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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS—MILTON WHITNEY, Chief.

SOIL SURVEY OF FREDERICK COUNTY,
VIRGINIA.

BY

J. B. R. DICKEY AND W. B. COBB.

W. EDWARD HEARN, INSPECTOR, SOUTHERN DIVISION.

[Advance Sheets—Field Operations of the Bureau of Soils, 1914.]



WASHINGTON:
GOVERNMENT PRINTING OFFICE,
1916.

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,

Washington, D. C., October 25, 1915.

SIR: In the extension of the soil survey in the State of Virginia during the field season of 1914 a survey was made of Frederick County.

I have the honor to transmit herewith the manuscript report and map covering this work and to request their publication as advance sheets of Field Operations of the Bureau of Soils for 1914, as authorized by law.

Respectfully,

MILTON WHITNEY,
Chief of Bureau.

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

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MAP.

Soil map, Frederick County sheet, Virginia.

SOIL SURVEY OF FREDERICK COUNTY, VIRGINIA.

By J. B. R. DICKEY and W. B. COBB.

DESCRIPTION OF THE AREA.

Frederick is the most northerly county of Virginia, being the northern apex of the rough triangle formed by the State.

It is bounded on the northeast by Morgan and Berkeley Counties, W. Va.; on the east by Clarke County, Va., from which it is separated by Opequon Creek, and on the south by Warren and Shenandoah Counties. On the west the Virginia-West Virginia line, following the watershed between the Cacapon River in West Virginia and Back and Cedar Creeks in Virginia, separates Frederick from Hampshire and Hardy Counties. The county has an area of 429 square miles, or 274,560 acres.

The eastern two-fifths of Frederick County lies in the Shenandoah or Great Valley of Virginia, which forms a part of the lowland limestone belt extending from New Jersey to Alabama. The valley is bounded on the northwest by Little North Mountain and its northern extensions, Round Hill and Green Spring Mountain. This ridge divides the county into two essentially different agricultural and topographic sections, which will be designated hereinafter as the valley and the hills, and will be treated more or less separately.

The valley section is about 8 to 10 miles wide by nearly 20 miles long and has a general elevation of 600 to 800 feet. Its topography may be described as undulating to rolling. It is roughest in the western part, where a series of ridges, of which Apple Pie Ridge is the most prominent, runs in a direction parallel to the mountains. Between and east of these ridges the land is generally smooth, and here are found the best and most productive farms of the county.

The eastern part of the valley, that part underlain by shales, is slightly higher in elevation than the adjacent areas underlain by limestone, and the topography is here that of a plain, sloping gently eastward, dissected by numerous drainage channels which become deeper and more numerous as one goes eastward, giving the

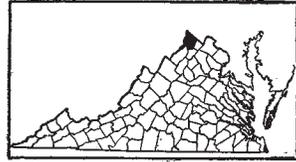


FIG. 1.—Sketch map showing location of the Frederick County area, Virginia.

smoothly rounded, billowy topography characteristic of this sort of shale country wherever found. In the western part of the valley or the limestone belt, erosion has followed the general trend of the rock folds, that is, northeast-southwest, and the stream channels are shallow and the stream valleys inconspicuous features of the topography.

To the west of Little North Mountain the country consists of mountains, ridges, and valleys belonging to the Appalachian system.

There are within the county three distinct mountain ridges, more or less broken by gaps, and running in a fairly regular northeast-southwest direction. The most easterly range, Little North Mountain, has already been mentioned. West of this is a series of low ridges and valleys forming the Hogue Creek Valley, and rising to Great North Mountain on the west. This mountain extends as far north as Gore as an unbroken ridge, at some places rising to the height of 2,600 feet. Its sides are generally rather steep and rocky and broken by numerous buttresses and spurs. The crest of the mountain is usually narrow and rocky, but occasionally broadens out to some extent. North of Gore this range degrades into a series of ridges and hills, but again appears as Sleepy Creek Mountain near the extreme northern part of the county. On the east side of the mountain, south of Hayfield, there is a fairly uniform ridge or foothill, locally known as the "Flint Ridge," with limestone on its west side and sandstone its crest.

West of Great North Mountain there is a series of well-defined ridges, paralleling the mountain, with rather narrow, longitudinal valleys between. From east to west, these ridges are called Pine, Big Timber, and Little Timber Ridges. The last are the more prominent and rise to a height of 500 to 600 feet above the intervening valleys.

On the extreme northwest the county includes parts of Bear Garden Ridge and Cacapon Mountain, where the massive Silurian sandstone again appears, associated on the east with other sandstones and limestones, probably the Oriskany and Lewistown. These ridges are steep and rugged, but east of them lies a high, rolling shale country, consisting of the northward extension of Little Timber Ridge, and still farther east an irregular succession of hills and valleys. The average altitude of the hill section of the county is probably about 1,000 feet, or less if the mountains are not considered.

There are in the county three main drainage systems: Opequon Creek, Cedar Creek, and Back Creek. The Opequon, rising along the slope of Little North Mountain, flows east to the point where it becomes the eastern county boundary; there it turns north and drains almost all the valley section north of Stephens City into the Potomac River. Its tributaries flow in a uniform easterly direction after leaving the limestone belt and have cut rather deep and often quite

steep sided, parallel valleys, which become deeper as the main stream is approached and with the great ramification of deeply eroded, intermittent tributaries afford the shale belt excellent surface drainage. The southeast corner of the county drains in a southeasterly direction into the Shenandoah and has a topography similar to the above.

The western section of the area lying south of Mount Williams and east of Great North Mountain is tributary to Cedar Creek. This very tortuous stream, forming the border of the county, flows first northeast along the base of Paddy Mountain, turns east through a wide gap in Little North Mountain, and on reaching the limestone country turns nearly south. After it leaves Great North Mountain most of its tributaries flow south or southwest, following the general trend of the ridges.

Probably half of the county, including all the northwestern hill section, drains north into the Potomac River by way of Back Creek. This stream, with its main eastern branch, Hogue Creek, flows northeasterly through well-defined valleys between the main Appalachian ridges. Some drainage from the "valley section," west of Apple Pie Ridge, also finds its way northwest through gaps into Back Creek. North of Gainesboro the northeasterly trend of the ridges is more or less lost and Brush and Isaac Creeks, with numerous smaller streams, flow in a general easterly direction into Back Creek. The extreme northern point of the county drains northeast through well-defined parallel valleys into Sleepy Creek. All the hill country has excellent surface drainage and generally along one and often both sides of the larger streams the lower slopes of the hills are too steep and stony to be farmed. Along Back and Cedar Creeks and also along some of the smaller streams are bottom lands of comparatively small extent, but of great agricultural importance in the hill section, as they are the most highly esteemed farm lands. A few insignificant remnants of what was probably higher terrace were noticed along Back Creek, but none was mapped.

In the limestone valley section and also along the limestone belt, next to Great North Mountain, large springs are of frequent occurrence, and most of the constant streams head at one or more of these springs. At Green Spring and near Winchester and Marlboro, as well as at other points, are springs which furnish sufficient water to operate small mills. These springs are really the outlets of underground streams, which flow through limestone caverns. At several points are found springs of mineral water of various kinds—sulphur, lithia, and iron.

In the nonlimestone sections many of the streams fail in the drier seasons, and this tendency seems to be increasing with the de-

forestation of the hills, as is suggested by the presence of old water mills along streams now intermittent.

Sink holes occur in the limestone valleys, but are seldom large. There are doubtless many small sink holes, which absorb most of the surface drainage, since the streams are few and large. The majority of the farms on limestone land are dependent on catch basins and water holes for water for stock.

The earliest settlers in what is now Frederick County were mainly Germans, Scotch-Irish, and Quakers from the older settled parts of Pennsylvania, New Jersey, and New York. Many Virginians also crossed the Blue Ridge from the Piedmont country, but most of these probably settled farther east and built up the large estates of Clarke County. As first organized, Frederick County included practically all the immediately surrounding counties of Virginia and West Virginia.

Until the Civil War development of this part of the valley was rapid and uninterrupted, but during the war it suffered severely. The battles of Cedar Creek, Kernstown, and Winchester, besides several lesser engagements, were fought in Frederick County, and large bodies of troops of one side or the other were quartered near Winchester almost throughout the war, since the valley was recognized as one of the most important thoroughfares between the North and South, as well as a great source of food supply for the Southern army. Raiders destroyed nearly all the fences and farm buildings and, with capital and labor both scarce, the county was years in recovering.

The census of 1910 gives the population of Frederick County, exclusive of Winchester as 12,789, or an average of 29.5 per square mile. This average, however, is not representative of the density of the population in the county as a whole, for the valley section is probably twice as thickly populated as the hill country.

Winchester, the county seat, is situated near the center of the valley section and is the largest and most important town within a radius of 40 miles. It had in 1910 a population of 5,864, showing an increase of 13.6 per cent over the preceding census. Several large woolen mills and numerous shops and factories are located here. It is an important shipping point for apples and has a cold-storage plant with a capacity of 100,000 barrels.

The valley side of the county has good railroad accommodations. Winchester is the terminus of the Cumberland Valley Railroad, a branch of the Pennsylvania system, which gives good shipping facilities to Harrisburg, 116 miles distant, Philadelphia, and the West. The Shenandoah Valley Division of the Baltimore & Ohio Railroad, from Lexington, Va., passes through Winchester, traversing almost the entire length of the valley section of the county and connecting at Harpers Ferry with the main line for Washington and points west.

The western part of the county is entirely without railroads, and its products must be hauled into Winchester or other shipping points by wagon, often for a distance of 20 miles. These long hauls are facilitated by several well-graded roads radiating from Winchester. Many of these, especially in the valley, have been macadamized by toll companies and are kept in good condition, but as the tolls are rather heavy and adverse sentiment is growing, it is proposed to have the roads taken over by the State.

The average country roads are kept in fair condition where the amount of travel warrants attention. The heavier shale soils are suitable for road building and in the limestone sections crushed limestone is freely used. In the hilly sections the grades are often rather steep, but not more so than necessary, as the tops of the ridges and the natural drainage ways are followed whenever possible. Several stage lines, some of them served by automobiles, radiate from Winchester, carrying mail, passengers, and light freight, while on the Valley Pike a large auto bus makes four trips daily to Strasburg, through Stephens City and Middletown, places of about 500 inhabitants, along the Baltimore & Ohio Railroad. To the north and west of Winchester there are no towns of importance, but country stores, post offices, and mills are numerous and form local markets and community centers.

The county is well supplied with churches and schools. Rural free delivery of mail reaches practically all parts of the county, and rural telephone lines are in common use.

CLIMATE.

Frederick County has a pleasant and healthful climate. The Blue Ridge forms a barrier against the damp winds and fogs from the ocean on the east, while the high mountains on the northwest protect the valley in a great measure from the cold northwest winds and winter storms from that quarter. The winters are generally rather open, little cold weather being experienced before Christmas. February is the coldest month.

At Stephens City the average date of the last killing frost in the spring is April 21 and of the first in the fall October 14, which gives an average growing season of 176 days, though frost has been known as late as May 23 and as early as September 23.

The western hill country is uniformly cooler throughout the year, and frost occurs a week or ten days earlier in the fall there and a week later in the spring, especially in the valleys.

The accompanying table gives the more important climatic data recorded by the Weather Bureau station at Stephens City, located in

the valley section of the county. Similar data for Mooresfield and Romney, W. Va., which may be considered as fairly representative of the western section of the county, give at least 5 inches less annual rainfall, while data for Lincoln, Va., just east of the Blue Ridge, gives about 4 inches greater precipitation than recorded at Stephens City.

Normal monthly, seasonal, and annual temperature and precipitation at Stephens City.

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
	° F.	° F.	° F.	Inches.	Inches.	Inches.	Inches.
December.....	34.9	69	- 1	3.06	1.35	3.36	3.6
January.....	32.2	74	- 5	2.46	2.91	2.48	6.9
February.....	30.5	78	-17	2.71	2.65	1.32	10.1
Winter.....	32.5			8.23	6.91	7.16	20.6
March.....	43.6	92	1	2.94	1.94	5.01	5.3
April.....	53.1	96	17	3.28	2.19	2.31	0.5
May.....	64.0	97	29	4.36	3.95	1.89	0.0
Spring.....	53.6			10.58	8.08	9.21	5.8
June.....	71.1	103	40	4.54	4.04	8.54	0.0
July.....	75.8	106	49	4.06	5.07	5.08	0.0
August.....	74.2	101	42	3.86	4.34	9.85	0.0
Summer.....	73.7			12.46	13.45	26.47	0.0
September.....	68.3	98	31	3.43	2.07	1.89	0.0
October.....	55.8	92	22	2.90	2.57	7.35	Trace.
November.....	43.8	80	11	2.31	0.78	1.39	0.9
Fall.....	56.0			8.64	5.42	10.63	0.9
Year.....	53.9	106	-17	39.91	33.86	50.47	27.3

AGRICULTURE.

Frederick County has always been an essentially agricultural section. Though there are deposits of iron, manganese, and probably some coal in the mountainous parts of the county, the distance from transportation practically prohibits their development, and compared with the products of the farm and orchards those of the mines are insignificant. Some lime is burned from the extensive beds of limestone in the valley sections, but this industry, also, has not been developed.

The early settlers, coming mainly from the more northern States, introduced their agricultural methods. They knew little or nothing

about tobacco culture or slave labor, and consequently the large estates commonly associated with Virginia were here never developed, each man tilling his own small place and raising some stock and the necessaries of life. Before the building of the Baltimore & Ohio Canal, when Harpers Ferry became a shipping point, the nearest market was at Alexandria, 70 miles away, and transportation was entirely by pack horse and wagon. Stone roads were early built along the chief lines of travel. The first railroad to be built in the county was what is now the Baltimore & Ohio, which began operations in 1835, but was not extended farther south than Winchester until after the war. The Cumberland Valley Railroad was completed about 1885.

The early settlers in the valley found a country well adapted to stock raising, on account of the good pastures of native grasses in the open forests on the limestone land. Stock, too, was easily gotten to market, and the raising of cattle, sheep, and horses soon became, as it continues to be, of some importance.

As the land was brought under cultivation, stock raising became relatively more important in the hilly country, where land was cheaper and not so productive, but beef cattle are still raised in some parts of the limestone valley where pasture land is abundant. Short-horn and Polled Durham seem to be the favorite breeds. In the fall large herds of feeders are driven in from the hills of West Virginia to be wintered and fattened on the grain and forage grown in the valley. These cattle appear inferior to the native stock in breeding. Dairying is becoming important in a section southeast of Winchester on the shale soils, and on the Frederick limestone soil west of Stephens City. Holstein herds are of most common occurrence. The milk is sold locally, shipped to Washington or collected for a creamery at Woodstock, in Shenandoah County. Silos are in use on almost every dairy farm and the business seems to be on a profitable basis.

Many good colts of a heavy type are raised in all parts of the county—more than enough to supply the home demand. The tendency is constantly toward a heavier type of horse, and sires of Percheron blood are being used freely, particularly on the valley farms. Raising horses is distinctly a side issue, however, as the mares are at farm work a large part of the time.

A few sheep are kept on almost every farm, but are of minor importance. The number of sheep is said to be increasing slowly, and improved animals, largely Shropshire, have been introduced recently.

Hogs enough to supply the farm with pork have always been raised, but recently pork production has been taken up on a more commercial scale. This is proving quite successful where proper precautions are used to prevent disease and where the pasturage system is employed. By alternating on rape and alfalfa the hogs

can be carried through the early summer with very little grain, and the large orchards in cover crops, such as cowpeas, furnish excellent pasture during the late summer until the weight of the apples brings the branches down where the hogs can reach them. The finishing is generally done on corn, which may be hogged down. The breeding of the hogs is generally good—Poland China, Berkshire, and Duroc Jersey being the prevailing breeds.

The accompanying table gives the acreage, production, and yield per acre of the principal crops of the county, as reported by the census of 1910:

Acreage and production of the principal crops of Frederick County for the year 1909.

Crop.	Area planted.	Production.	Yield per acre.	Crop.	Area planted.	Production.	Yield per acre.
	<i>Acres.</i>	<i>Bushels.</i>	<i>Bushels.</i>		<i>Acres.</i>	<i>Tons.</i>	<i>Tons.</i>
Corn.....	24,147	532,370	22.05	Hay ¹	16,861	16,544	0.98
Wheat.....	23,276	316,017	13.58		<i>Trees.</i>	<i>Bushels.</i>	
Rye.....	5,013	45,494	9.08	Apples.....	273,245	351,490	
Oats.....	2,577	45,909	17.81	Peaches.....	128,844	13,559	
Buckwheat.....	1,114	13,894	12.47				
Potatoes.....	577	55,885	96.85				

¹ Hay was reported as half timothy and half mixed clover and timothy.

Wheat and corn were probably the earliest crops grown and are still of chief importance. With wheat appearing twice in almost every rotation, the acreage is large, and in diversified farming it is the chief cash crop. On the limestone lands the yield of wheat averages for a series of years about 20 bushels per acre. Where preceded by a crop of cowpeas turned under, yields of as much as 37 bushels on a measured acre have been recorded. Where yields fall below 8 or 9 bushels per acre, as is often the case in the hills, wheat is unprofitable, but a large acreage is still sowed because it fits into the rotation and furnishes a nurse crop for grass, and also because it is the custom to supply the home with flour ground at the local mills.

On the hill soils rye often takes the place of wheat. Rye gives slightly better returns than wheat on the lighter soils. The average of 9 bushels given for the county is probably representative, as nearly all the rye is grown in the hill country.

The limestone soils, especially those of the Hagerstown series, have always been considered excellent corn soils. The large dent type of corn, both yellow and white, is grown and yields of 50 bushels per acre are common on the stronger valley and bottom soils. On the hill soils yields are seldom more than 30 bushels per acre. A white dent

variety (No. 119) developed by the United States Department of Agriculture, has made as much as 85 bushels on a measured acre of limestone soil. The early practice was to crop a field to corn as long as it proved profitable, but it is now seldom grown more than once in the rotation.

Except where ensiled, the corn is all shocked and the ground seeded to wheat around the shocks. A crop of silage corn has frequently been grown on land from which a crop of timothy had been removed in June, but unless the grass is cut very early the corn is apt to be injured by frost before it is sufficiently mature. All the manure made on the farm is commonly spread on the sod to be plowed down for corn, and it is found a good practice to apply the manure the summer or fall preceding the corn crop, rather than in the spring just before plowing. On land not subject to erosion fall plowing of sod land intended for corn is found beneficial.

The acreage of oats is comparatively small and depends somewhat on the opportunity for early seeding. The yield per acre of oats on the better farms averages about 35 bushels. Winter oats have been grown successfully, but their use is not common. Almost all the oats and corn grown are fed on the farm.

The growing of buckwheat is entirely confined to the hill country, except as occasionally used for a cover crop in orchards. A marked increase in acreage is taking place, and the returns are good. The yield averages about 15 bushels on the heavier soils, but is somewhat higher on the fine sandy loams, which do not crust after seeding.

Winter barley is a crop that is just coming into use and promises to become of importance in place of the second crop of wheat in the rotation. On good soil the ordinary yield is about 40 bushels per acre. The grain can be sold at a fair price or fed.

Timothy is commonly seeded with the second crop of wheat, and clover is sowed the following spring. This gives a crop of mixed hay the succeeding year, after which the clover gradually dies out, much more rapidly on the nonlimestone than on the limestone soils. Two tons of mixed hay per acre are often cut on the limestone soils. Much difficulty is experienced in getting a stand of clover on the hill soils and bottom lands. Liming has generally proved beneficial. Redtop, or herd's grass, is sometimes added in the seeding, and gives large yields of hay and good pasturage after the clover and timothy begin to decline. The quality of redtop hay is considered poor, however, and discrimination against it is made on the market. Hay fields are generally pastured more or less after harvest, but the main dependence is placed on the natural or permanent pastures. Those in the valley consist of the rougher and more rocky and broken areas of the limestone soils, which support good growths of bluegrass, and thus will carry stock in excellent condition throughout the summer. In the

eastern shale belt there are also bluegrass pastures, but they are not equal to those on the limestone soils. In the western hill country the native pastures are not so strong, but stock is turned into the abandoned or uncultivated fields, woods, and smaller creek bottoms, where it keeps in fair condition.

Alfalfa is rapidly becoming an important crop with the more progressive farmers and 1,400 acres of alfalfa and alfalfa mixed with other grasses were reported in 1914. The Hagerstown soils and the heavier marl bottoms seem to give the best results, and small fields sowed 5 to 7 years ago are still profitable. Three or four cuttings of alfalfa are made each year, giving a total yield of 2 to 6 tons per acre. The first cutting is made between May 25 and June 10, with subsequent crops about every five weeks. Bluegrass soon invades the fields on limestone soils, but does not seriously reduce the yield within the first five years.

In favorable years some hay is baled and marketed, but the bulk of it is fed on the farm. There is a brisk demand for alfalfa hay and its production for sale has proved quite profitable on some small areas. When the hay crop is short millet is sometimes sowed in July to supplement the forage supply. Cowpeas are sometimes grown for hay and for hog pasturage or as a green manure. While the crop does very well, its use is largely confined to the apple orchards, where it is grown as a cover and green manuring crop.

Irish potatoes are grown in small patches for home use only and seem to do fairly well on all soils, but no special attention is given to the crop.

In the neighborhood of Cross Junction and farther north a considerable acreage of tomatoes is grown in small patches on the Dekalb and Upshur soils to supply small canneries. The contract price is generally about \$9 per ton and the yield varies from 5 to 10 tons per acre, depending on the season. Some truck of various kinds is grown near Winchester to supply the local market. The areas within the Huntington silt loam which are shown on the map by inclusion symbol appear to be favored for trucking.

Considerable fruit for home use has always been grown by the farmers of Frederick County, and about 1890 commercial peach orcharding on the shale soils of the valley became important. During the next decade the industry increased rapidly in importance, and 160,000 trees were reported in 1900. About that time, the San Jose scale, peach yellows, and borers becoming very destructive, the number of bearing trees began rapidly to decrease and no new orchards were set out.

In recent years peach growing has revived somewhat on the Dekalb soils of the hill country, and with proper care has proved moderately profitable, though the distance to shipping points is a draw-

back. Heath (cling) and Elberta seem the best varieties on the mountain lands. Fruit of better quality is obtained on the sandy types, though the yield is larger on the heavier shale soils. Peaches are also used to a small extent as fillers in apple orchards, and on the soils derived from limestones the large yellow varieties, such as the Crawford, are probably the best. The peach crop is shipped to various markets, but a large part of it is disposed of locally. There are many excellent sites for peach growing to be had at reasonable prices in the western part of the county, but the distance to shipping points prohibits any extensive commercial development.

About 1895 apples became an important commercial crop. Since then apple growing has increased with remarkable rapidity, as a consequence of the success of the earlier plantings, until Winchester has become one of the largest apple-shipping points in the country (see Pl. I, fig. 1). In 1909, 273,245 apple trees were reported, and it is believed that the number of trees has doubled since that year. It is estimated that in 1914 nearly 300,000 barrels were packed and shipped, a considerable proportion of the crop going into the export trade. Besides those barreled, possibly half as many apples were sold loose to the cider mills, evaporating plant, and shipped loose in carload lots. The largest orchards are around Winchester, Kernstown (Pl. I, fig. 2), and Stephens City and extend north from the first-named place along or near Apple Pie Ridge for a distance of about 8 miles to White Hall. There are also some smaller commercial orchards in the hill country around Gore, Gainesboro, and Whitacre, one at the latter place being extensive.

The largest and oldest orchards are on the Hagerstown clay loam and Frankstown gravelly silt loam of the Apple Pie Ridge. The latter soil is regarded as especially well suited to orcharding on account of its excellent air and surface drainage, its loose and easily tilled surface soil, and its naturally strong and retentive subsoil. The Hagerstown clay loam being a still heavier and more productive soil than the Frankstown, possibly promotes a trifle more rapid growth and slightly heavier yields; but, on the other hand, it is harder to till, and, lying at lower elevations, sometimes has not quite so good air drainage. It is stated by some growers that the fruit on it does not color and mature quite so well as on some of the higher lying soils, and consequently does not have the best flavor and keeping qualities.

What has been said regarding the Frankstown soil applies also to some extent to the Frederick soils, or "flinty limestone soils," as where the latter are used for orchards they have a similar elevated topography, though the soil is somewhat more difficult to keep in good condition than the Frankstown, being heavier and often more

stony. Yields and quality on these soils, however, seem to be very good, and the silt loam is quite extensively used for orchards. Some apples are grown on the Berks and Colbert soils, but not enough to warrant a detailed discussion.

All varieties seem to succeed fairly well on the valley soils, and not very much attention is paid to adaptation of varieties to soils, so that the question may be the subject for profitable investigation. Ben Davis and York Imperial make up possibly 75 per cent of the total plantings and of these the latter probably forms 60 per cent. This variety is a heavy and regular bearer, a vigorous grower, and not especially subject to disease. The fruit is large, well colored, and of fair quality, and the price paid for it is as high as for any variety grown, with the exception of the Newtown Pippin. The York Imperial is an excellent shipper and is in large and growing demand for the export trade, for which in normal years perhaps 25 per cent of the crop is used.

The Ben Davis has proved a profitable variety in this section. It is a heavy and regular bearer and a good shipper, but the quality and sometimes the size is inferior, and the demand is not so brisk as for the York Imperial, though the price has been fairly good. It is also said that the Ben Davis does not endure drought so well as the other commercial varieties and is subject to attacks of scale and scab.

Other market apples grown on the limestone soils are the Grimes Golden, Yellow Newtown, or Albemarle Pippin, and the Northwestern Greening. These are light-colored apples of excellent quality and command high prices. They are well suited to the clear, dry climate of the valley, which is necessary to produce a clear-skinned apple, free from disease; but they require a good, rich soil and better care than the varieties first mentioned. The Grimes seems especially susceptible to collar rot, which makes it a short-lived tree, and the Newton must be sprayed for bitter rot to get the best results. A good many Stayman Winesap, Rome Beauty, Baldwin, and other varieties are grown.

In the hill section both light and heavy types of the Dekalb and Upshur soils are used for apples. The Upshur gravelly fine sandy loam is probably the most suitable apple soil, being warm, mellow, well drained, and comparatively strong. Apples grow more slowly on the hill soils and a paying crop is seldom expected before the ninth or tenth year. Crops, too, are probably not quite so heavy as on the valley soils, but the quality and color are excellent and are appreciated by the buyers, while orchard sites are comparatively cheap. Marketing the crop is one of the chief drawbacks to this section, as the cost of hauling sometimes reaches 20 cents per barrel. The use



FIG. 1.—HAULING APPLES TO RAILROAD STATION, WINCHESTER, VA.



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FIG. 2.—EXTENSIVE BEARING APPLE ORCHARD, CHIEFLY YORK IMPERIAL, ON HAGERSTOWN CLAY LOAM, NEAR KERNSTOWN, VA.

of steam and kerosene traction engines, each of which can haul two wagons and over 100 barrels at a trip, is becoming common, and some reduction of the expense is thus effected.

York Imperial and Ben Davis are the leading varieties in the hills, as elsewhere, but the Winesap, Gano, Black Twig, and Jonathan are also of considerable importance. Conditions are here especially favorable to producing a highly colored apple, and the light-skinned varieties are not so much grown, as it is said they require a retentive soil that will keep the apple growing till late in the season. Some orchards of the summer and early-fall varieties have been set out recently. These are mainly Yellow Transparent, Duchess, and As-trachan. The trees are too young to give any indication of the success of the experiment.

Cultural methods in orchards are not very uniform or highly specialized. Until the trees begin to bear they are quite often inter-cropped with the usual rotation of corn, wheat, and timothy and clover, with buckwheat extensively used in the hill section. The tree strip is generally kept plowed up and cultivated even when the orchard is in grain or grass. When the apple yield begins to pay for the use of the land, clean culture is practiced in the better managed orchards until July or August, when a cover crop of Clay cowpeas or clover is often sowed to be plowed under in the winter or early spring. Rape makes a fairly good cover crop where hog pasture is desired. Some large orchards have been in sod for many years and still bear good crops, but do better where the grass mulch system is used. Young trees are occasionally set out and given no further care than to grub the sod from a small area around each tree, but the ultimate success of such methods is doubtful.

Peaches and Kieffer pears are occasionally used as fillers in apple orchards, but usually where fillers are used some standard or early-maturing short-lived variety of apple, such as the Grimes Golden, is planted and later removed. Some Kieffer pears are marketed, principally from Apple Pie Ridge, but the number of trees is not increasing, as the price obtained for the fruit is not high enough to make it very profitable.

All successful apple growers spray at least once with lime-sulphur mixture for scale during the dormant season. Another spraying with arsenate of lead and lime-sulphur is given soon after the petals fall and sometimes a second and third spraying of this at intervals of five and nine weeks after the first. For varieties like the Newton, susceptible to the bitter rot, a spraying with arsenate of lead and Bordeaux mixture is often necessary in August. Peaches must be sprayed for the scale and brown rot with the lime-sulphur mixture. Blight sometimes attacks the new

wood of the apple trees and kills the twigs to a considerable extent, but never extends into the old wood and does not appear to do much injury to the trees. Cedar rust is quite destructive to apples where cedar trees are plentiful, as in the neighborhood of Middletown and on the Berks shale soils. The laws of the State, however, demand the cutting of cedar trees where the orchard interests are important enough to warrant it. The York Imperial is especially susceptible to cedar rust.

In the general agriculture of the county much the same rotation is practiced on all the soils. This consists of sod land plowed in the winter and spring for corn, and corn stubble harrowed or disked up and seeded to wheat or rye around the shocks. The wheat stubble is plowed and sowed in the fall to wheat and timothy, clover being sowed in the spring. The grass is mowed and pastured for 2 to 5 years. Where oats are grown they follow corn and are succeeded by wheat, and when it is too wet in the spring to seed the oats early the land is sometimes returned to corn. Buckwheat is commonly sowed on sod land plowed in June, and is usually followed by rye in which grass may be sowed. Better stands of grass are obtained on almost all soils where the wheat stubble is plowed and seeded down to grass alone about the middle or last of August. Where the corn is ensiled the ground can be well enough fitted, especially if a disk harrow is used, for grass to be seeded with the wheat, thus making wheat appear only once in the rotation.

Somewhat over \$57,000 is reported as spent for fertilizers in 1909. Fertilizers are used quite generally on small grains and to a less but growing extent on corn. Applications are usually small, 200 to 300 pounds per acre being the quantities commonly used for wheat and corn in the valley, although it is only recently that corn has been fertilized, except with manure. Seedings of grass without a nurse crop and of alfalfa have been given as much as 600 pounds of phosphate per acre, and seem to repay the increased expense. In the hill country, where all fertilizer must be hauled from 10 to 20 miles, applications are still smaller, 200 pounds generally being used on wheat and about 100 pounds on corn, rye, and buckwheat.

Various brands and formulas of fertilizer are applied rather indiscriminately on different soils and crops, but a 12-5 mixture for wheat, or simply acid phosphate, appears to be the most generally used. A mixture of half bone meal and half acid phosphate has been recommended, but is rather expensive. Small applications of fertilizer are sometimes made around the young fruit trees.

The manure made on the farm is all applied to the sod to be plowed for corn. Manure spreaders are commonly used on the best farms and the manure fairly well taken care of, though in many

cases it is left under the drip of the barn roof and exposed to the weather until much of its value is lost.

Large lime kilns are operated at Stephens City, and the whole valley section is abundantly supplied with limestone, but very little lime has been used for agricultural purposes in the past. Although many of the soils are derived directly from limestone, their manner of formation was such that almost all the lime has been leached out, and its application is almost always followed by increased yields. The use of lime in the valley section is growing very rapidly, especially where it is desired to grow alfalfa. Ground limestone is coming into favor, and the increase in its use has effected a lowering of the price.

Around Star Tannery, where there are numerous ledges of limestone, it has become the practice to burn and apply about 50 bushels of lime per acre to the wheat land nearly every other rotation. This has a marked beneficial effect on corn and clover. Practically all the hill lands and creek bottoms, especially the heavier types, would be benefited by frequent small applications of lime or ground limestone. Generally there is an abundant supply of raw material within 5 or 6 miles and plenty of cheap firewood, but there are no kilns and no lime is burned or used except in the one restricted area mentioned. The usual price of lime at the small kilns is 10 cents a bushel.

According to the census of 1910 there were in Frederick County 1,765 farms, comprising 240,127 acres, or 86.4 per cent of the area of the county. Of the acreage in farms the census showed 154,562 acres, or 64.4 per cent, improved. This is a decrease of 6,550 acres from the report of 1900, the falling off being doubtless all in the western hill country, where there are many fields in a semiabandoned condition, growing up to field pine and sumac. The reason for this abandonment is not so much soil exhaustion as the drift of the younger generations to the cities and to the more profitable employment on the valley lands, leaving the less profitable and rougher farms in the more remote regions untilled. The same 10 years showed a decrease of 3.4 per cent in rural population, and this loss is probably all in the western part of the county. The total number of farms in the county, however, was increased by 162 during that decade, due largely to the subdividing of farms in the valley.

The average size of farms in the county was given as 136 acres in 1910. The average acreage improved is given as 87.6 acres, or 64.4 per cent of the farm. In the valley this would doubtless be much higher, possibly 85 or 90 per cent, while in the hills seldom more than 50 acres of the average-sized farm are cultivated. The tendency in recent years is still further to discontinue the cultivation of the hills where there is any bottom land on the farm.

Many large tracts in the western part of the county are held solely for their timber and tanbark, which form their chief resources, as thousands of acres are entirely unsuited to any agricultural purpose. Large tracts of Rough stony land along the upper slopes of Great North Mountain have recently been purchased at an average price of about 75 cents an acre by the National Government as part of an extensive forest reserve.

On the highest and most rugged parts of the mountains the timber is of little value, being largely scrub or "jack" oak, with some pine and chestnut oak. The lower slopes and the ridges and valleys grow good timber in great variety, including white, black, red, chestnut, and other varieties of oak, also pine and chestnut, with some fine specimens of walnut, sycamore, tulip poplar, and sugar maple on the lower lying and deeper soils. The peeling and hauling of tanbark, especially the bark of the chestnut oak, was once an important industry in the hills, but the best varieties are now rather scarce, and several tanneries once operated in the west and southwest have for some time been discontinued.

Lumber in the form of crossties, barrel stock, and sawed timber continues to be one of the chief products of the hill country. Small portable sawmills and stave mills are numerous and to many furnish more remunerative employment than farming, while a large number of men and teams are necessary for the long hauls to market. The shipping of apples and lime in the valley demands large numbers of barrels, which are supplied to a great extent by mills and cooperages throughout the southwestern section. Pine is used for the lime barrels and the better grades of wood, such as oak and chestnut, for apples.

Farm equipment in Frederick County seems generally adequate for the type of agriculture practiced, considering the texture of the soil and the topography of the fields. Where, as is in some places the case, the fields are so sloping that all hauling must be done with a sled, only the most primitive tools can be used. In the valley and on the better hill farms, however, improved cultural and harvesting tools are used, while manure spreaders and disk harrows are becoming common. In the hills, teaming brings in so much more ready money that farming is sometimes given second place, while in the valley, and to a less extent in the hills, apples, being often the money crop, need and receive attention at a time when other farm crops are apt to suffer from the lack of it. On farms on which there are no apples, the farmer finds himself unable to pay as high wages for help as the apple growers, and so has to get along with just enough outside labor to put in and harvest his crops, and many details, such as the cutting of weeds, must be neglected.

The farm-labor supply is almost entirely native white and is fairly efficient, but rather inadequate, making wages high. A farm hand gets from \$20 to \$30 and board per month, or, if married, about the same wages with a house and some privileges. The amount spent for farm labor in the county in 1910 was \$208,308, or about double the amount reported in 1900. The increase is due to the higher wages and to more help being hired, as well as to the large amounts paid out each autumn to apple pickers who come in for the season from the hills and the surrounding country. These receive about \$1.25 a day.

The census of 1910 reports 79.4 per cent of the farms of the county as operated by the owners, but in the hill section the percentage is much higher. Various systems of share tenancy are in use and there is considerable cash renting, especially of orchards and grazing land in the valley. Good limestone farms rent for \$5 or more, or good bluegrass pastures for \$3 or more, an acre.

Plate II, figure 1, shows a typical house of the better class in the hill country. One of the finer Colonial houses on the Valley Pike is also shown in figure 2 of the same plate.

The average value of farm land in the county was reported by the census of 1910 as \$32.94 an acre, having more than doubled in the preceding 10 years. It would probably be hard to find a county in which there is more range in the price of agricultural land. Fairly well improved farms in the hills can be bought for \$10 an acre, while arable land in brush and timber has been sold recently for as low as \$1 an acre in the extreme northern part of the county. Hill-section farms, comprising some creek bottom, or those having some of the nongravelly, heavier types of soil, bring from \$25 up, and seem generally fairly well improved and prosperous.

In the valley the limestone soils range from \$50 an acre for farms on the more or less broken areas to over \$200, depending on contour, location, soil, and suitability for fruit growing. If there is a commercial orchard on the farm, the price is proportionally higher. Bearing orchards have brought over \$500 an acre. Farms on the eastern shale belt range from \$50 to over \$100 an acre.

The farm practices in the valley section are in general as good as could be expected, but on account of the high value of land it is hard to make general farming pay interest on the capital invested. The most successful way to increase the net income seems to be by growing some special crop, such as apples, or by raising hogs on pasture.

Crop yields, however, could doubtless be increased by better tillage, larger and more scientific use of fertilizers, and the use of more lime, stable manure, and green manuring crops, such as cowpeas

and crimson clover, wherever they could be worked into the rotation. Alfalfa succeeds on almost all of the limestone and bottom soils and sometimes on the shale land.

The chief objection to the customary crop rotation is that it contains too much wheat, which is an exacting crop and not especially profitable. The system could be improved by the substitution of winter barley for one or both wheat crops, as this is an equally good nurse crop for grass, and may be fed at home. There is also much need for better seed-corn selection, the largely increased yields obtained from the Department of Agriculture corn No. 119 showing what can be done in this respect.

Community breeding of live stock would increase the profits of this industry and improve the quality of the stock faster than it could be done in any other way, and the Holstein and Polled Durham breeders have already organized.

Truck farming might prove profitable, especially with heavy truck on some of the marl soils, as they are generally located fairly close to the railroad.

For the hill section it is hard to make recommendations which would not entail too heavy an expense to be practicable where the lack of transportation facilities and other conditions combine to make farming unprofitable. The chief needs of the soil are organic matter, fertilizers, and lime. If dairy stock were substituted for the beef cattle, which are commonly of inferior quality, the quantity of manure would be the same or greater and there would be a larger and more steady income out of which phosphates and lime could be purchased. Most of the hill section is too remote and conditions are too crude for the successful production of market milk, but if a few creameries could be started, or even if butter could be made on the farm, there would be fair returns and also skim milk to be turned into pork at a profit.

Deeper plowing of the hill land, possibly with reversible or two-way plows, would increase their power to hold moisture and reduce surface wash, thus making the soils more productive.

Wheat on the hill farms is unprofitable with the usual yields and might well be displaced by barley, or at least be grown but once in the rotation. The tendency in this section is to set out commercial orchards, and this seems to be the most profitable line of farming at present, but there is always a long wait for the first crop and the apples are a heavy commodity to market, so that if prices decline competition with better located orchards may prove impossible.

In a great many cases farming in the hills would be more profitable if the rougher lands were left in pasture or reforested and the manure and care concentrated on the best fields. This seems to be the tendency where there is any bottom land on the farm.

SOILS.

The soils of Frederick County fall into three broad general divisions or provinces, according either to differences in the origin of their material or to the manner of their formation. The most extensive division comprises the soils of the Appalachian Mountain Province, or the soils derived from shales and sandstones, while the most important agriculturally is that group of soils found in the Limestone Valley Province. All the soils in these provinces are, with possibly one exception, residual, that is, derived in place from the underlying rock beds. The third division includes the alluvial soils, i. e., those lying along the streams.

All the rock formations of the county are sedimentary, that is, composed of materials originally laid down under water. Later these rocks were elevated, folded, broken, and subjected to weathering and erosive agencies. For various reasons erosion took place much more rapidly at some points than at others, so that different beds are now exposed, the limestone land in the valley once being covered by hundreds of feet of sandstone and shale beds such as are found east and west of it.

The limestone soil material is composed of the insoluble or less readily soluble residue left when the calcium and magnesium were dissolved out of the parent rock. These soils are seldom very deep to bedrock, but it is estimated that as much as 75 to 100 feet of limestone rock must have been dissolved to make a foot of soil. Four main series of limestone soils are mapped, their differences depending on the nature of the insoluble residue of the parent rock and perhaps as much on the nature of the weathering processes.

Where the limestone is probably purest the resulting material is dark brown on the surface, with a red or reddish clay subsoil, and is mapped as Hagerstown. Two types of Hagerstown soil were mapped, the clay loam and stony clay loam, depending on the quantity of rock in evidence. In the Frederick series there are two types, the silt loam and stony loam. The surface soil is yellowish or grayish brown and the subsoil to a depth of 20 inches or more usually is yellow. Chert fragments are typically present in considerable numbers in the soil of the silt loam, and, of course, are much more abundant in the stony loam. The soil is probably derived from an impure or cherty limestone. In the Frankstown series the lime seems to have been dissolved out of certain strata of the limestone, leaving a soft, noncalcareous shale, which is always present in the soil as small angular fragments, the soil and subsoil both being yellow. Other soils of limestone origin are the Colbert silt loam and the included Hollywood clay loam, both of which are heavy, poorly drained, and of small extent. The lime-

stone soils occupy the whole west side of the valley section, and are there derived from the Cambrian and Ordovician limestone. Other small areas occur in the neighborhood of Great North Mountain and Bear Garden Ridge, and in these localities the parent material is the Lewistown limestone, which belongs to the Devonian period. The important limestone soils are all well drained and their topography varies from undulating to rather steeply rolling.

The soils of the Appalachian Province are the products of the disintegration of sandstone and shale rocks, fragments of which are generally present in the soil as gravel or stones. Three main series were mapped in this province—the Berks, Dekalb, and Upshur. The first includes light-brown soils derived from thin-bedded shales, generally dark in color. The series is most extensive on the rolling "pine hills" on the east side of the valley, where the soil is derived from the Martinsburg shales of the Ordovician age. Small areas also occur west of the mountains, here being derived from Devonian formations. The Dekalb and Upshur soils, occupying most of the hill country west of the Little North Mountain, are derived from Devonian sandstones and shales. The Upshur soils are derived from rocks of Indian-red color and are here represented by the gravelly fine sandy loam and gravelly loam. The Dekalb soils are gray and brownish and come from the light-colored or brown parent material. Every texture from a loamy sand to a silt loam was found in the Dekalb series, and much of that series, as well as of the Upshur, is stony or gravelly. The topography of these two series is rolling to quite hilly, and the drainage is almost always good.

The alluvial soils are composed of material washed down in times of high water and deposited on the flood plains of the streams. The coarser material was dropped as soon as the streams left their banks, but the finer silt and clay were carried on and deposited in the slack water near the foot of the slopes. Thus the bottom soils tend to grade from light along the stream channels to heavier farther back from them. From the manner of their formation, these soils are derived from a great variety of materials, especially along the larger streams. Where limestone soils have been an important source of the alluvium the soil was mapped as Huntington silt loam, otherwise the name Pope was used and two types were recognized, the fine sandy loam and silt loam. These two types are the most productive soils of the hill country, though crops on them are occasionally damaged by floods.

Peculiar marl-bottom soils found in the valley section along streams rising in the limestone country are included and described in connection with the Huntington silt loam. The soils consist of a loose, granular, gray material and a darker, heavier material. There is little doubt that these highly calcareous soils are the result of a precipitation from the lime-impregnated water, mixed later, especially

on the areas of heavy texture, with alluvial and colluvial material washed in upon it.

The use of the term Rough stony land is confined to the mountainous or very rugged areas. Steep, rocky slopes of small extent and high, precipitous banks along streams were included with adjacent types and indicated on the map by the outcrop symbol.

The following diagram is an approximation of the order of the geological formations represented in the county, and the soils derived from each. No detailed geological work has been done in this county, so that nothing regarding the geology can be stated positively.

Age.	Rock formation.	Soil series or type.
Devonian...	Shales and sandstones.....	{ Berks.
		{ Dekalb.
		{ Upshur.
Silurian.....	Oriskany sandstone.....	{ Dekalb stony sandy loam, deep phase.
		{ Rough stony land.
	Lewistown limestone.....	{ Hagerstown.
		{ Frederick.
		{ Dekalb.
Romney shale.....	{ Rough stony land.	
	{ Dekalb stony sandy loam.	
Ordovician..	Martinsburg shales.....	{ Berks.
		{ Hagerstown.
	Chambersburg limestone.....	{ Frederick.
		{ Frankstown.
Stones River limestone.....	{ Colbert.	
	{ Pope.	
Recent.....	Alluvium.....	{ Huntington.

The following table gives the names and actual and relative extent of the several soils of the county:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Dekalb gravelly loam.....	66,752	24.3	Dekalb stony loam.....	7,168	2.6
Berks shale loam.....	49,280	18.0	Pope fine sandy loam.....	¹ 5,568	2.0
Hagerstown clay loam.....	27,712	10.1	Huntington silt loam.....	4,800	1.7
Frederick silt loam.....	25,664	9.3	Dekalb silt loam.....	4,736	1.7
Rough stony land.....	22,528	8.2	Berks silt loam.....	3,968	1.4
Upshur gravelly fine sandy loam.....	14,464	5.3	Upshur gravelly loam.....	3,840	1.4
Hagerstown stony clay loam..	10,048	3.7	Frankstown gravelly silt loam	3,520	1.3
Dekalb stony sandy loam....	7,680	3.1	Colbert silt loam.....	² 2,816	1.0
Deep phase.....	704		Pope silt loam.....	2,688	1.0
Dekalb gravelly fine sandy loam.....	8,256	3.0	Frederick stony loam.....	2,368	.9
			Total.....	274,560

¹ Pope stony sandy loam included.

² Hollywood clay loam included.

HAGERSTOWN CLAY LOAM.

The Hagerstown clay loam in its typical development is a brown to reddish-brown loam or silty loam with a depth of 4 to 8 inches. The subsoil is a brown, reddish-brown or reddish, friable clay, which

becomes a stiff red clay at about 18 inches. Every field of this type presents a more or less spotted appearance, owing to the occurrence of numerous patches of clay of a reddish color, while the intervening areas may be silt loam of a duller brown color. These silt loam areas are developed in the depressions and on the very gentle slopes, and have a depth of 10 to 15 inches. Such areas would have been mapped as Hagerstown silt loam if they had been larger. Outcrops of massive blue and gray limestone are characteristic of the type, and where numerous are indicated on the map by symbols. Surrounding these outcrops the soil is a heavy clay of a deeper red color than usual. The dip of the rock is generally fairly sharp, but in a few small areas the underlying strata are almost flat. The soil is thin in places where the rock approaches the surface.

Along the ridges west of Winchester the type sometimes varies in texture. Interbedded strata of reddish sandstone appear in places and sometimes give a sandy or fine sandy texture to the surface soil and, to a less extent, to the subsoil, while there are some sandstone and chert fragments on the surface. Included in this type, and generally lying on the knolls and ridges, are areas of Frederick silt loam too small to be separated on the map. Along the eastern side of the valley there are areas of red or olive Hagerstown clay, which are of small total extent and were not mapped.

This type seems to have been derived from a rather pure limestone, as only occasionally are chert fragments abundant on the surface. Like the other limestone types, the soil material is composed of the insoluble residue from the solution and disintegration of the underlying limestone rock. In this solution most of the lime was dissolved and carried away, and, as drainage is to a great extent downward through the soil into underground channels, the processes of solution and removal of what lime remained have been more complete than in soils in which the drainage is more largely surface run-off. Considering these facts, it is not surprising that the soil often gives an acid reaction and is benefited by applications of lime.

This type has an important development along the eastern side of the valley, though it may occur wherever limestone is found, and some was mapped near Great North Mountain. The soil is most typical along the Martinsburg and Valley Pikes for almost their entire length within the county. The topography is undulating to rolling and is splendidly suited to general farming and orcharding. Drainage seems always to be good. Surface drainage channels frequently are not well developed, but surplus water is carried off through cracks or small sink holes in the parent rocks to subterranean channels.

For general farming this is the most valuable soil of large extent in the county, and it is almost all in field crops or in orchards. It

was doubtless the first land farmed, since old records agree that it was not generally wooded when the first settlements were made, though there are now many splendid groves of white oak, hickory, and other hardwoods.

This type is extensively used for apples and some of the largest orchards in the county are located upon it, around Winchester and Kernstown. The York Imperial seems to be the leading variety, but all others grow and seem to do well. The trees are thrifty, bear early and heavily, and are long-lived. Aside from orcharding general farming is commonly practiced, with wheat as the money crop and some beef cattle raised or finished during the winter. Dairying on this type seems of secondary importance. Corn probably averages 50 bushels per acre and is occasionally grown twice in the rotation, as this is considered a strong corn soil (see Pl. III, fig. 1). Wheat makes 20 or 22 bushels per acre and is followed by timothy and clover. These grasses take well and are mowed about 3 years when the sod is again plowed for corn. Hay yields from 1½ to 2 tons per acre. Timothy generally predominates after the first or second year. Bluegrass comes in naturally, but the land is generally too valuable to be left in pasture. Alfalfa has succeeded well in several places.

This type of land is excellently improved, the houses are often of massive limestone, and all the buildings are generally large, well painted, and kept in good repair. Well-laid walls of limestone gathered from the fields are a feature of the landscape on this type, but do not indicate a stony soil, as there are very few loose stones near the surface. Most of the farms on this type are held at high prices, on account of their prospective value as orchard sites or, in the case of the old homes along the pikes, for historic or sentimental reasons (see Pl. II, fig. 2). Fairly well improved land within 3 miles of Winchester has sold for \$250 an acre, but some good farms almost as well located could probably be bought for less than \$150, and more remotely situated places, comprising more or less of the more broken types of soil, can be had for less than \$75 an acre.

This type is probably the best farmed in the county, where orcharding does not claim too large a share of the farmer's attention. Fall or winter plowing, which promotes early seeding and a good seed bed, is commonly practiced. More alfalfa is being sowed every year, and wheat is often restricted to one year in the rotation. The silty spots here and there possess a mellower structure and are more easily tilled than the typical clay loam areas. Alfalfa does well on these silty areas.

HAGERSTOWN STONY CLAY LOAM.

The surface soil of the Hagerstown stony clay loam consists of 6 to 8 inches of light-brown or yellowish to reddish-brown, heavy loam to clay loam, and is underlain by heavier material which grades at rather

shallow depths into the characteristic reddish-brown or red clay. The stone content consists almost entirely of limestone ledges and outcrops, though some loose fragments of limestone and chert may occur. Most of these fragments have been gathered up and built into walls. In places the rock surface is so large that the type might have been mapped as Rough stony land but for the fact that all limestone land has a comparatively high value. On the very rocky areas the outcrop symbol was used on the map, and where the ledges were not numerous enough to interfere seriously with cultivation the soil was included with the Hagerstown clay loam and the outcrop symbol used.

This soil occupies the rougher and more hilly parts of the limestone valley, quite frequently occurring along streams and drainage ways and on slopes where erosion has carried off the products of rock weathering at a rapid rate. The largest areas are in the northwestern and southwestern parts of the valley section. All the type has excellent drainage.

Though some of the less rocky patches in this soil are farmed to the usual crops and produce good yields, a large part of the type is in open woods and fine bluegrass pastures. The grass grows close up to the rock ledges, where the soil is surprisingly thin, and the sod is so dense that other vegetation can get but little foothold (see Pl. III, fig. 2). Some of these pastures are very old, and it is on these rougher areas that the growing of beef cattle and sheep is of most importance. Scattered trees and clumps of trees are characteristic of these pastures and furnish plenty of shade for the stock. White oak, red oak, hickory, locust, and some walnut form most of the groves. Some of the type is used for orchards, and where not too rough apples may be profitable, though the rocks often make tillage almost impossible. Corn is said to give excellent yields where one of these old pastures is broken up, and putting the more tillable pastures through a rotation once every 10 or 15 years probably would be beneficial by preventing their getting too compact and sod bound.

On account of its value as pasture, little of this type can be bought for less than \$45 an acre. Comprising as it generally does only part of the farm, the actual price would probably be higher. Good pasture land conveniently located rents for about \$3 an acre.

FRANKSTOWN GRAVELLY SILT LOAM.

The surface soil of the Frankstown gravelly silt loam consists of a light-gray, yellowish-gray, or light-brown silt loam having a depth of about 8 to 12 inches. It is underlain by a yellow, heavier silt loam, which grades at 18 inches or less into a dingy-brownish or ochereous-yellow, friable clay loam to clay. Bedrock, consisting of limestone and an interbedded soft, yellow, shaly rock, may be encountered at almost any depth and occasionally outcrops on the

slopes. Both surface and subsoil contain 20 to 60 per cent of angular gravel and small fragments of this soft "soapstone" rock and some small, grayish, cherty material is often present.

The characteristic soapstone rock from which this "apple-pie land" is derived is very light in weight. It is thought to be a bed of the valley limestone from which in some way the lime has been dissolved, leaving the mass of yellow impurities which, weathered further, form the soil. Blocks of this yellow rock, when broken open, sometimes show a hard, gray limestone center, surrounded by the yellow material, which gives no effervescence with acid.

This type occurs on a broad ridge—Apple Pie Ridge—which enters the county at the north about $1\frac{1}{2}$ miles east of Green Spring Mountain and parallels the mountains to a point about opposite Winchester. From this point it appears as isolated areas here and there, generally on high points and following the same direction, parallel to the higher ridges, until it passes out of the county near Marlboro. This type lies above the associated Hagerstown and Frederick soils, the topography being rolling and the drainage excellent.

Almost the whole of this soil is cleared and farmed, but it is as an apple soil that it has become so well and favorably known. From White Hall south to Winchester a very large part of the ridge is devoted to apples, and some of the finest and most productive orchards are located on it. All varieties seem to do well on this soil, but York Imperial, Ben Davis, Yellow Newtown, and Baldwin are the standards, with many others of less importance. The soil being loose and gravelly is easily kept in good tilth, but it is heavy enough below to be retentive of moisture. Air and water drainage are excellent and the distance to shipping points is seldom over 6 miles.

As a general farming soil, this type also ranks well. Corn does not do so well as on the Hagerstown soils, probably averaging 30 bushels per acre, while wheat makes 18 to 20 bushels and hay yields fairly well. Alfalfa is grown successfully, but generally requires lime, which would doubtless benefit other crops as well.

The usual system of general farming is practiced, but is very often subordinated to orcharding and is apt to be somewhat neglected in consequence. Where the owner of the property does not live upon it, as is often the case, the buildings and fences on this type are sometimes allowed to fall into bad repair, but generally the improvements are quite substantial and the buildings and fences kept in good condition.

Land on the ridge is held at high figures owing to its value for orchard sites. Even where no trees are set out, probably little of the Frankstown soil could be bought for less than \$100 an acre, and where conveniently located twice this amount might be asked. Bearing orchards command a high price.

FREDERICK SILT LOAM.

The Frederick silt loam consists of 8 to 10 inches of light-gray to yellowish-brown silt loam underlain by a yellow, or sometimes reddish-yellow, compact silt loam or silty clay loam which at 12 to 20 inches or more may change to a dull-red, heavy clay, becoming redder with depth. Chert and flinty limestone are typically present on the surface and throughout the soil profile, while in some local spots enough yellowish-white chert chips are present to make the soil gravelly. Outcrops of limestone are common, but probably are not so numerous as in the Hagerstown soils. Where numerous enough to be important they are indicated on the map by the rock outcrop symbol. Plowed land on this type often presents a very spotted appearance, eroded knolls and ridges having a pinkish-red color where the underlying clay is exposed against a gray background. This reddish clay may in some places lie rather close to the surface, and in such cases the separation from the Hagerstown is based on the gray or light yellowish brown surface soil and the relatively high chert content, the boundary line often being more or less arbitrary.

This type, like the Hagerstown soils, is derived from the solution of limestones, probably limestones of a less pure nature and with a higher chert content. The topography is generally rolling, the type, where associated with the Hagerstown, occupying the higher elevations and having a decidedly rougher contour. The drainage is very largely through subterranean channels and is always good.

This type, known generally as "flinty limestone land," is quite extensive and important. It lies largely along the western side of the northern valley and covers almost all of the southern part of the limestone country west of the Baltimore & Ohio Railroad. Though not considered quite so valuable as the darker colored limestone soils, it is quite productive and generally well improved and farmed. General farming, with quite a little dairying west of Stephens City, is practiced and the usual rotations are followed. Wheat is generally grown two years in succession, except on some of the dairy farms, and yields average between 15 and 18 bushels per acre. Corn probably ranges from 25 to 40 bushels per acre, but clover and grass seem to do well, the yields on the better farms nearly equaling those on the Hagerstown soils. The differences in yield on this soil and the Hagerstown clay loam are probably not all due to soil differences, since this type as a whole has possibly been farmed more continuously to wheat and has not been so well fertilized.

The Frederick silt loam is considered a good apple soil. The prevailing varieties of apples are grown, and while growth and yields may not quite equal those on the darker colored limestone soils, both the color and quality of the fruit are excellent.

Farms on this type without a commercial orchard upon them sell for about \$75 to \$100 an acre. Where dairying is practiced the buildings indicate an especially prosperous condition and the price would probably run well over \$100 an acre. Similarly high prices are asked where apple orchards are growing.

FREDERICK STONY LOAM.

The Frederick stony loam consists of a light-gray to brownish-gray fine sandy loam to silty loam, grading into a heavier, yellow loam at 6 to 8 inches. This becomes still heavier and more compact and grades into a reddish-yellow, light-red, or yellowish-brown, friable clay somewhere within the 3-foot section. Angular chert, sandstone, and quartzite fragments of varying size are abundant on the surface and scattered through the soil and subsoil. The surface is sometimes a mass of chert fragments from 2 to 4 inches square. Limestone outcrops occur, but are not very common.

This type is derived from a solution of limestone that contained a large quantity of chert and some interbedded sandstone. It is found chiefly in the western part of the valley section, where it caps hills and ridges occupied mainly by the Frederick silt loam. In this type is also included the variable, light-textured ridge material between Hayfield and Gainesboro, where some shale may also be found. Similar material is mapped at intervals all along "Flint Ridge," on the east side of Great North Mountain. The topography may be described as rolling to steeply sloping and the drainage is always good.

Although farmed to some extent in the rougher parts of the county, this is not a desirable agricultural type, being commonly rough and stony and not naturally very productive. A large part of it is in forest of fine red and chestnut oak, with some trees of other species. The soil might do well in peaches and apples. Excellent peaches are grown upon similar soil in West Virginia. Where farmed to general crops, the stones act as a mulch and better crops of corn and rye than would be expected are produced. Some thrifty looking apple orchards were seen on this type southwest of Stephens City. Where not in fruit trees, much of this land could probably be bought for \$25 to \$35 an acre.

COLBERT SILT LOAM.

The Colbert silt loam consists of 8 to 12 inches of rather heavy silt loam of a light-gray or yellowish-gray color, underlain by a compact yellow silt loam, which quickly passes into a yellow plastic clay, sometimes mottled with gray, and often becoming olive yellow and very stiff at 24 inches or more. Small iron concretions are com-

monly found in the surface and subsoil, in some places being much larger and more numerous in the lower depths. The type is developed in level and undulating areas and in depressions generally at a slightly lower level than the surrounding Hagerstown and Frederick soils. Undulating areas are commonly darker in color on the higher points and whitish or light gray below.

The type is generally, but not always, poorly drained, and open ditches and tiles could be used to advantage on the flatter areas. The poorly drained areas are sometimes spoken of as "persimmon land." Typical areas were mapped near Kernstown. The area east of Rest is for the most part fairly well drained and not much inferior to the other limestone types. Depressed areas in the Frederick silt loam were mapped as this type.

Where drainage is adequate this type seems to be productive and is considered a good soil, but it often occurs as only part of a field and is likely to be worked when too wet and so become cloddy and refractory. Wheat is somewhat subject to winter injury, and clover does not take well. Orchards on some of the drier areas seem to do well enough, but the type evidently is not as good fruit land as the better drained limestone soils. Where found in large areas, farm improvements on this soil do not appear to be so good and crop yields and land values are probably 20 or 25 per cent lower than on the surrounding land.

HOLLYWOOD CLAY LOAM.

The Colbert silt loam includes a number of areas of the Hollywood clay loam, which are shown on the soil map by the inclusion symbol. In these areas the surface soil is a black or dark yellowish brown heavy clay loam, 4 to 8 inches deep. The subsoil is a dull-black or drab, heavy, plastic clay, which generally becomes olive yellow at about 24 inches, and is frequently mottled with rusty brown and drab. This soil occupies flat, depressed areas. The outer edges may have a considerably lighter texture as a result of overwash material. Here the surface has a yellowish-brown or gray color. This soil in many places lies around the heads of drainage ways or along small streams, where the channels are not deep and the drainage is poorly established.

This is the heaviest soil in the county and is stiff and hard to handle, but it is productive and gives excellent yields of corn and grass. When in grass and small grains this type cracks considerably on drying, but cultivated crops never suffer from lack of moisture. A good part of the type is farmed, though the total extent is small. Corn yields 50 bushels per acre if well tended. Two tons or more of hay are frequently harvested from an acre, timothy and redtop doing better than clover. Wheat may be winterkilled, but otherwise does



FIG. 1.—TYPICAL HOUSE OF THE BETTER CLASS IN THE HILL COUNTRY.
Built of sandstone and logs and roofed with hand-shaved shingles.

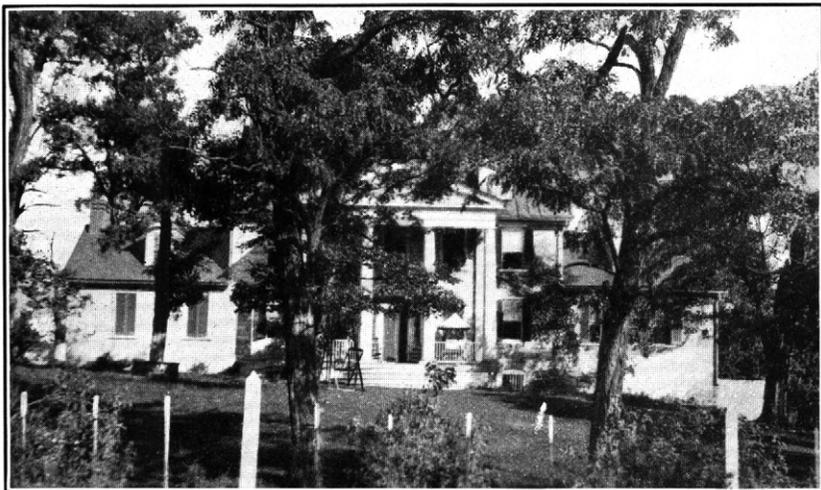


FIG. 2.—ONE OF THE FINER COLONIAL HOUSES ON THE VALLEY PIKE.
Built of native limestone by one of the early settlers.

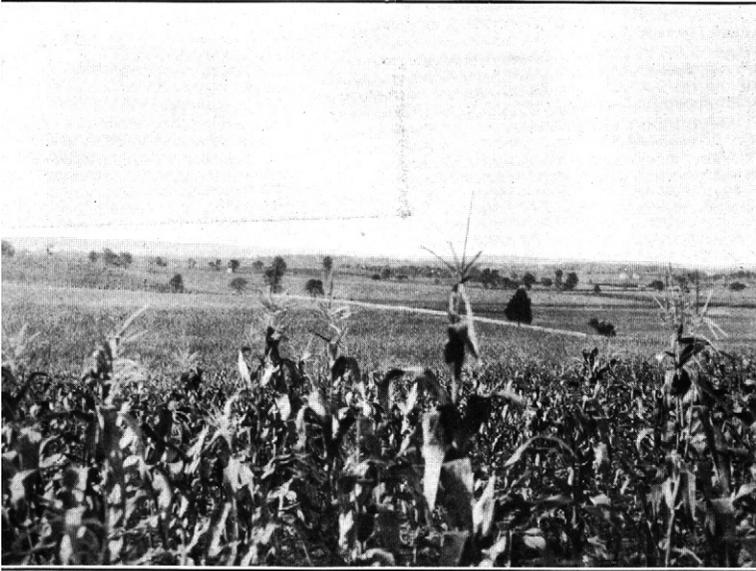


FIG. 1.—CORN ON HAGERSTOWN CLAY LOAM, NEAR WINCHESTER, VA.

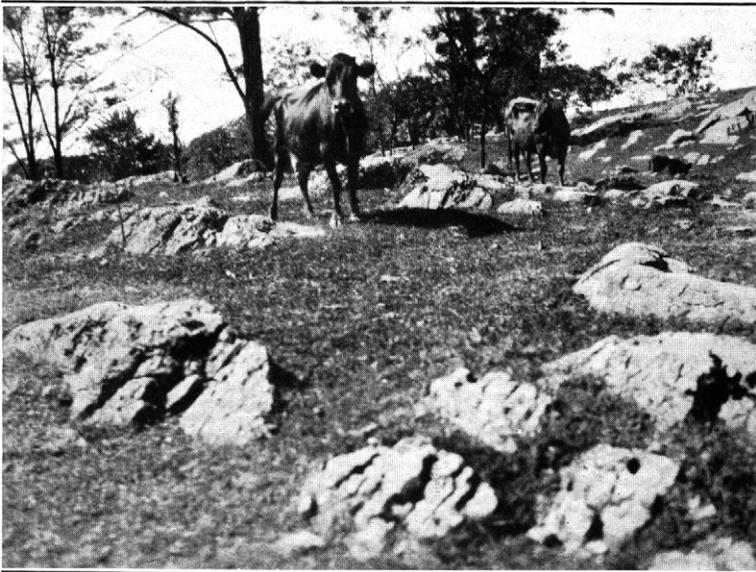


FIG. 2.—BLUE GRASS PASTURE AMONG ROCKS ON HAGERSTOWN STONY CLAY LOAM.

well. The type is naturally adapted to pasture and many areas are in bluegrass.

Surface drainage, with open ditches at least, is generally necessary on this type, and lime would probably improve the physical condition of the soil and increase the yields of crops.

BERKS SHALE LOAM.

As typically developed the soil of the Berks shale loam is a grayish-brown to brown silt loam to a depth of 6 to 8 inches. The subsoil is a pale-yellow silt loam, which may quickly grade into a yellowish-brown or mottled yellow and gray, friable silty clay, extending to the bedded shale, which is reached anywhere between 10 and 24 inches. Distributed over the surface and mixed with the soil and subsoil are large quantities of small, thin, platy shale fragments, probably composing 15 to 50 per cent of the surface soil. In some places where erosion has been active the surface soil is underlain at 6 to 8 inches by the disintegrating shale and the partly decayed rock may be turned up in plowing. Outcrops of the shale beds are sometimes seen on the slopes and knolls. Small areas of Berks silt loam are included in this type on the more level areas and where colluvial wash has collected.

This is the second type in extent in the county. The largest and most typical area of this soil covers almost the whole of the east side of the valley section, the belt being about $2\frac{1}{2}$ miles wide at the northern end and 6 at the southern. This extensive area is derived from the disintegration of the Martinsburg shale. In the west-central part of the county, lying to the north and on the east slope of Great North Mountain, and also in the vicinity of Nain, are developed small areas. These areas are closely associated with the Dekalb soils and are probably derived from the Devonian shales, although they have the characteristics of the large area derived from the Martinsburg shale, and are for that reason mapped as the same soil type.

The shales giving the Berks series are generally of a darker color and of a more fissile nature than those giving rise to the Dekalb soils, the colors including brown, drab, and the darker grays and yellows. The topography is characteristically smoothly rolling and, while sometimes rather deeply eroded, the difference in general level is seldom very great and the hills are commonly of a uniform height. These have smoother sides and are usually more rounded than the hills in the Dekalb country. Some of the shale where it borders on the limestone is calcareous and gives rise to a narrow transitional zone locally known as border land. The soil in this zone is considered very good. It is mostly mapped as the Berks silt loam.

The surface drainage of the Berks shale loam is generally good, but in the more level parts, such as adjoin the limestone, where the drainage system is not so well established, moisture conditions are not so satisfactory, as the internal movement of water is not free. Where the soil is deep the subsoil is of a rather impervious nature, and where the rock comes close to the surface this prevents the water escaping. When the water in the surface foot or more of soil is exhausted, there is no further reservoir to draw upon and crops sometimes suffer severely for lack of moisture. Tile drainage would doubtless be advantageous where the soil is deep enough to warrant it, but the shale ledges would add to the expense of laying the drains.

As it is easily worked and generally occurs where there are good transportation facilities, this type is very extensively cleared, but on some of the rougher, thinner areas farming is apt to be of a desultory type, and many areas would probably be better left in forest or at least in permanent pasture. This soil was once extensively used for peach growing, but this industry has now largely been moved to the Dekalb soils. In well-drained areas of deep soil peaches should do well with proper care, and apples would probably succeed on similar locations, especially if given some fertilization.

The best farms on this type of soil are almost all run as dairies and some form of stock farming is essential to permanent success on this sort of land. Though there is some blugrass on this soil, the pastures are not nearly so good as those on the limestone soils, so that beef cattle have never proved very profitable.

The usual rotation is followed, but as the land is not very strong, it is found better to grow only one crop of wheat, and as most of the dairy farms have silos, this can be conveniently done. Yields of crops on this type vary widely, depending on the depth of the soil and the kind of farming that has been practiced upon it. On the somewhat better farms corn yields 35 to 40 bushels per acre, wheat 12 to 15 bushels or more, oats 20 to 25 bushels, and hay about 1 ton.

The improvements on this shale land vary considerably, being as good as could be desired on some of the dairy farms near the railroad, while on some of the rougher parts they are almost as poor as could be found in the hill section. Land values range from over \$100 an acre for some of the best farms to less than \$50 for some of the farms west of the mountain which include a smaller proportion of cleared land.

BERKS SILT LOAM.

The surface soil of the Berks silt loam, to a depth of 6 to 8 inches, is a brown to yellowish-brown silt loam, often gray on the surface when dry. It is underlain by a yellow, compact silt loam, grading at 15 to 24 inches into a yellow, friable clay or silty clay, in many

places mottled and stiff below 30 inches. The bedded shale may be encountered anywhere below 20 inches or even nearer the surface, and some shale chips are generally present in the soil and subsoil.

The type is developed on the more level areas and in depressed places which are generally too small to map. It differs from the shale type mainly in having a smoother topography, greater depth of soil, and fewer shale chips. This soil occurs throughout the Berks shale loam, but is best developed near the junction of the shale and limestone formations, where it is sometimes spoken of as "border land."

The soil is deeper, smoother, and more productive than the shale type, but it is not so well drained and is harder to work and to keep in good tilth. Some of the best shale farms in the valley are composed partly of this type, and little of it east of the mountain could be bought for less than \$100 an acre. West of the mountain it does not seem so productive, considerable areas of it are not cleared, and the price is rather low. Wheat and timothy hay yield somewhat better on the silt loam, but the yields of other crops are about the same as on the better parts of the shale loam, depending on the adequacy of drainage.

Liberal applications of lime, with the plowing under of plenty of organic matter, such as manure, cowpeas, or other green manuring crops, would make this a good soil where drainage is satisfactory. The "border land" already referred to is regarded as having the strength of the limestone land and the ease of tillage and freedom from surface cracking that are properties of the shale.

DEKALB GRAVELLY LOAM.

The surface soil of the Dekalb gravelly loam consists of 6 to 10 inches of gray, yellowish or brownish-gray silty loam or loam, underlain by yellow or yellowish-brown silty loam, becoming heavier with depth and sometimes grading into a brownish-yellow or faintly reddish yellow friable clay at 20 inches or more. On the surface and disseminated through the soil and subsoil are small, blocky or angular shale and rather fine grained sandstone fragments and smaller chips, the quantity varying from 15 to 50 per cent of the soil mass. Where erosion has been active in old fields the surface of this type is sometimes almost covered with such fragmental rock, and on the steeper slopes where erosion has kept pace with decomposition outcrops of shale and sandstone may occur. The soil is not as a rule so shallow as the Berks shale loam, however, and the shale is generally thicker bedded and lighter in color, though some dark beds occur. This soil, as mapped, is derived entirely from Devonian shales and sandstones.

In some places the sandstone may be entirely absent over considerable areas and in this case the soil is somewhat heavier, approaching the Dekalb silt loam in texture and being locally known as "soapstone land." Along some of the lower slopes narrow strips of soil closely resembling the Berks shale loam occur. Where these areas were of sufficient size to be mapped and the topography resembled the Berks, they were separated, but many small areas were included in the Dekalb and the boundary where drawn between the two was generally more or less arbitrary. Included with this type are also small areas and narrow bands of Upshur gravelly loam too small to show on the map. Occasionally small patches of soil having an orange-yellow or rusty-red subsoil were also encountered. Where sandstone is present in the underlying rock, rather small blocks of a reddish or gray color may be common on the surface.

This is the most extensive type in the county and covers a large part of the western hills and lower mountain slopes of the southwestern, northern, and northwestern parts of the county (see Pl. IV, fig. 1). It is typically developed around Mount Williams, Cedar-grove, Light, Cross Junction, Fairview, and Hinckle. The topography varies from rather steeply rolling to quite hilly, and is generally rougher and not so rounded as that characterizing the Berks shale soils. The slopes, however, are commonly smooth and cultivable where not too steep. Along drainage ways the slopes are sometimes precipitous, and are indicated on the map by the rock outcrop symbol. On account of the topography the surface drainage is rapid and complete. The gravel content tends to make the subsoil loose and open, thus favoring the free internal movement of absorbed water. Surface erosion seems rather active, but the type is not particularly subject to gullyng.

Much of this type is, and should remain, uncleared. The native forest growth consists largely of oak and pine, with some chestnut. The best of the timber has been removed. Where this type is abandoned, pine and sumac rapidly spring up, and many slopes that have proved too steep for profitable cultivation are being reforested with the former.

The high shale content makes this soil easy to keep in good tilth, but at the same time causes it to be rather leachy and droughty, so that all crop yields are rather low, even in favorable years. The usual system of farming is followed and the customary rotation employed. Wheat and rye probably average less than 10 bushels per acre, though better yields are common. Corn yields about 25 bushels and buckwheat about 15 bushels per acre. Clover is uncertain and hay seldom yields more than 1 ton per acre. Peaches, espe-

cially the Heath, seem to do well, and there are several commercial peach orchards on this type.

Farms composed entirely of this soil are seldom valued at more than \$10 an acre, and are not generally well improved, except in the neighborhood of Mountain Falls, Star Tannery, Cross Junction, and Cedargrove, where much of the land is the "soapstone" variation and somewhat more productive. A very large percentage of the abandoned fields are on this type of soil, and some of the unimproved tracts can be bought for less than \$5 an acre.

DEKALB GRAVELLY FINE SANDY LOAM.

The soil of the Dekalb gravelly fine sandy loam consists of 7 to 10 inches of light-gray to grayish-brown fine sandy loam, underlain by a yellowish-gray heavy fine sandy loam, which in many places changes to a light yellowish brown fine sandy clay at 24 inches. The gravel, which makes up 15 per cent or more of the soil mass, consists primarily of small yellow and gray sandstone chips. These fragments commonly increase in number and size with depth. Sometimes there are enough larger sandstone pieces on the surface to interfere with cultivation, and where such areas are large they were mapped as Dekalb stony loam. Along parts of Big Timber Ridge and at a few other points the gravel content falls quite low, but as the sand content in these places seemed to increase and to be of a coarser texture the soils have a similar agricultural value and were not separated. Included with this type are also small areas of Upshur fine sandy loam.

This soil occurs throughout the hill section, very frequently capping the ridges of Upshur or Dekalb material of a heavier nature, and generally lying at the higher elevations. The largest bodies are around Howards Chapel and Siler in the northern part of the county and all along the top of Big Timber Ridge. The drainage of all of this type is excellent, though the topography is somewhat smoother than that of the heavier gravelly Dekalb type, and probably considerably more of it is under cultivation. This type, too, seems to be slightly better improved and farmed. It is held at \$15 or more an acre.

This is not considered a productive or retentive soil, but it is easy to work and the better crop yields reported are probably due largely to better farming. Buckwheat is thought to do especially well on this soil, and averages 20 to 25 bushels. Rye yields about 10 bushels per acre, wheat rather less, and corn about 25 or 30 bushels. Apples and peaches have fine color and quality on this soil, but yields are pos-

sibly lower and growth slower than on some others of the hill soils. Plate IV, figure 2, shows an abandoned field on this type growing up in old-field pine.

DEKALB SILT LOAM.

The Dekalb silt loam consists of a yellowish or grayish-brown heavy silt loam, 6 to 8 inches deep, underlain by yellow, compact silty clay loam, often with a slight olive tint, and grading below into a yellowish-brown, friable, silty clay, sometimes mottled with drab and yellow. Generally this soil is fairly deep, but in some places the disintegrating shale is encountered at a depth of 24 inches. A few small shale fragments are always present on the surface and in some areas there are enough angular pieces of sandstone to make local areas decidedly stony. Small areas are included in this type near Hayfield in which the surface soils approach a fine sandy loam in texture and the subsoils occasionally show a slightly reddish color.

Included in the Dekalb silt loam are patches of Dekalb loam. This variation is more friable and better drained than the silt loam on the lower slopes of the hills in coves and cove deltas, where a considerable part of the soil material has been washed down from above. It is seen on the slopes adjacent to Back Creek, in the vicinity of Gore. On some of the gentle slopes at the base of steep hills there are encountered a few spots of light-gray silty clay loam or clay having a rather plastic mottled subsoil. Some of this heavy material was found in the vicinity of Gore. The soil is colluvial in origin and often poorly drained, but is especially desired for the production of wheat and grasses.

Around Mountain Falls, in the valley east of Great North Mountain, there are areas of light-gray silt loam underlain by brownish-yellow silty clay loam grading into silty clay. Underneath this subsoil at depths of 15 to 30 inches is thin-bedded, black shale, but the soil is similar to the Dekalb silt loam, though possibly more compact, cold, and wet, and not so highly esteemed by the farmers.

The typical soil is chiefly developed in the valley south of Hayfield, where it occupies the more level areas within the Dekalb gravelly loam, which have not been made thin and gravelly by surface erosion, the line of demarcation between the two types being often somewhat arbitrary (see Pl. II, fig. 1). The topography is gently rolling and the surface drainage adequate, but owing to the rather dense subsoil the type is apt to be wet and soggy in the more level or depressed areas. Tile drainage would considerably benefit the flatter areas. Some areas were mapped on the more level tops of ridges, and here the drainage is good.

Most of this type is cleared and the usual system of general farming is followed. The soil, being deep and rather heavy, is retentive of

moisture. Owing mainly to poor drainage and the low organic-matter content, resulting from the exhaustive system of farming, the soil is rather difficult to work and has a tendency to clod and crust. Lime is always beneficial but is sparingly used, and crop yields could be greatly improved by plowing under green or stable manure, more thorough cultivation, and liberal fertilization with phosphates. Some of the type is probably better suited to grass and pasture than to cultivated crops.

A considerable proportion of the type is under cultivation, especially near Gore and west of Mount Williams. Corn yields from 20 to 35 bushels per acre, wheat 15 bushels or less, and hay from 1 ton to 1½ tons.

This soil is as a rule fairly well improved and farms on it sell for \$25 or more an acre.

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

Mechanical analyses of Dekalb silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
211427.....	Soil.....	3.0	3.6	1.3	3.0	2.9	61.0	25.1
211428.....	Subsoil.....	3.2	4.0	1.2	2.4	1.8	54.3	33.3

DEKALB STONY LOAM.

The surface soil of the Dekalb stony loam is a light-gray to yellowish-gray fine sandy to silty loam, 8 to 10 inches deep. It is underlain by a yellowish loam or fine sandy loam, which may grade into a brownish-yellow or even reddish-yellow silty clay loam within the 3-foot section. Scattered over the surface and mixed with the soil and subsoil are large quantities of angular, platy sandstone and quartzite, and some shale fragments of yellow, gray, or reddish color and ranging in size from fine gravel to 10 inches or more in diameter. Bedded shale and sandstone outcrop on some of the steeper slopes, and along the mountains many large boulders have rolled down upon this type from above and now lie upon the surface or are embedded in the soil material.

This soil is developed mainly on the crests of ridges, on the mountain sides, and on the steeper slopes. Drainage is everywhere thorough.

The best development of this type is seen on the east and west side of Great North Mountain. Areas are also found in the northwestern part of the county, and in strips paralleling the Little North Mountain ridge. It comprises areas similar in texture to the Dekalb gravelly loam and gravelly fine sandy loam, but contain-

ing so much stone and being usually so steep as to prevent cultivation. Little of the type has been cleared, and while apples and peaches might be profitable in favorable locations, there is plenty of land better suited to fruit culture that can be had at low prices, so that the stony type were better left in forest. Some small patches around mountain cabins are cultivated to corn and garden crops after the largest stones have been removed, but the yields are light.

DEKALB STONY SANDY LOAM.

The Dekalb stony sandy loam consists of 6 to 10 inches of yellowish-brown or light grayish brown medium to fine sandy loam, underlain by a heavy yellow sandy loam, the whole being somewhat loose and porous in structure. On the surface and mixed with the soil and subsoil are many fragments of gray, yellow, and reddish sandstone. Small fragments of sandstone may be numerous enough to make the soil gravelly. Shale fragments may also occur. Bedrock lies near the surface in many places and outcrops are not uncommon. The type as a whole varies from a rather stony fine sandy loam to Rough stony land, which it generally borders, and as mapped may include small areas of either of these soil classes, all being more or less non-agricultural.

This type occurs mainly on Great North and Cacapon Mountains and the near-by ridges (see Pl. IV, fig. 1). A few areas, especially in the extreme southern part of the county, are nearly level in places and not very stony, but the greater part of the type is steeply sloping and all of it is well drained.

Though scarcely an agricultural soil, some of the more level areas are cleared and cultivated to a small extent after the larger stones have been removed. Crop yields are very light, especially in dry years, but buckwheat, rye, and corn are grown. Apples, peaches, and light truck might be grown profitably on the less stony areas if transportation facilities were better. As it is, most of the type were better left in the native forest. Farming on this type is of the rudest kind and the buildings are generally poor. Taken as a whole, it is probably the lowest priced land of any agricultural value in the county.

In addition to the typical soil, there is included with this type a strip of sandy loam ranging in color from grayish brown to reddish brown with a pronounced red subsoil. This occurs on the upper east side of the ridge just east of Great North Mountain, and has been derived from red sandstone modified probably by limestone. Chert and sandstone fragments are numerous on the surface, and at 2 feet the subsoil is a mass of broken rock. This variation is largely under cultivation and in moist seasons yields fairly well. As this soil is warm and well drained it should be suitable for early truck, but present transportation facilities are poor.

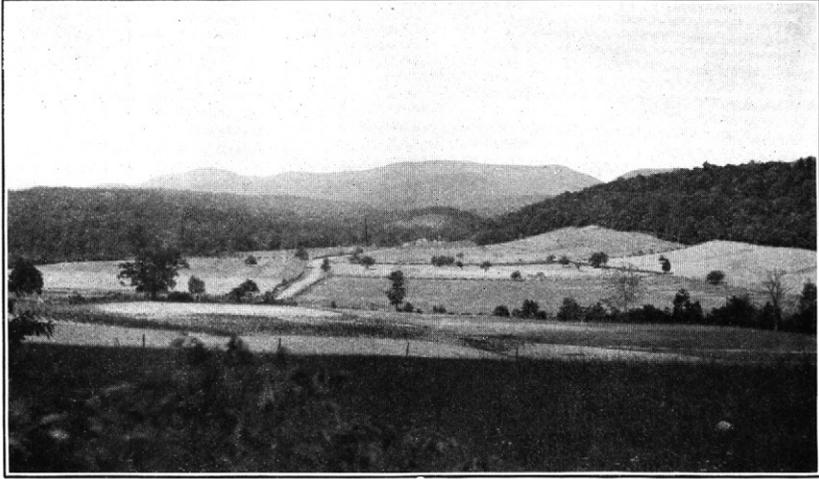


FIG. 1.—VALLEY SOUTH OF MOUNTAIN FALLS.

Dekalb gravelly loam in foreground, Dekalb silt loam in center, Flint Ridge with Dekalb stony sandy loam on the right, and Great North Mountain in the background.

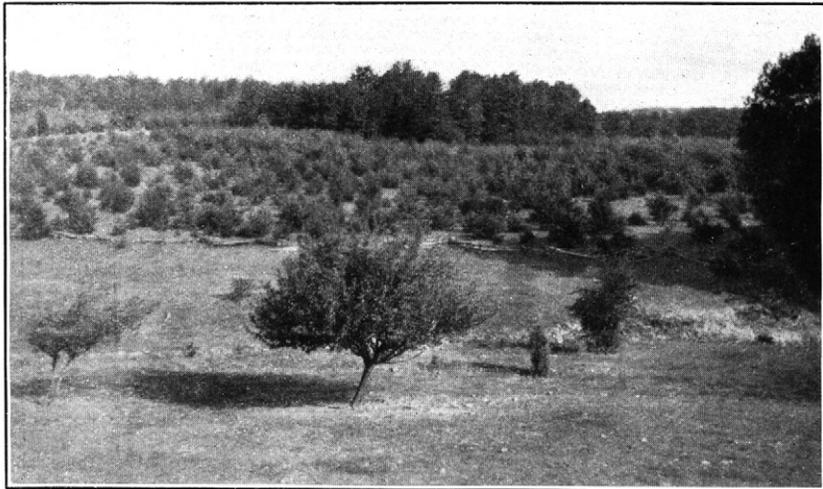


FIG. 2.—ABANDONED FIELD ON THE DEKALB GRAVELLY FINE SANDY LOAM, GROWING UP IN OLD FIELD PINE.

Dekalb stony sandy loam, deep phase.—The cross-lined areas of Dekalb stony sandy loam represent the Dekalb stony sandy loam, deep phase. This phase consists of 6 to 8 inches of grayish-brown to yellowish-brown, medium sand to loamy sand, which is underlain by a light-brown or pale-yellow loamy sand to loamy fine sand. The immediate surface is in some places almost white, but both soil and subsoil have a darker yellow or orange color. This soil is derived from rather soft, yellow and gray sandstone, large rounded bowlders and smaller fragments of which occur on the surface and throughout the soil profile, but not often in large numbers. It is less stony than the typical soil. The topography is rolling to steep, as the phase occupies the upper parts of some of the rougher ridges, the largest areas being on Bear Ridge and Bear Garden Ridge.

This phase is of small extent and is mainly in forest, which seems to be predominantly chestnut. Some small patches are cultivated, but no idea of the crop yields could be obtained. It is thought that with better shipping facilities it would be good fruit land, and it might be used for trucking, but is too light for general farming, and the most of it were better left uncleared. Land values on this phase are generally very low, as little of it is improved and it is generally remote and inaccessible.

UPSHUR GRAVELLY FINE SANDY LOAM.

The Upshur gravelly fine sandy loam consists of 7 to 10 inches of Indian-red to reddish-gray or grayish-brown fine sandy loam, underlain by a somewhat heavier fine sandy loam of a more intense Indian-red color. From 10 to 50 per cent of small Indian-red chips and fragments of sandstone and some shale are mingled with the soil and subsoil, the quantity increasing with depth, so that it is often impossible to penetrate more than 2 feet with the soil auger. Bedded shale and sandstone may be encountered at almost any depth and ledges of these rocks occasionally outcrop on the steeper slopes. Large sandstone fragments sometimes occur on the surface, but seldom in quantities sufficient seriously to interfere with cultivation. A few small areas of Dekalb soils, too small to separate, were included in this type.

This soil occupies comparatively extensive areas in the western part of the county, especially around Whitacre and Siler and east of Mount Williams, where it covers the lower ridges and rolling hills. In the western part of the county it often occupies the lower slopes and valleys between the higher ridges, though in many places the lower areas are heavier in texture and have been mapped as the Upshur gravelly loam. Drainage is always thorough.

This is regarded as one of the most desirable of the hill soils and the more level areas and gentler slopes have been extensively cleared and cultivated. The usual type of farming is practiced and the customary crops are grown. Buckwheat holds an important place in

the cropping system, giving yields of 20 or even 30 bushels per acre on the better farms. Corn yields about 25 to 30 bushels and wheat about 10 bushels per acre, rye doing a little better. Hay yields are rather light. There are several large orchards on this type, especially around Whitacre, and apples seem to do well. The York Imperial is probably the leading variety. The soil is easily cultivated, has good depth on the uplands, and is not to a great extent subject to erosion, so that orchards may be kept well tilled and grow and yield satisfactorily.

Farms on this type seem to be rather better improved than on the corresponding Dekalb type, and not very many abandoned fields are seen. However, it is not a particularly strong soil and to get paying yields more organic manures should be used and the land deeply plowed to make it more retentive of moisture. Prices for this grade of land vary from about \$15 to \$25 an acre, or even higher, depending on topography, location, improvements, and the opportunity for fruit culture.

UPSHUR GRAVELLY LOAM.

The surface soil of the Upshur gravelly loam consists of an Indian-red or pinkish-red silty loam, with a depth of 5 to 10 inches. The subsoil differs but little from the surface, except that the Indian-red color is more pronounced. Both soil and subsoil carry from 15 to 60 per cent of angular shale chips and small fragments, some of which may be rather arenaceous. The shale content and the size of the pieces increases with depth, and below 20 inches a mass of broken rock may be encountered. On the steeper slopes ledges of the shale may outcrop. This soil has a small development in the central and western parts of the county. The largest bodies occur near Bethel Church and east of Fairview.

This type is closely associated with the Dekalb gravelly loam and the two are often so mixed that accurate separation was not attempted. It occupies the lower slopes of the rolling hills and is always well drained, being in places too steep for farming. A considerable part of the type is cleared and farmed, as it is considered a rather better soil than the corresponding type of the Dekalb and is probably a more productive soil than the lighter member of the Upshur series, though as a whole the topography is rougher and much of it should be left in forest. The crop yields given for the Upshur gravelly fine sandy loam apply to this type quite as well, except that buckwheat yields somewhat less. Land values are ordinarily \$15 to \$20 an acre.

POPE FINE SANDY LOAM.

The Pope fine sandy loam consists of 6 to 8 inches of a dark or reddish brown, mellow fine sandy loam to light loam, underlain by a

light brownish yellow, heavier fine sandy loam, which may become a fairly heavy loam at lower depths. The type occupies level first bottoms along the larger streams and is well developed along Cedar Creek, Back Creek, and the smaller streams in the northern and southwestern parts of the county. It is derived from mixed alluvial material carried down from the Dekalb and Upshur hills and deposited in time of high water. A very small proportion of limestone material may be included, as many of the streams head in limestone springs, though they drain scarcely any soil of limestone origin. Where the derivative material is largely Upshur the soil is redder, though not so red as might be expected. There is considerable variation in texture, the larger bottoms generally grading from a light fine sandy loam close to the stream to a loam or even silt loam where the slope of the upland begins. This heavier material was separated as the Pope silt loam where of sufficient extent. The small bottoms are apt to be gravelly or even stony along the streams.

These stream bottoms are occasionally subject to inundation, perhaps once in five years, but the water never stands on the land for more than a few hours and floods do not seem to interfere seriously with the growing of any crop. Some small areas are lower and commonly subject to more frequent overflows and rather severe washing, so that they are useful for pasture only. Drainage of the type is good, save for the strip of heavier material along the upland.

This is considered the best and most productive soil of the hill section, and all areas of any considerable size lying high enough to escape frequent flooding are cleared and cultivated. The usual type of farming and the usual rotations are followed. Corn yields from 40 to 50 bushels per acre, wheat 15 to 20 bushels, and hay 1 ton to 2 tons.

These bottoms are the best farmed soil of the hill country and probably receive fertilization and attention at the expense of the upland soils, which stand in great need of both. Farms along the bottoms are well improved and their owners seem prosperous, the number of new and substantial barns being especially striking. These farms are valued at \$25 to \$40 an acre, depending on location, character of buildings, and the area of bottom land included.

Results of mechanical analyses of samples of soil and subsoil follow:

Mechanical analyses of Pope fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
211425.....	Soil.....	1.0	3.0	4.0	40.2	26.4	17.2	7.8
211426.....	Subsoil.....	1.7	3.8	4.4	34.4	25.8	20.6	9.1

POPE STONY SANDY LOAM.

Areas in Pope fine sandy loam color with stone symbols represent the Pope stony sandy loam. The type consists of a light-brown or yellow, loose, medium to fine sandy loam, underlain at varying depths by heavier material of a lighter color. Large rounded boulders, smaller fragments, and gravel of yellow and gray sandstone are numerous and in places nearly cover the surface. The type occupies the flood plains and low adjacent areas of rather torrential streams rising along the slopes of Great North Mountain, and the soil material must therefore be largely wash from the Silurian sandstones. The topography is level to gently sloping and the drainage is in many places deficient in the flat areas.

This is an extremely variable and almost nonagricultural type. Little of it is cleared, and that is used for pasture almost entirely, as the stone content generally prohibits cultivation. The total extent of the type is small and no idea of its value could be obtained.

POPE SILT LOAM.

The Pope silt loam consists of a brownish, yellowish, or grayish silt loam, 6 to 10 inches deep, underlain by a pale yellowish brown or light-brown, heavy silt loam, becoming heavier in texture and lighter in color below 20 inches. Poorly drained areas next the uplands may have a whitish surface and show some mottling in the subsoil. Sandstone fragments and small shale chips are often quite numerous along the smaller streams where the bottoms are narrow. This type represents the alluvial material derived almost exclusively from sandstone and shale, though some slight limestone influence may be present. It occupies first bottoms and along the smaller streams is subject to overflow, but on the broader bottoms of the larger creeks it is not flooded to a serious extent, save at times of exceptionally high water. In the larger bottoms this type generally occupies the position farthest from the stream, which has a border of Pope fine sandy loam. Where the total extent of the silt loam is small it is generally included with the fine sandy loam on the map. In the northwestern part of the county some of the Pope silt loam occurs on the terraces and would have been mapped as Holston silt loam had the areas been larger.

The type is often poorly drained, as it may lie a little lower than the material nearest to the stream, so that the surface water can not readily drain off. It is also in a position to receive the seepage from the uplands, and having a close-structured subsoil, it often stays wet until late in the spring. It is developed mainly along Hogue Creek and other streams in the north-central part of the county.

This soil is almost all cleared and is cultivated except where the bottoms are small and isolated or where they are very low and subject

to frequent flooding. A few of the higher bodies are seldom overflowed and are well drained. It is a more refractory soil than the Pope fine sandy loam, and, not being so well drained, is colder and later, but it is productive and in favorable seasons the yields are quite satisfactory. Wheat may be subject to winter injury, especially if the water tends to lie on it, and clover does not catch very well and is apt to be heaved out by alternate freezing and thawing during the winter. The type, however, does well in grass and if drainage of the wetter areas is impossible it might better be kept in hay and pasture grasses, such as timothy and redbtop. Adequate drainage has in places been obtained by digging an open ditch along the edge of the upland to catch the seepage from above and to carry off the surface water, emptying it into the stream at some point lower down. Lime and stable manure are also generally needed to sweeten the soil and improve its physical condition and productiveness. In most places the smaller bottoms do not need drainage, but they are more subject to flood injury. In order to be shown on the soil map, these small bottoms and meadows have often been made to include narrow strips of material of a colluvial nature.

Where the Pope silt loam is the predominating type on the bottoms, the improvements do not seem to be quite so good nor the land values so high as where the fine sandy loam predominates, but there is very little difference in value between this and the Pope fine sandy loam.

Mechanical analyses of samples of the soil and subsoil of this type gave the following results:

Mechanical analyses of Pope silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		<i>Per cent.</i>						
211423.....	Soil.....	0.0	0.7	0.6	4.6	20.6	58.8	14.4
211424.....	Subsoil.....	.0	.4	.4	2.1	13.7	55.9	27.4

HUNTINGTON SILT LOAM.

The surface soil of the Huntington silt loam varies from a light-brown to dark-brown loam to heavy silt loam. It is underlain at 8 to 10 inches by a yellowish-brown or in places mottled light-brown and dark-brown heavy silt loam to clay loam. Some areas of almost black surface soil with a heavy drab or mottled drab and yellow clay loam subsoil were included in this type, as were also small areas of Hollywood clay loam, where too small to be separated on the map. Along the small streams the type may also contain some spots of fine sandy loam, and it is stony and gravelly in many places close to the stream channels. The type occupies the first bottoms along all the streams where the limestone influence is material

and is derived from alluvial wash from the limestone soils, often locally influenced by shale material where the uplands are of shale derivation. It occurs in narrow belts along the streams rising in or flowing through the limestone soils. Strips of it developed in the form of low terraces or second bottoms seldom overflow.

In general, these first bottoms are subject to occasional flooding and are about equally divided between pasture and cultivated crops, almost all of them being cleared. The well-drained higher areas are used for the general-farm crops and give very good yields. This soil is especially suited to the production of corn and hay. It is naturally a rich soil. Corn produces about 50 bushels, wheat from 18 to 20 bushels, and hay about 2 tons per acre. Alfalfa does well where the land is not foul with weeds, as is sometimes the case in these bottoms. A well-fertilized and well-manured acre of improved corn on an alfalfa sod yielded 125 weighed bushels in 1914, which was a dry year.

The most extensive areas of this soil are associated with the Berks shale loam and are there regarded as the most valuable part of the farm for pasture and cropping. No price could be set upon these bottom lands, as they are never sold separately, but they materially increase the value of the farms which comprise them.

Areas in Huntington silt loam color shown on the map by symbol represent bodies of first-bottom alluvial material high in calcium carbonate. Such areas would have been mapped as a new series of soils had their development warranted it. This material is restricted to bottoms and flats along the streams rising in limestone springs, and is associated with the typical Huntington silt loam.

These areas of marly material have been formed by the calcareous precipitation of lime-impregnated waters, probably at some time when their overflow was impeded and they spread out as ponds or marshes, thus allowing extensive evaporation to take place. The action of acid on this marl is very violent, and analyses have shown it to be high in calcium carbonate.

The surface soil to a depth of 6 to 12 inches consists of a gray to dark-brown loam or clay loam. The subsoil is a drab silty clay loam, sometimes mottled with yellow, and may contain specks of white marl. Frequently below 24 inches an ashy-gray, loose, marly loam may be encountered.

As described above, the soil is composed to a large extent of material washed by flood waters from the surrounding limestone and shale lands and deposited over or mixed with the marl. In some places, however, both surface and subsoil are composed of almost pure calcareous material of a gray or nearly white color, and varying from coarsely granular to ashy in structure, giving the texture of a rather sticky loam. Where the stream has cut down through this

nearly pure material it is sometimes consolidated into a soft granular, calcareous rock.

This is one of the valuable soils of the area, and all of it is cleared. While the heavier portions are likely to be too poorly drained for cultivated crops, they are excellent grass lands, and when drainage is satisfactory excellent crops of corn are grown year after year. Alfalfa also seems to do exceptionally well, as seen on one large well-drained area near Clear Brook. Some of the loamy areas near Winchester are used for market gardening and seem to be well adapted to this purpose, being well drained, easily tilled, fertile, and retentive of moisture. Crops on this soil are said never to suffer from lack of moisture.

As the lime content of the marly portion of this soil is high and in a relatively soluble form, and as the material is soft and easily gotten out, it could be used advantageously upon the upland soils instead of ground limestone, especially on the Berks shale loam, which lies adjacent to much of it and is greatly benefited by liming. It would not be necessary to grind or burn it. This plan has in a small way been tested and is said to have given excellent results.

ROUGH STONY LAND.

A large part of the slopes of Great North Mountain, Cacapon Mountain, and parts of the lesser mountains, together with the crests of some of the more rugged ridges, are either so steep or so completely covered with rock outcrops, fragments, and boulders that they are of no agricultural value. Such areas are mapped as Rough stony land. Often the areas are both steep and stony and, although they may contain small patches of soil that possibly could be cultivated, such patches are so isolated and difficult of access as to be practically worthless for that purpose. Soil of almost any series or type may be found in the areas mapped as Rough stony land, but usually what little soil there is between the stones is of a sandy nature, as the parent rocks are for the most part sandstone.

In some places along the crests and steepest parts of the slopes of the mountains the rocks are almost bare of soil or vegetation, but generally these mountains support a fair forest growth. Recently the National Government purchased large tracts of this sort of land along the crest of Great North Mountain, to be incorporated into the Potomac Forest Reserve. The price paid for these tracts ranged from 50 cents to \$1.25 an acre.

SUMMARY.

Frederick County is situated in the most northerly part of Virginia and is bounded by West Virginia on the north, northeast, and northwest. The county has an area of about 429 square miles, or 274,560 acres. The eastern two-fifths of the county lies in the Shenandoah

Valley, and the western part lies in the Appalachian Mountain region. The average elevation of the valley section, which is undulating to rolling, is about 700 feet, and the range in the hill section is from 900 to 2,600 feet.

The first settlements were made in 1732 by families from the more northerly colonies. The rural population in 1910 was nearly 12,000. Winchester, with a population of nearly 6,000, is the largest town.

Eighty-five per cent of the county is reported in farms, the average size of which is 136 acres. The farms in the valley are much more intensively cultivated and more productive than those in the hill section. General farming is carried on, with apples as an important special crop, particularly in the valley. Winchester is one of the larger apple-shipping points in the East.

Wheat is the chief money crop in general farming. Corn and hay are also important products. Oats, rye, barley, and buckwheat, the latter confined to the hill section, are also grown. Dairying and stock raising are of considerable importance.

Farming in the valley is generally well done, farms having excellent improvements and the price of land being high. In the hills much of the land is too steep for economic cultivation and were better left in forest or pasture. The small bottoms in the hill section, however, are well cultivated and productive, and farms along them indicate prosperity.

The limestone lands in the valley are divided into three main series. The Hagerstown series comprises the strong, dark-colored soils, which are the most highly prized for all general crops. The Frederick soils consist of the lighter colored limestone lands, which generally contain more or less chert, while the gray, shaly lands along Apple Pie Ridge, which are extensively used for apple orchards, are mapped as Frankstown gravelly silt loam.

In shale areas where the shale is thin-bedded, dark colored, and generally close to the surface, the Berks series of soils is found. These are best developed east of the limestone belt in the valley. They are marked by smoothly rolling topography. West of the mountains the soils are derived from the Devonian shales and sandstones and the main series is the Dekalb, or gray and brown lands, and the Upshur, or red lands. These soils are generally gravelly, and may be silt loams to fine sandy loams or lighter. A large part of the most mountainous and entirely nonagricultural land was mapped as Rough stony land.

The alluvial soils are not extensive, but are important agriculturally in the hill country. They fall mainly in the Pope series and vary in texture from silt loams to sandy loams. Where limestone material has influenced the first-bottom soils, they are mapped as Huntington silt loam.

[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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