suffer for lack of moisture even during the driest seasons. The rocks from which this soil is derived are high in soda and relatively low in potash. They contain some hematite, which is responsible for the local name "ironstone."

About 40 per cent of the type is cleared and under cultivation or in permanent pasture. It is not extensive but fairly important. Where the stones have been removed and the soil is properly handled, the yields compare favorably with those on the soils of the Frederick Valley. The native forest consists mainly of hardwood trees, including practically all species growing upon the upland

areas of this section. Oak, hickory, ash, and chestnut predominate. Locust occurs as a second growth.

Wheat, corn, and hay (timothy and clover) are the chief crops. A fair acreage is in permanent pasture. Corn yields 30 to 60 bushels per acre, wheat 15 to 25 bushels, hay 1½ to 2 tons. Clover ordinarily thrives. The land supports a good pasture.

This soil is handled in much the same way as the Limestone Valley soils. The prevailing five-year rotation—corn, wheat two years, hay (timothy and clover) two years—is followed. In some cases the sod is pastured for a number of years before returning to corn. All the available manure is applied to sod land before plowing. Lime is applied usually once during each rotation period, at the rate of 20 to 45 bushels per acre. Only small amounts of fertilizers are used. Acid phosphate or bone meal, 150 to 250 pounds per acre, is used for wheat. The stones upon the surface present the greatest obstacle in bringing this land under cultivation. These are usually removed from the fields and placed in fences or in piles. The soil is heavy and to plow it satisfactorily requires heavy draft. It is difficult to handle, clodding if plowed too wet and baking and cracking when dry. It therefore requires a considerable amount of disking and harrowing to bring the seed bed into good tilth.

The price of this land varies greatly, according to the location and improvements. The best improved farms sell for $150 to $250 an acre; the uncleared land has a very low value on account of the cost of removing the stones.

To improve this soil, the addition of organic matter is of first importance. This can be accomplished by shortening the rotation period so that a sod may be turned under and lime added oftener. Lime and an increased supply of organic matter will improve the physical condition of this land, preventing clodding and baking to some extent, and lessen the work necessary to bring it into good condition for seeding. The more stony areas can best be used for pasture. Considering the high price of land, it might pay to remove the stones even from these areas, blasting where necessary.

IREDELL STONY CLAY LOAM.

The surface soil of the Iredell stony clay loam is a grayish-brown to yellowish-brown silty clay loam, about 5 to 7 inches deep, which grades into a yellow, dull-yellow, or buff-yellow, heavy, plastic, impervious clay. At 24 to 30 inches partly disintegrated parent rock of a dingy-yellow or greenish-yellow color is encountered in many places. The surface is usually covered or partly covered with rounded bowlders of dark diabasic rock, which show concentric weathering. Smaller pieces of stone are found, usually blocky in shape and of a bluish to buff color. Numerous small iron concre-

tions are scattered upon the surface and throughout the soil. The unweathered rock lies for the most part 4 to 10 feet below the surface, and there are very few outcrops.

The type is derived from dikes of diorite or trap rock that intrude the Triassic formation. These dikes vary from one-eighth to one-fourth mile wide and extend for many miles without a break. The dike rock is harder than the adjoining formations and stands out as low ridges 50 to 100 feet above the surrounding country. The type is developed prominently north and east of Emmitsburg and upon a number of ridges extending south. One ridge reaches from where Middle Creek crosses the Pennsylvania line through Rocky Ridge to the Monocacy River. Another, one-half mile distant and parallel, extends from Mummy Bridge by Le Gore Bridge to Le Gore. The southern extension of this ridge shows the Montalto stony clay loam development. Another ridge of Iredell soil extends down the eastern side of Middle Creek from near the Pennsylvania line past Toms Creek Church to the mouth of Toms Creek, and still another lies 1 to 1½ miles east of the ridge. Scattered areas of the soil lie in the vicinity of these main developments.

The type occupies a ridgelike position and has a gently undulating to sloping topography. The sides of the ridges in places are rather abrupt, but in most places gently sloping. The drainage is well established.

This land is not important, as so little of it is under cultivation that it may be considered nonagricultural. The few cleared patches are devoted to pasture and furnish fairly good grazing. Most of the wooded area is fenced and used as a range for cattle. Corn, wheat, and hay are grown in the small fields under cultivation. The yields are low. The land is difficult to cultivate, as the soil is shallow, the surface bakes and cracks upon drying, and the subsoil clods readily.

If the stones were cleared from this soil, large amounts of organic matter added, and heavy applications of lime made, it would produce fairly good crops. The soil is better adapted to the production of grains and grass than intertilled crops.

MURRILL GRAVELLY LOAM.

The surface soil of the Murrill gravelly loam is a yellowish-brown to brown mellow loam, about 6 to 10 inches deep. The subsoil is a yellow to brownish-yellow, firm but fairly friable clay loam. Distributed throughout the soil and subsoil is from 20 to 40 per cent of rounded quartz gravel, the particles ranging from one-half inch to 2 inches in diameter. In a few places, indicated on the map by stone symbols, there occur rounded sandstone fragments or cobble-

stones, in most cases ranging from 2 to 6 inches in diameter, but in some cases reaching a diameter of several feet. Such spots are locally known as "sandstone land." The gravel content over the greater part of the type does not interfere seriously with cultivation, but in some places it does. The larger stones are especially objectionable.

This soil is colluvial in origin, being derived from material washed down from areas of Ashe and Dekalb soils and deposited in the valley at the mouths of present or former drainage ways. The deposits vary in thickness from several feet to 50 feet or more, and usually rest upon limestone, although in places the underlying rock is sandstone or, as near the base of Catoctin Mountain, shale.

This soil forms irregular-shaped areas lying near the eastern base of Catoctin Mountain from Mount St. Marys to Yellow Springs, and also from Blue Mountain School to Catoctin, and in the vicinity of Mountaindale. The surface of the greater part of the type is gently rolling to rolling, but some of the more stony areas occupying higher elevations have a more rolling to hilly topography. The natural drainage is well established. The high gravel content apparently increases the moisture-holding capacity of this soil, while at the same time promoting drainage.

The Murrill gravelly loam is one of the inextensive types of the county. Probably 50 or 60 per cent of it is cleared. The rest is forested with white oak, red oak, chestnut oak, chestnut, hickory, ash, poplar, and maple. Locust is notable in the second growth, many trees of this species occurring in the old fields. Corn, wheat, oats, and hay (timothy and clover) are the main crops. Dairying is developed to a small extent. Tomatoes are grown for canning. Corn yields from 20 to 50 bushels per acre, wheat 12 to 25, oats 15 to 30, and hay 1 to 1½ tons per acre. Peaches and apples do fairly well on this soil. The more stony areas of the soil are less productive. Such areas can be utilized profitably for fruit culture and pasture.

Land of this type sells at $100 to $250 an acre. Its location near a State road and rail transportation influences its value.

The recommendations for the improvement of the Frankstown silt loam and Dekalb loam apply equally well to the more important areas of the Murrill gravelly loam. Much of the stony land can be made available for cultivation by removing the stones.

ALLEN GRAVELLY LOAM.

The Allen gravelly loam is a brown or yellowish-brown to reddish-brown mellow loam, which passes gradually at 6 to 10 inches into a red, fairly heavy but friable clay loam to clay. About 20 to 40 per cent of the entire soil mass is composed of rounded quartz gravel, the individual particles varying from one-half inch to several inches in diameter. Besides this quartz material rounded sandstone

cobbles, varying from a few inches to a foot in diameter, are scattered over the surface. The soil is colluvial in origin, being derived from material washed largely from the Porters soils and deposited upon the valley formations, usually at or near the mouth of some former or present stream course. The deposit varies from a few feet to 100 feet in depth, averaging 30 to 40 feet. It is deposited over limestone, slate, and Triassic sandstone. The rounded sandstone bowlders on the surface come from the sandstone of the Catoctin Mountain. Similar bowlders occur upon all the soils that border the base of this mountain.

The Allen gravelly loam is developed in more or less fan-shaped areas. It occurs in fair-sized bodies at Yellow Springs, Mountaindale, northeast of Catoctin, in the vicinity of Thurmont, and about 2 miles southwest of Mount St. Marys. It occurs on elevations that rise about 100 feet above the general level of the Monocacy Valley. The topography is gently sloping to hilly. The run-off is rapid, and drainage and aeration are thorough. At the same time the capacity of the soil for storing moisture is large. Nearly all the type is cleared and under cultivation. The original forest consists of hardwoods, mainly oak, hickory, walnut, poplar, ash, maple, and chestnut. Locust seems to predominate as a second growth. A fair acreage is in pastures that support a good sod. The type is used for general farm crops, corn, wheat, and hay (timothy and clover), and for orcharding. Some oats, buckwheat, and Irish potatoes are grown on small patches. There are a number of flourishing peach and apple orchards. A few cattle are fattened for market, and dairying is developed to a small extent. Tomatoes are grown for canning, and other vegetables for home use. This is naturally a strong soil and is usually well farmed. Corn yields 35 to 75 bushels; wheat, 15 to 25 bushels; and hay, 1½ to 2 tons per acre. The gravel is not abundant enough to interfere seriously with cultivation, and is beneficial in that it forms a mulch that helps hold moisture. The farm practice is practically the same as upon the Hagerstown and Athol soils. The selling price of this land ranges from $100 to $150 an acre.

The methods given for the improvement of the Hagerstown and Athol soils may be followed to increase yields upon this land.

River Flood Plains.

Elk loam.

The soil of the Elk loam is a brown to yellowish-brown mellow loam to silty loam, which grades at 8 to 10 inches below the surface into a yellowish-brown fairly compact but friable clay loam to silty clay loam. The deposit is usually 4 to 10 feet deep and the substratum may include strata of quartz gravel and sand. In places (indicated

upon the map by gravel symbols) there is a noticeable amount of gravel upon the surface and scattered through the soil and subsoil. Along the Potomac River rounded quartz and sandstone cobbles are scattered upon the surface. Spots are also found where the subsoil and substratum consist of a reddish-brown to red friable clay loam. This soil, as developed from Tuscarora to the mouth of the Monocacy River, carries a relatively high percentage of fine sand and approaches a fine sandy loam in texture.

The Elk loam occurs as second-bottom or old-alluvial deposits, derived largely from wash from limestone soils. It is developed along the Potomac River from Knoxville to Brunswick, from near the mouth of Catoctin Creek to Lander, and from Tuscarora to the mouth of the Monocacy; and along the Monocacy River between its mouth and Greenfield Mills, and in a few scattered areas between this point and Frederick. The type occurs 40 to 75 feet above stream level and lies well above normal overflow. The topography is fairly level to gently sloping. The drainage is good, owing to the porous nature of the gravelly substratum. Erosion has removed the surface soil in many places, usually along the edge of the type nearest the stream.

Practically all of the Elk loam is cleared and under cultivation. The remaining forest is largely oak, poplar, elm, sycamore, and beech. Corn, wheat, and hay (timothy and clover) are the chief crops. In the vicinity of Brunswick it is used in the production of sugar corn, potatoes, and vegetables. Corn yields 30 to 65 bushels; wheat 10 to 20 bushels; and hay about 1 ton per acre. The same general farm practices are followed as upon the Frederick Valley farms. The Elk loam sells for $100 to $250 an acre, according to location.

The same methods are recommended for the improvement of this type as given for the Hagerstown and Frankstown soils. It is fairly well suited to such legumes as cowpeas, soy beans, crimson clover, and vetch. These crops should be used where it is difficult to get a stand of red clover. The soil is easy to till and responds readily to fertilizers and other amendments. Cover crops should be used to protect the areas in which erosion is active.

HUNTINGTON SILT LOAM.

The Huntington silt loam, as developed in Frederick County, has three variations, differing mainly in color, owing to variations in the material from which it is derived.

Along the Potomac River bottoms the soil is a dark-brown to chocolate-brown, mellow, fairly heavy silt loam, 8 to 12 inches deep, passing into a subsoil slightly lighter brown in color, slightly com-

pact, and of a silty clay loam texture. Along the banks of the streams the material is relatively sandy.

Swales lie next to the upland in places, and the soil is in a semi-swamp condition. These areas, which are indicated by swamp symbols, have a dark-brown surface soil, mottled in places with gray, rusty brown, or yellow and a steel-gray or drab subsoil, mottled with rusty brown or yellow. These areas, which are small, support a growth of cat-tail and rushes and are not used for farming.

The Huntington silt loam along the Potomac is derived from limestone and Appalachian Mountain soils. It occupies all of the first-bottom or overflow land along this stream and forms some islands. The surface lies 10 to 30 feet above stream level.

As developed along the Monocacy River below Frederick Junction, the soil of the Huntington silt loam is a brown mellow silt loam having a reddish cast, and the subsoil is a light-brown silt loam only slightly compact. The materials here are washed from the limestone soils of the Frederick Valley and from the red Triassic sandstone soils of the upper Monocacy Valley. The areas along this river lie 10 to 20 feet above normal stream level.

The Huntington silt loam as found along Israel Creek has a brown to grayish-brown silt loam soil underlain by a yellowish-brown heavy silt loam to silty clay loam, fairly firm and friable. The soil along the creek is derived from limestone soils, strongly influenced by the wash from the phyllites and slate formations. It lies only a few feet above stream level and occurs in a broad level bottom. Drainage is not thoroughly established.

In general the Huntington silt loam has a level topography. It is subject to overflow but is for the most part well drained between overflows.

The Huntington silt loam is practically all cleared and used for crop production or pasture. The few remaining trees are sycamore, elm, beech, birch, and willow. The three variations of this soil have about the same crop value. Along the Potomac and Monocacy Rivers the land is used mainly for corn, with a small acreage in grass (timothy). A fair acreage is in permanent pasture. On Israel Creek and the small streams of the Frederick Valley most of the type is in permanent pasture, with an occasional field in corn or grass. Corn yields 40 to 75 bushels per acre, and hay 1½ to 2½ tons per acre. The land, which supports a good sod, is used for pasturing dairy cows, beef cattle, sheep, horses, and hogs. It is naturally productive, and is maintained in that condition by annual depositions of material. Corn is grown continuously for many seasons without the aid of fertilizer, manure, or lime. No rotation is followed. Sod land remains undisturbed for indefinite periods.

The land sells for $100 to $150 an acre, and a few better located areas are held at slightly higher prices.

This land is well suited to the growing of corn and hay crops. There is apparently little need of using fertilizers or manure, though sod land of long standing should receive an application of lime before it is plowed.

BERMUDIAN SILT LOAM.

The soil of the Bermudian silt loam is a reddish-brown, mellow, smooth silt loam, about 8 to 12 inches deep, passing into a red or Indian-red heavy silt loam or silty clay loam, only slightly compact and friable. In places gravel beds are encountered in the lower part of the profile, and the presence of such beds in the substratum is general. In areas where the deposits are of mixed origin, as upon Owens Creek, from Loys to Hoovers Mill, and upon Hunting Creek, in the vicinity of Eicholz Mill, the surface soil is brown and the subsoil is yellowish brown, with a slightly reddish cast in places in both soil and subsoil.

The Bermudian silt loam is an alluvial soil, typically derived from the wash of soils of Triassic origin, and bears a strong resemblance to these soils. The type occupies first-bottom land along the Monocacy River above Frederick Junction and upon the tributary streams that flow from the Penn soil belt or upper Monocacy Valley. The stream bottoms are from one-eighth to one-fourth mile wide and have a fairly level topography. A few swells mark the areas along the larger streams. These extend in the direction of the main current and the soil here carries a noticeable quantity of gravel. The drainage is usually well established, owing to the porous nature of the substratum. The surface of the soil lies from 3 feet to 20 feet above stream level, with an average of 5 feet along the medium-sized streams and ranging from 10 to 20 feet along the larger streams.

Practically all of this type is cleared and under cultivation or in pasture. There are a few scattered trees in the fields and a fringe of trees along the stream banks, mainly sycamore, elm, beech, maple, ironwood, oak, hickory, ash, and willow. Most of the area of this soil is in pasture. The land naturally supports a good sod of native grass but it is customary also to seed some areas with tame grasses. This land constitutes the main pastures of considerable numbers of dairy and beef cattle. A few sheep and some hogs also are pastured upon the land. Corn is the chief crop and hay (timothy and clover) is grown to some extent. Other crops, such as wheat and oats, occupy very small acreages. Corn yields 35 to 75 bushels per acre and hay 1½ to 2½ tons per acre.

Crops are rather uncertain along the smaller streams because of floods, but most of the heavy floods come in the spring before planting time.

No rotations are followed, the fields remaining in corn or pasture for indefinite periods. As a rule, no fertilizer, manure, or lime is used upon this land.

The Bermudian silt loam ordinarily sells for $100 to $150 an acre, with somewhat higher prices for the better improved farms.

The recomendations for the improvement of the Huntington silt loam may be followed to increase yields upon this land.

CONGAREE SILT LOAM.

The Congaree silt loam is a brown mellow silt loam, about 10 inches deep, underlain by a subsoil of yellowish-brown heavy silt loam or silty clay loam, only slightly compact and friable. Along the streams that flow from the eastern base of Catoctin Mountain this soil has a lighter texture than in other places, being a light silt loam throughout the entire profile. Beds of coarse material are not encountered commonly in this soil, but some beds in which slate and some quartz fragments occur lie along streams in the Linganore Hills region.

The Congaree silt loam occupies first bottoms along the streams that receive their wash largely from schist and slate soils and is developed mainly along the streams of the Middletown Valley, the intermountain region, and the Linganore Hills. The bottoms average one-eighth to one-fourth mile wide and their surface lies about 3 to 10 feet above the normal stream level. The surface is fairly level, having a slight slope with the stream. The drainage is usually well established, but a few spots of poorly drained soil are found in the Linganore Hills region.

Nearly all of this soil is cleared and is used for cultivated crops or pasture. The rest is forested with oak, hickory, ash, sycamore, elm, maple, beech, birch, and willow. More than half the cleared land is in permanent pasture, which supports a heavy growth of native grass. It is used for grazing dairy cattle, work stock, beef cattle, sheep, and hogs. Corn is the principal crop. A small acreage is in wheat and oats, but these crops have a tendency to lodge, and their yields are uncertain. Hay (timothy and clover) is grown to a small extent. Corn yields 40 to 80 bushels per acre. Lime, manure, and fertilizers are not used. Rotations are not practiced, the fields continuing in corn or grass for indefinite periods. The soil is easily tilled when plowed in the proper moisture condition.

As the Congaree silt loam usually forms only parts of farms and is rarely sold separately, the price is determined by that of the adjacent land. It sells for $75 to $150 an acre.

Crops are rarely damaged by floods, but during wet seasons there is too much moisture in the ground. Tile drainage would improve this soil and widen the range of crops that can be grown. The soil

is well suited to corn and grass and can be utilized best by growing these crops. They should be interchanged oftener, using a somewhat definite plan of rotation—corn several years, grass for hay, and pasture for several years after the mowing fails. This is naturally one of the most productive soils in the county and is not in need of fertilizer or manure.

WEHADKEE SILT LOAM.

The soil of the Wehadkee silt loam is dark gray to almost black in the surface few inches, grading into a gray heavy silt loam that continues to a depth of 6 to 8 inches. The subsoil is a gray heavy silty clay loam, mottled with drab, yellow, rusty brown, and white, slightly sticky and plastic in structure. The lower subsoil is usually water-logged.

The Wehadkee silt loam occurs as first-bottom land along streams that receive their drainage water largely from schist and slate soils. In a few places the material is derived partly from limestone soils. The type is closely associated with the Congaree, and differs from it mainly in drainage. The Wehadkee silt loam is developed along streams that have reached a temporary base level. It is also found in the so-called glade areas lying along the eastern base of Catoctin Mountain in the vicinity of Thurmont and Lewistown. Most of the fishponds of the goldfish industry are located upon this land. The surface is flat, and the drainage is poor.

While nearly all this type is cleared, it is utilized almost entirely for grazing. It carries a good sod of native grass, which can be grazed even during the driest seasons. A semimarsh condition prevails in spots, and much of this type was formerly marshy, but open ditches have relieved this condition to some extent. Little effort has been made at thorough drainage because the soil lies so near the stream level. The tree growth is largely water oak, water maple, black oak, and willow. Some parts of the type can be readily drained. If this is done and the soil is heavily limed, it would be fairly well suited to the production of corn, oats, hay, and grass. A number of dairy and beef cattle and a smaller number of sheep, horses, and hogs are kept upon this land.

POPE SANDY LOAM.

The Pope sandy loan has a yellowish-brown sandy loam soil, about 7 to 10 inches deep, underlain by a yellow to brownish-yellow gravelly sandy loam. The soil lacks uniformity, ranging from a stream wash consisting of sand and bowlders in some places to a fine sandy loam in others. A few waterworn sandstone bowlders and some gravel are present over most of the areas.

The Pope sandy loam occupies first bottoms along streams whose drainage basins lie mainly in areas of the Dekalb soils and Rough stony land. These bottoms are fairly level, lie 3 to 5 feet above stream level, and are thoroughly drained.

Most of the type is in forest consisting of sycamore, elm, beech, birch, and willow. The small cleared areas are utilized for pasture. The forested areas are also used as a range for cattle and hogs. This type is developed for short distances along the streams that flow from the eastern side of Catoctin Mountain. It is not well suited to the production of crops, as the currents of these streams when in flood are so swift that crops would be destroyed.

MISCELLANEOUS.

ROUGH STONY LAND.

The Rough stony land in Frederick County consists of land so covered with stone as to make it of little or no agricultural value. It occupies the steep and broken parts of the mountain districts and is developed mainly in areas of sandstone and quartzite formations. The interstitial soil material, largely Dekalb, is of loam or sandy loam texture. The Rough stony land of this material is developed on the summit of Sugar Loaf Mountain, over much of the slopes, in the gorges of Catoctin Mountain, and on the ridge combs of South Mountain. On Second Mountain and scattered through the intermountain region the Rough stony land occupies the region of basic volcanic rocks that have been little changed by the upheavals through which this region has passed. The interstitial material is Ashe silt loam and Porters loam. The stones of dark diabasic rock in places almost obscure the surface and in other places stand out as bare cliffs.

Practically all the Rough stony land is in forest, which comprises nearly all the tree species found in the area. Prominent among them are oak, chestnut oak, chestnut, and pine of the sandstone mountain ridges, and rhododendron, mountain laurel, and spruce pine of the mountain gorges. The forest in the area of acid volcanic rocks consists of a heavy growth of hardwood trees, oak, hickory, chestnut, walnut, poplar, and ash. These areas also have a covering of bluegrass wherever the ground is exposed. The sandstone mountains support little grass, but the underbrush furnishes fairly good browsing for cattle, sheep, and goats. Small spots are found that are free enough of stone to be cultivated.

The Rough stony land is usually in large holdings and little of it is upon the market. It is valued mostly for its timber. The type should be left in forest.

SUMMARY.

Frederick County comprises an area of 663 square miles, situated in the north-central part of Maryland. The chief physiographic features consist of two parallel mountain ranges, South Mountain and Catoctin Mountain, extending northeast and southwest across the western part of the county; the Middletown Valley and the intermountain region lying between these ranges; the Monocacy Valley lying east of Catoctin Mountain; and the low rolling Linganore Hills region south and east of this valley. The topography of the mountain region is steep and broken, that of the valleys is comparatively smooth, and that of the Linganore Hills rolling to hilly.

The elevations of the area range from 200 feet above sea level in the southeastern corner to 1,980 feet in the mountains in the northwestern part of the county. The greater part of the land lies between 300 and 600 feet above sea level. It is drained by the Monocacy River and Catoctin Creek into the Potomac River. The course of these streams is southward with the general slope of the region.

The climate is mild, with a mean annual temperature of 52° F.

The population of the county is 52,541, of which 71.5 per cent is classed as rural. Frederick is the largest and most important town, with a population of 11,066.

The county is well supplied with rail transportation and good public roads. Baltimore and Washington are the principal markets.

Frederick County is well developed agriculturally. General farming and stock raising are followed. Wheat, corn, and hay are the main crops, with sweet corn the chief special crop. Dairying and fattening beef cattle are the principal live-stock industries. The income on the larger farms is derived mainly from the sale of wheat and cattle, on the medium-sized farms from dairy products, chiefly milk, and on the small farms from sweet corn, poultry, apples, and peaches. Crop rotations are generally followed, the most popular system being (1) corn, (2) wheat, (3) wheat, (4) hay (timothy and clover), (5) hay (timothy). Some omit the second year of wheat, and there is a strong tendency to shorten the rotation to (1) corn, (2) wheat, (3) clover. Commercial fertilizers are used extensively for wheat. Lime and manure are applied during each rotation. Many of the large valley farms are rented. About 69 per cent of the farms are operated by owners.

Frederick County is a region of varied soils. They differ in origin, position, and drainage, and in physical and chemical properties. Four soil regions are represented; the Appalachian Mountain, Limestone Valley, Piedmont Plateau, and River Flood Plains.

Twenty-seven soil series are represented by 42 soil types, including Rough stony land. In addition three soil phases are mapped. Most of the soils are silt loams and loams, with a fairly large area of gravelly loams. A number of soils have a wide development, but no one soil stands out predominantly in area or agricultural preference.

The Dekalb soils, although fairly extensive, are not so well suited to farming as the valley soils. They have gray surface soils and a yellow subsoil. The stony loam has a steep and broken topography. The loam and shale loam are smaller in area but have smoother surfaces and are better suited to crop production. They are good fruit soils and are utilized to some extent for orchards.

The Hanceville gravelly loam is scattered throughout the Dekalb soils in small areas. It has a brown surface soil and a red subsoil. It is best adapted to fruit.

The soils of the Talladega and Chandler series are closely related, occurring in the same general position and being both derived from a mica-slate. The two series differ mainly in color, the Talladega having brown surface soils and a red subsoil, and the Chandler having grayish-brown surface soils and a yellow subsoil. Each series is represented by the silt loam and slate loam. These soils occupy the foothills along the eastern base of Catoctin Mountain. They are of limited extent and not strong agriculturally.

The Ashe soils are developed extensively in the region between South Mountain and Catoctin Mountain. They are derived from the Catoctin schist and have brown surface soils and a yellow subsoil. The loam and silt loam are the best farming soils of the series. They occupy most of the Middletown Valley. The gravelly loam and stony loam are found in the intermountain region.

The soils of the Porters series occur closely associated with the Ashe soils, but occupy a much smaller area. They are derived from schist and diabasic rock and have brown surface soils and a yellowish-red to red subsoil. The silt loam is developed along the edges and northern end of the Middletown Valley, in the valleys of the intermountain region, and to a less extent upon the mountains. The stony loam is found exclusively in the mountains in the northwestern part of the county. The Porters soils are strong and well suited to general farming and orcharding.

The Hagerstown soils, though not extensive, are valuable types for general farming. They are derived from limestone and have brown surface soils and a yellowish-brown to red subsoil. The loam is the most extensive and important type. The sandy loam occupies a small area and is unimportant.

The Frankstown silt loam is fairly extensive, occupying most of the Frederick Valley. It is derived from limestone interbedded with

calcareous shale, and has a brown soil and a yellow subsoil. It is an important type, well suited to general farm crops, especially wheat and corn.

The Colbert silt loam has a limited development and is not important. It is derived from limestone under poor drainage conditions, and has a dark-gray surface soil and a yellow or mottled subsoil. It is utilized for pasture.

The soils of the Penn series have red surface soils and an Indian-red subsoil. They are extensively developed in the upper Monocacy Valley. The silt loam has a smooth surface and is fairly well suited to general farming. The gravelly loam occupies the slopes and breaks along streams and is best adapted to fruit.

The Lansdale silt loam, developed in the flat or poorly drained areas of the Penn soils, has a gray surface soil and a yellow or mottled subsoil. It is best suited to grass.

The Lehigh gravelly loam has a grayish-yellow surface soil and a yellow subsoil. It is of relatively small extent.

The Athol gravelly loam has a brown surface soil and yellowish-red to red subsoil. It is well suited to general farming but has a limited development.

The soils of the Chester series have a fairly extensive development and are important farming soils. They have grayish-brown surface soils and a yellow firm subsoil, and are derived from slates and schist. They are found scattered over the Linganore Hills region. The loam is not as extensive as the gravelly loam but is a better soil. It occurs on the flattened ridge tops of the gravelly loam areas. The stony loam has a small development on low ridges. It is not well suited to crop production and is usually in forest.

The Manor soils are widely developed in the Linganore Hills region. They are derived from phyllites and slates, and have grayish-brown to reddish-brown soils and a yellow to red greasy subsoil. The loam is the best farming soil of the area, occupying the hill-tops and gently sloping hillsides. The gravelly loam and slate loam occupy hillsides and have an extensive development. They are light soils, but fairly well suited to farming when fertilized.

The Cardiff slate loam occurs upon low well-defined ridges along the eastern side of the Frederick Valley. It is derived from a gray slate or schist and is characterized by a gray surface soil, a yellow subsoil, and a shale substratum. It is fairly well suited to orcharding.

The Conowingo gravelly silt loam has a dark grayish brown surface soil, underlain by a heavy yellow subsoil and a shale substratum. It is inextensive and unimportant.

The Montalto and Iredell soils are closely related, being derived from dikes of trap rock and occurring as low narrow ridges. The

Montalto stony clay loam has a brown surface soil and a yellowish-red to red heavy subsoil. The Iredell stony clay loam has a brown or yellowish-brown surface soil and heavy plastic yellow to greenish-yellow subsoil. Both types have an abundance of rounded bowlders upon the surface and are known as "ironstone" land. They are used to a small extent for crops.

The Murrill and Allen soils are colluvial in origin. The Murrill gravelly loam has a yellowish-brown surface soil and a yellow subsoil and is derived from Dekalb and Ashe soils. The Allen gravelly loam has a brown to reddish-brown surface soil and a red subsoil and is derived largely from Porters soils. Both soils are small in area. They are utilized for general farming and orcharding.

The Elk loam is the only terrace soil in the county and occupies a small area. It has a yellowish-brown surface soil and yellowish-brown to red subsoil, and carries some rounded quartz gravel. It is used to a small extent for farming.

The recent-alluvial or first-bottom soils of the county are classed in five series, differing mainly in the material from which they are derived. These alluvial soils are all well suited to corn and grass.

The Huntington silt loam has a brown surface soil and a yellowish-brown subsoil and is derived from wash of limestone soils.

The Bermudian silt loam is derived from wash from red sandstone soils. It has a reddish-brown surface soil and a red subsoil.

The Congaree silt loam is derived mainly from schist and phyllites. It has a brown surface soil and subsoil.

The Wehadkee silt loam is derived from the same material as the Congaree but has been subjected to poor drainage conditions. It has a dark-gray or drab surface soil, with a mottled drab, gray, and yellow plastic subsoil.

The Pope sandy loam has a yellowish-brown surface soil and a yellow subsoil. It is derived mainly from wash from Dekalb soils.

Rough stony land includes the steep and stony mountain areas that are practically nonagricultural.

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[PUBLIC RESOLUTION—No. 9.]

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

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

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

Approved, March 14, 1904.

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

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