

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Survey
of
**Hardy and Pendleton Counties,
West Virginia**

By

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and

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Bureau of Chemistry and Soils

**In cooperation with the West Virginia Geological Survey
and the West Virginia Agricultural Experiment Station**

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SOIL SURVEY OF HARDY AND PENDLETON COUNTIES, WEST VIRGINIA

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INTRODUCTION

Hardy and Pendleton Counties lie within the Appalachian Mountains, mainly in the Appalachian ridge belt, Pendleton County extending far enough westward to include a narrow belt of the Allegheny Plateau. The region consists of a series of northeast-southwest mountain ridges, in most places from 1 to 2 miles wide, separated by broad hilly lowland belts ranging up to 5 or more miles in width.

The rocks are dominantly noncalcareous, consisting of shales and sandstones. Comparatively important areas are underlain by limestones.

The dominant soils are noncalcareous, leached, or podzolic, though, because of the strong relief of the surfaces on which they lie and their imperfect stage of development, leaching has not been excessive. With the exception of the soils from calcareous rocks, this fact is not so significant as it is in many regions where the dominant soils have developed from limestones or crystalline rocks, since the materials of the rocks themselves contain low percentages of calcium and phosphorus, and in some places, especially where sandy, of potash. Because of development under forest cover these soils all have a low content of organic matter. The alluvial soils, of which the proportional total area is small, are productive.

The dominant upland soils are members of the Dekalb, Elliber, Meigs, and Lowell series, from noncalcareous rocks, with considerable areas of Hagerstown, Westmoreland, Frederick, and Upshur soils from limestones or other rocks containing some lime carbonate. The alluvial soils are dominantly members of the Huntington and Pope series, with smaller areas of related soils.

Only about a third of the total area of the two counties has been cleared of the forests and used for crops or pasture. Much of the area of upland soils is used for pasture because of the rough relief and the presence of stones. The best pasture lands are those with soils derived from calcareous rocks. Although most of the uplands in both counties are rough, too much so for crop growing, crops of grain are grown on them in considerable areas because of the small area of smooth lands available.

The best grain lands are the alluvial lands. These are present in belts of important width along the large streams only. The comparatively high productivity of these soils for grain and the importance of grain for feed in a region where livestock raising is necessarily the most important agricultural industry give them a value somewhat greater than their inherent productivity alone would warrant. Farms containing important areas of these soils are the farms on which livestock feeding can be carried on, and the large areas of rough or steeply sloping

land on the uplands must be used for grazing. Therefore, the upland farms must be relatively large and the farms on alluvial lands may be small.

The climatic and soil environment of the region are favorable to the production of a wide range of grain, grass, legume, vegetable, and fruit crops, except where this is limited by rough relief. The region lends itself readily to self-sufficing agriculture mainly and to an exclusive commercial agriculture only slightly. This tends to develop a stable contented population with a possible rich community life, but makes difficult the building and maintenance of expensive highways, school buildings, and church buildings, because of the limited cash income of the people.

COUNTIES SURVEYED

Hardy and Pendleton Counties lie in the eastern part of West Virginia in that part of the State known as the Eastern Panhandle. The Virginia State line forms the eastern and southern boundaries. (Fig. 1.)

The area is very irregular in outline, consisting, figuratively, of two squares connected by the narrow southern extension, 8 miles long by 6 miles wide, of Hardy County. The two counties comprise a total area of 1,283 square miles, or 821,120 acres, Hardy County comprising 586 square miles and Pendleton County 697. The greatest length of the area from north to south is more than 65 miles. Hardy County is approximately 28 miles wide on the northern boundary and narrows considerably toward the southern boundary, and Pendleton County ranges from 22 to 28 miles in width.

The area lies wholly within the strongly folded Appalachian Mountain region, its surface relief ranging from rolling to mountainous, predominantly mountainous. Physiographically the area presents a series of parallel high, narrow mountain ranges and lower hogback ridges, separated by longitudinal lowland belts, in which narrow valleys have been cut by the existing drainage system. In only a few places are the valleys more than a quarter of a mile wide, except along the three larger rivers.

Shenandoah Mountain, the crest of which forms the eastern boundary of Pendleton County, together with its northern extension through central Hardy County, known as South Branch Mountain, forms a continuous unbroken range for a distance of 60 miles. The highest point on this range, Reddish Knob, at the southeastern corner of Pendleton County, has an elevation of 4,398 feet above sea level. A short distance from the point at which the range leaves Hardy County the elevation is 2,997 feet. These elevations show a northward decrease of 1,401 feet. North Fork Potomac River and South Branch Potomac River within a like distance have a fall of 1,393 feet, showing a close relationship between the dip of the mountain ranges and that of the stream levels. A similar range, North Fork Mountain, extends through the west-central part of Pendleton County with

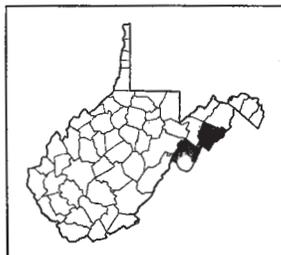


FIGURE 1. Sketch map showing location of Hardy and Pendleton Counties, W. Va.

an average elevation of about 4,000 feet and reaching a maximum elevation of 4,566 feet on Kile Knob. These mountains and the Allegheny Front, including Spruce Mountain in Pendleton County and North Mountain in eastern Hardy County, form the outstanding massive mountain features of the area. Spruce Knob, the high point of Spruce Mountain, reaches an elevation of 4,860 feet above sea level and is the highest point in West Virginia. The lowest point in the area is the point at which South Branch Potomac River leaves Hardy County, 747 feet above sea level. The maximum range in elevation within the area is 4,113 feet. The Allegheny Front reaches a maximum of 4,760 feet, and the average elevation is about 4,300 feet.

Lying below the steep upper slope of North Fork Mountain, extending eastward across the narrow valley of South Branch Potomac River to Moorefield River, and comprising about one-third of Pendleton County, is a belt of narrow mountain ridges and knobs, with an average elevation of about 2,700 feet above sea level. These are cherty limestone and sandstone ridges with narrow saddlelike and V-shaped gaps and steep-sided limestone and shale valleys. The valleys and ridges have a general northeast-southwest trend, with the drainage passing through gaps from one valley to another, ultimately reaching the master stream. The most prominent members of this low mountain group are South Fork, Dickinson, Neds, Thorn, Horner, Jack, Simmons, Ruleman, Castle, Bobs, Pickle, Lankey, Colic, Peters, Big, and Cave Mountains and Long and Sandy Ridges.

The South Branch Potomac River, cutting through this belt of rough country, through most of its course flows in a narrow valley. In many places the steep, precipitous, and scarplike valley slopes rise almost directly from the river bed. Near Upper Tract the valley reaches a maximum width of about 1 mile.

A similar group of mountains, ridges, and lowland belts lies in eastern and northeastern Hardy County, and they have an average elevation of about 2,000 feet. The principal mountains in this group are Short, Long, Buck, and Cove Mountains, and Anderson, Sandy, Warden, and Pine Ridges. The individual mountains of this group are somewhat more massive than those of the similar group in Pendleton County, but unlike those in Pendleton County, erosion has exposed the underlying limestone and shale in only a few places. More of the massive hard sandstone remains, and much of the small area of grazing and farm land here consists of talus material from sandstone.

Lost River, cutting a deep gorgelike valley through a number of these ridges, sinks west of Wardensville and after an underground passage of more than 2 miles emerges into an alluvial valley which immediately widens to about 1 mile, and continues at this width until it passes into Hampshire County 4 miles north of Wardensville. This river from its point of emergence west of Wardensville to its junction with Potomac River at Berkeley Springs, in Morgan County, is known as Cacapon River.

East of the crest and paralleling South Branch Mountain is a deeply dissected intermountain plateau about 6 miles wide, giving rise to secondary mountain ridges and gently rounded or steeply rolling hills. It is in this type of country and the river bottoms and terraces that the more extensive farming operations are carried on.

The South Branch Valley, beginning at the point where South Branch Potomac River enters Hardy County and extending to the

head of The Trough near Old Fields, may be considered the only valley development of note in Hardy and Pendleton Counties. Here the bottoms and terraces along the river reach a maximum width of about 3 miles. Gently rolling or rolling shale hills gradually rise to the west as the steep slope of Patterson Creek Mountain is approached. It is on the river-bottom farms of this valley that farming has had its greatest development.

On the west slope of North Fork Mountain and extending almost the entire length of Pendleton County is a narrow eroded limestone and shale valley that is bounded on the west by the River Knobs, a narrow ridge of hard resistant sandstone. Small streams having their source high up on North Fork Mountain converge funnellike in crossing the valley to find an outlet through deep-cut and almost perpendicular walled gaps between the River Knobs. The valley consists of a maze of A-shaped ridges and V-shaped valleys, with their lowest elevations immediately below the River Knobs and rising rather rapidly toward North Fork Mountain. These ridges form drainage divides between the numerous small drainage systems occurring within the valley.

In all parts of the area where limestone formations occur, numerous caves, sink holes, and lime sinks are present. They receive much rainfall and drainage water, which give rise to numerous perennial springs. Of the large number of different-sized caves, occurring principally in Pendleton County, one, Seneca Caverns, is being developed commercially. Passages through it have been cleared and lighted for a distance of about one-half mile.

All the land in Hardy and Pendleton Counties is drained by South Branch Potomac River, except that part of Hardy County lying east of South Branch Mountain, where the drainage waters find their way into Lost and Cacapon Rivers. The drainage system is decidedly trellislike in its arrangement.

Of the once large number of small water-power developments along the spring-fed mountain streams and larger rivers, only comparatively few remain to-day. Electric lighting for Moorefield is developed from South Branch Potomac River in Grant County. Only a few grist and flour mills are now operated by water power. Possibilities for water-power development seem to be good, as all the larger streams have a fall ranging from 10 to 50 feet a mile.

Before the advent of the early settlers, all the valleys and mountains were covered with a heavy forest. Naturally the soils best suited to agriculture were best suited to forest growth, consequently, the best of the extensive forests fell before the pioneer's ax to make way for his home and agricultural operations. A small quantity of the timber was used in building houses, barns, and fences, but most of it was burned in order to remove it from the land.

The original forest growth consisted largely of hardwoods, principally the various oaks. Some ridges and mountain slopes supported dense stands of pitch, or yellow, pine and white pine, almost to the exclusion of the hardwoods. At the present day all that remains of these once good but inextensive groves of pine are small groups of, or scattered, large trees. Many of the pine trees have died from undetermined causes during the last two or three decades, as evidenced by the second-growth hardwoods that have come in and the decaying pine stumps and trees that remain on the ground.

Most of the easily accessible lower mountain slopes have been cleared of the better merchantable timber, which was largely white oak, with some hickory, chestnut, chestnut oak, sugar maple, and other hardwoods, together with some white pine, pitch pine, and hemlock in the gaps and deep draws and along small streams. The second growth, largely of the same trees as the original forest, furnishes some small timber for crossties and for local use. Much of this type of forest land is covered with a dense growth of underbrush and vines, including locust, laurel, blackberry, raspberry, and wild grape.

On the upper mountain slopes and high crests the predominating tree is chestnut oak, which seems better adapted to the rough stony and shallow soils than some of the less hardy oaks. On the more favorable sites of these elevations, white oak, red oak, black locust, some maple, and hickory grow, also some pitch pine and scrub pine, and the underbrush consists of laurel, locust, brush, and brambles. The high ridge and mountain tops, classified as rough stony land, include large areas on which the forest growth consists principally of stunted or scrubby chestnut oak, ground or jack oak, locust brush, grapevine, huckleberry, and brambles.

Spruce Mountain and the Allegheny Front support a distinctive tree growth, much of which is not common in other parts of the area. Originally it was covered by a dense growth of spruce and beech, together with numerous other hardwoods, such as wild cherry, ash, sugar maple, and basswood, with hemlock in the deep draws. Practically none of the once dense covering of large trees remains. After lumbering operations, subsequent burning destroyed most of the small trees that were left standing and precluded others coming in, so that only small second-growth trees now remain. Much of the land that was denuded of timber grew up to fern, bracken, and brambles. In places bluegrass was seeded on the bare areas and is now furnishing good grazing sod, but other areas, which grew up to a locally termed "moonshine" grass, provide only fair grazing. On the land now protected from fire, second-growth trees are making a much more vigorous growth than on land subjected to burning.

The principal native grass of this region is bluegrass, which will naturally sod almost any land that is cleared of forest growth, being especially adapted to soils derived from calcareous rocks.

Early settlers, following the stream valleys, cleared and opened up the bottoms and terraces, as they were best adapted to farming because of their smooth surface relief and productive soils. Later the adjacent uplands were cleared for pasture or farming as needed. Settlers from Virginia, Maryland, and Pennsylvania, pushing westward seeking new homes, cheaper lands, and better opportunities, were the first to come into this region. The present population is largely descended from these early settlers.

Hardy and Pendleton Counties were both formed while West Virginia was still a part of the State of Virginia.¹ Hardy County was formed in 1785 from Hampshire County, and Pendleton County was formed in May, 1788, from parts of Hardy, Rockingham, and Augusta Counties. The present boundaries of Pendleton County were established in 1847.

¹ TILTON, J. L., PROUTY, W. F., TUCKER, R. C., and PRICE, P. H. HAMPSHIRE AND HARDY COUNTIES. W. Va. Geol. Survey County Rpts., 1927, 624 p. illus. [n. p.].

According to the 1930 census, Hardy County has a population of 9,816 and Pendleton County 9,660, all classed as rural. The stream valleys, small limestone valleys, and ridge lands are the most densely populated, but throughout the rough mountain country settlements are widely scattered and the population is sparse.

Moorefield, the county seat of Hardy County, with a population of 734, is the largest town in the area. It is located on the Petersburg branch of the Baltimore & Ohio Railroad and is an important shipping point for farm and forest products. Wardensville, at the terminus of the Winchester & Wardensville Railroad, a standard-gage road built for the purpose of removing timber from this part of Hardy County and other counties to the north and east in West Virginia and Virginia, serves as a shipping point for some farm products, as well as a receiving point for goods sold in the immediately surrounding country. Other local trading centers in Hardy County are Baker, Lost City, Lost River, and Mathias, in the Lost River Valley, and Old Fields, Kessel, Durgon, and Oakdale, in the South Branch Potomac River Valley.

Franklin, the county seat of Pendleton County, has a population of 431. It may be considered only a local trading center, as it is located 30 miles from Petersburg, Grant County, the nearest railroad shipping point. All supplies are brought in by motor truck, principally from Petersburg, but some are hauled from Baltimore and other points outside the State by returning trucks that carry out most of the lambs, wool, poultry, and hogs. Finished cattle from the North Fork Potomac River and South Branch Potomac River Valleys are generally driven to Petersburg, and those from the Moorefield River Valley are sent to Harrisonburg, Va. Most of the supplies for Fort Seybert, Brandywine, and Sugar Grove in the Moorefield River Valley come from Harrisonburg. Dryrun, Circleville, Riverton, and Teterton in the North Fork Potomac River Valley receive goods principally from Petersburg, some from Harman in Randolph County, W. Va., and some from Harrisonburg, Va. Other local trading points in Pendleton County are Johnstown, Cave, Ruddle, Upper Tract, Kline, Deer Run, Onego, and Hunting Ground. Most of these towns are located on or near improved State highways, and transportation costs are little if any higher than the cost of all-rail transportation. Harrisonburg, Baltimore, Pittsburgh, and Philadelphia are the principal outside markets.

The country roads throughout the area are fairly good but for the most part are not kept in repair. Most of the mountain roads are rough but usually are passable. The numerous water-level gaps through the mountain ranges and ridges provide easy access from one valley to another and furnish good locations for connecting roads between the main roads which traverse the larger stream valleys. In both the George Washington and Monongahela National Forests the Federal Forest Service is building and maintaining some roads for recreational and fire-protection purposes, at the same time giving improved road service to some of the most isolated farming communities. The State highway department, in continuing its policy of improved and hard-surfaced road construction, is yearly making all sections more accessible to motor-vehicle travel. The State highway traversing the entire South Branch Potomac River Valley, with branch

connections with highways of other States, makes overland travel very desirable. Daily motor-bus service from Franklin to Cumberland, Md., via Petersburg, Moorefield, and Romney, makes connections with interstate bus lines to the east, north, and west. Local and long-distance telephone service is reasonably good from Moorefield and in most parts of Hardy County, but local service in Pendleton County is very poor and no long-distance connections are available.

Moorefield and Franklin have daily mail service, and all parts of the area, by star routes and local post offices, have service daily except Sunday. Churches and schools are established in all communities. Most of the towns and larger villages have good high schools or junior high schools, but the more thinly populated sections have only elementary schools. The length of the school term ranges from seven to nine months.

Industrial development of these counties has made very little progress, owing largely to lack of adequate transportation facilities. The harvesting, and in a small way the manufacture into finished products, of the forest resources is the principal industry. A lumber company, located at Moorefield, operates a narrow-gage railroad extending along the Moorefield River Valley into the northern part of Pendleton County. Much of this company's best-quality product leaves the area as finished building lumber. Rough lumber from Wardensville is shipped to finishing plants in Virginia. Most of the timber leaving Pendleton County is trucked to Petersburg and shipped by rail from that place. Small portable sawmills operate throughout the mountains, and much of their product is in the form of crossties, bridge timber, and timber for railroads, most of which is sold to the Baltimore & Ohio Railroad and is sent to their creosoting plant at Green Spring in Hampshire County.

A recently established veneer mill at Moorefield is cutting black walnut, maple, and choice oak lumber into finished veneer wood for use in furniture and cabinet construction and for interior finishing of buildings. All the timber used in this mill is brought in by motor truck from the surrounding country, some being hauled from a distance of more than 50 miles.

In Pendleton County, eight small plants, operating only part time, are engaged in the manufacture of poultry crates. The crates are bought largely by local poultry buyers who sell them in turn to outside poultry buyers. One small plant near Sugar Grove is engaged in cutting special timber for ax and plow handles which is hauled to Harrisonburg. Near Circleville a local novelty wood shop manufactures cabinets and rustic and finished furniture. A large tannery at Moorefield supplies a market for tanbark and hides from the surrounding country. Local wood-working plants throughout the area, most of them as a side line to farming, supply the needs of the immediate territory.

CLIMATE

Owing to the wide range in elevation, climatic differences are great in different parts of the area included in the present survey. On the Allegheny Front and on Spruce Mountain the summers are normally cool and short and the winters cold and long, and in the valleys to the east and northeast the summers are warm, with hot spells of short duration and cool nights.

According to the Weather Bureau records the mean seasonal temperature in the valleys is from 1.4° to 7.2° higher than in the mountains, with the greatest variations during the spring and summer. Weather Bureau stations in the valleys of Hardy and Pendleton Counties, at elevations differing only 686 feet, show mean monthly temperature differences ranging from 1.7° to 6.1° from May to September.

The rainfall is well distributed through the year, being greatest during the summer, when needed by growing crops and pastures, and lightest in the fall and winter. The average annual snowfall is twice as great in the mountains as in the valleys. The heaviest snowfall is usually in February.

The average frost-free season at Moorefield, Hardy County, is about five months; at Brandywine, Pendleton County, four and one-half months; and along the Allegheny Front, about the same as at Brandywine. Killing frosts have been reported at Brandywine as late as June 4 and as early as September 6, and at Moorefield as late as June 1 and as early as September 6.

The prevailing winds are from the west during most of the year. Tables 1 and 2 give the more important climatic data for these counties and are compiled from the records of the Weather Bureau stations at Moorefield and Brandywine, situated at elevations of 900 and 1,586 feet, respectively.

TABLE 1.—Normal monthly, seasonal, and annual temperature and precipitation at Moorefield, Hardy County, W. Va.

[Elevation, 900 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1930)	Total amount for the wettest year (1911)	Snow, average depth
	°F.	°F.	°F.	Inches	Inches	Inches	Inches
December.....	34.2	71	-26	2.20	3.05	2.51	5.0
January.....	32.5	77	-24	2.55	1.22	6.73	10.1
February.....	30.0	75	-25	2.37	1.06	1.14	10.8
Winter.....	32.3	77	-26	7.12	5.33	10.38	25.9
March.....	41.7	93	-6	2.67	1.42	2.32	6.0
April.....	52.9	93	12	3.55	1.49	2.61	2.7
May.....	63.2	97	25	3.55	1.00	6.35	(¹)
Spring.....	52.6	97	-6	9.77	3.91	11.28	8.7
June.....	69.9	99	36	4.16	4.87	4.52	.0
July.....	74.5	104	41	3.42	.56	1.52	.0
August.....	73.4	109	40	3.24	.88	6.10	.0
Summer.....	72.6	109	36	10.82	6.31	12.14	.0
September.....	67.4	99	27	2.68	.54	5.58	(¹) .0
October.....	55.6	102	16	2.18	.08	5.33	
November.....	44.0	82	2	1.64	.67	1.27	.9
Fall.....	55.7	102	2	6.50	1.29	12.18	.9
Year.....	53.5	109	-26	34.21	16.84	45.98	35.5

¹ Trace.

TABLE 2.—Normal monthly, seasonal, and annual temperature and precipitation at Brandywine, Pendleton County, W. Va.

[Elevation, 1,586 feet]

Month	Temperature			Precipitation		
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1930)	Total amount for the wettest year (1918)
	°F.	°F.	°F.	Inches	Inches	Inches
December.....	33.5	68	-28	1.77	2.60	2.70
January.....	30.2	64	-10	2.07	.70	3.94
February.....	31.9	69	-5	1.79	.95	1.07
Winter.....	31.9	69	-28	5.63	4.25	7.71
March.....	42.4	80	3	2.47	1.30	3.77
April.....	49.8	85	14	3.15	1.30	5.18
May.....	58.4	92	31	2.60	.65	3.69
Spring.....	50.2	92	3	8.22	3.25	12.64
June.....	66.9	93	34	3.39	2.95	5.44
July.....	71.1	96	43	3.35	.20	4.20
August.....	69.9	97	39	3.13	1.50	3.66
Summer.....	69.3	97	34	9.87	4.65	13.30
September.....	64.4	90	30	2.43	1.55	3.87
October.....	49.9	91	18	2.23	1.15	2.40
November.....	40.8	79	11	1.91	1.10	1.17
Fall.....	61.7	91	11	6.57	3.80	7.44
Year.....	50.7	97	-28	30.29	15.95	41.09

AGRICULTURE

Agriculture was the chief pursuit of the early settlers of Hardy and Pendleton Counties. Because travel was difficult and transportation facilities were meager, the settlers were by necessity compelled to be practically self-sustaining and independent. Corn, wheat, and rye were the principal crops and a few cattle, sheep, and hogs were raised for milk, wool, and meat. Potatoes, garden vegetables, and small quantities of tobacco were grown. Hunting, fishing, and trapping helped to supply the home with food and furnished the furs and skins that could be traded for the few supplies not produced at home. The clothing was made of home-grown wool, carded and woven into cloth at home. The bottom lands were generally devoted to grain and hay production, and the adjacent slopes were cleared and used for grazing.

The land has always been farmed for the most part in small tracts by the owners. Prior to the Civil War only a small number of slaves were owned in the area, and the freeing of them did not greatly affect agriculture.

The river and creek bottoms, cleared by the pioneers, and the smoother uplands, which were early brought into cultivation, are still farmed and constitute the most fertile soils in the area. As the livestock industry developed, additional ridge and mountain lands were cleared, most of which were used for pasture, subsistence crops being grown on the smoother spots.

Since 1880 the acreage and production of grain crops has been fairly constant, but the acreage of hay has almost doubled. The acreage of potatoes and garden crops, most of which are grown for home use, fluctuates with home needs or local demands. Commercial orcharding is carried on in a small way in Hardy County, but most of the fruit trees listed in census reports are included in home orchards. The production of livestock, dairy products, poultry, eggs, and wool has steadily increased since 1900.

The acreage and production of the principal crops in 1929, as reported by the census for Hardy and Pendleton Counties, are given in Table 3.

TABLE 3.—*Acreage and production of principal crops in Hardy and Pendleton Counties, W. Va., in 1929*

Crop	Hardy County		Pendleton County	
	Acres	Bushels	Acres	Bushels
Corn, harvested for grain.....	6,065	162,974	6,024	126,527
Cut for silage.....	1,585	Tons 12,366	432	Tons 2,558
Cut for fodder.....	790		280	
Hogged off.....	12		21	
Wheat.....	5,140	Bushels 68,856	5,143	Bushels 71,742
Oats threshed.....	1,889	40,829	1,267	31,408
Cut and fed unthreshed.....	333		192	
Rye.....	1,035	9,947	989	12,175
Buckwheat.....	667	5,199	391	3,878
Potatoes.....	467	45,085	478	47,071
Hay crops, total.....	7,990	Tons 10,728	15,323	Tons 16,975
Timothy and (or) timothy and clover mixed.....	5,278	6,798	9,807	11,762
Clover.....	948	1,585	437	661
Alfalfa.....	474	1,183	116	134
Other tame grasses.....	1,132	1,002	4,762	4,237
Wild grasses.....	53	49	43	34
Small grains cut for hay.....	25	26	80	69
Legumes for hay.....	80	117	78	78
Apples.....	Trees 84,496	Bushels 73,868	Trees 55,461	Bushels 49,487
Cherries.....	5,657	2,989	6,881	2,348
Peaches.....	18,421	9,658	7,716	2,589
Pears.....	2,833	1,516	1,876	1,405
Grapes.....	Vines 2,491	Pounds 34,220	Vines 1,924	Pounds 28,171
Raspberries.....	Acres 10	Quarts 4,067	Acres 3	Quarts 3,081
Strawberries.....	17	10,996	3	
Blackberries.....	2		9	
Maple sirup.....				Gallons 1,166
Maple sugar.....				Pounds 4,938
Forest products:		Board feet		Board feet
Saw logs and veneer logs.....		4,717,000		6,122,000
Firewood.....		Cords 13,623		Cords 16,002
Fence posts.....		Number 10,203		Number 46,800
Railroad ties.....		24,668		13,938
Poles and piling.....		11,750		220

Hay and forage occupy the largest acreage of the crops grown in the area, and practically all of these crops is consumed on the farms or sold locally. The larger part of the hay crop is composed of mixed timothy and clover, with small acreages of each grown separately. Small acreages are devoted to alfalfa and soybeans. Corn is the principal grain crop and is grown on almost as large an acreage as hay. All the corn is fed on the farm or sold locally. Wheat ranks next to corn in acreage. Much of the wheat is grown for a home supply of flour, the surplus from the larger farms being sold to near-by mills from which it goes into local trade channels. Wheat production is far below its consumption within the area. All other grain crops are produced as a home supply. In Hardy County potatoes are produced on a small scale for sale to outside cities. The making of maple sugar and sirup, once rather important, has now become an almost negligible industry.

The 1930 census report lists 217,874 acres in Hardy and Pendleton Counties used for pasture, which is about a 10 per cent increase over the acreage in 1924. Pastures occupy more than three times the acreage devoted to all other crops.

Table 4 gives the value of all agricultural products of the two counties, as reported by the 1930 census.

TABLE 4.—*Value of all agricultural products by classes in Hardy and Pendleton Counties, W. Va., in 1929 and value of livestock in 1930*

Product	Hardy County	Pendleton County	Product	Hardy County	Pendleton County
Cereals.....	\$310, 907	\$270, 569	Livestock and livestock products:		
Other grains and seeds.....	9, 932	2, 745	Cattle.....	\$570, 636	\$777, 427
Hay and forage.....	224, 982	247, 960	Swine.....	62, 578	74, 636
Vegetables (including potatoes and sweetpotatoes).....	64, 338	67, 042	Sheep.....	274, 956	391, 959
Fruits and nuts.....	117, 777	71, 392	Goats.....	6, 830	3, 159
All other field crops.....		3, 265	Poultry raised.....	142, 916	156, 037
Farm-garden vegetables for home use.....	47, 261	55, 867	Bees.....	3, 683	9, 202
Forest products.....	147, 597	147, 720	Butter, cream, and whole milk sold.....	122, 547	20, 937
Livestock and livestock products:			Wool and mohair.....	30, 041	50, 611
Horses.....	165, 812	236, 308	Chicken eggs produced.....	231, 344	146, 289
Mules.....	18, 530	2, 289	Honey.....	1, 057	2, 430
Asses and burros.....	210		Total.....	2, 553, 934	2, 737, 844

The use of commercial fertilizers has become the general practice within the last 20 years. Lime is just coming into general use, although its value has long been known. A large part of the lime used in Hardy County is in the form of burnt lime and comes from sources outside the county, although some local deposits of marl are being developed as a source of farm lime. Farmers of Pendleton County, owing to lack of transportation facilities and to the large amounts of limestone occurring within the county, have developed this local source by installing cooperative or private crushers. Some local kilns furnish a small quantity of burnt lime.

In 1929, the number of farms in Hardy County reporting the use of fertilizer, including commercial fertilizer, manure, marl, lime, and ground limestone, according to the 1930 census report, was 599 or

54.6 per cent of all farms, with a total expenditure of \$24,801, or \$41.40 a farm. Pendleton County, according to the same report, lists 735 farms, or 57.8 per cent of all farms, expending \$18,213, or \$24.78 a farm. Hardy County reported the purchase of 827 tons of commercial fertilizer and Pendleton County 801 tons. Superphosphate (16 or 20 per cent) is the principal fertilizer used. Some muriate of potash and nitrate of soda are used by a few farmers. Some ready-mixed fertilizers are used for potatoes or special crops, 4-16-4² and 0-12-5 mixtures being the most common.

Between 1880 and 1900 the number of farms in Pendleton County increased, but it has remained about constant during the last 30 years, and now the number is 1,272. The average size of the farm has decreased from more than 300 acres to 214.5 acres, of which about 16.6 per cent is classed as improved land which includes crop land and plowable pasture. From an average size of 411 acres, the farms in Hardy County have been reduced to 203.1 acres of which 30.5 per cent is classed as improved land. The census lists 1,098 farms in Hardy County in 1930.

Farms in both counties range from 2 acres to more than 1,000 acres in size, the largest number being between 50 and 174 acres. Average farm-land values for the area more than doubled between 1910 and 1920. Since then there has been a marked decline, the average acre value in Hardy County being \$15.88 and in Pendleton County \$18.97.

According to the 1930 census report, the percentage of farms operated by owners, tenants, and managers, respectively, in Hardy County, is 89.1, 10.1, and 0.8 per cent; and in Pendleton County, 89, 8.8 and 2.2 per cent. There is no established system for tenant farming, as some tenants pay a cash rent, some pay on the share-crop basis, and others are allowed the use of a certain acreage of land in lieu of payment for performing certain duties or labor for the landowner.

Farm labor is in general paid on a per diem basis as most work is seasonal. Where winter cattle feeding is done in connection with other farming operations, the laborer is paid on a monthly basis, and when he has a family to support he is allowed to produce home subsistence crops in addition. The 287 farms in Hardy County reporting an expenditure for labor in 1929 report \$85,540 expended, or \$263.20 a farm; and in Pendleton County, 568 farms reported an expenditure of \$55,171, or \$94.15 a farm. The rate of pay is in general low, less than \$2 a day with no subsistence. Farm work is of a general character, and it reaches the peak during small-grain harvest, cutting and shocking corn, filling silos, and husking corn. Some farmers pay a certain amount a bushel or shock for husking corn, instead of the customary day-labor rate.

Farmhouses on the better smooth-land farms are well built and modern, many being of brick construction. In the rougher and more remote mountain sections the houses are smaller, but most of them well built, and nearly all of the more recently constructed ones have received a coat of paint. The barns are adequate for taking care of work animals, for storing grain and part if not all of the hay crop, and for furnishing storage space for farm machinery and tools. Farm implements on the river-bottom and smooth-land farms are of the modern tractor-drawn or horse-drawn types commonly kept on farms

² Percentages, respectively, of nitrogen, phosphoric acid, and potash.

of medium size where corn, small grain, and hay are produced. On small farms and farms composed of hilly land the use of improved machinery is limited. Where land is cultivated in small patches in the rough mountain sections the shovel plow and spring-tooth harrow constitute the principal farm implements, and much of the planting, cultivating, and harvesting is done by hand. Work animals, where heavy farm machinery is used, are a good grade of draft-type horses or mules, but where the machinery is lighter, the work animals are correspondingly lighter. Many horses of the lighter type are kept in remote sections, principally as saddle horses and for light farm work.

The cattle are principally good grades of the Hereford, Shorthorn, and Aberdeen Angus breeds. A very small number of purebred cattle of the different breeds are kept on some farms. In recent years some grade Jersey and Holstein-Friesian dairy cattle have been brought in, especially into Hardy County, where the sale of whole milk is increasing.

Sheep are good grades of the dual-purpose or meat-producing breeds, as most of the revenue comes from the sale of lambs. Hogs, raised principally for home use or local sale, are of improved native stock that has been crossed with the heavier market breeds.

Poor transportation facilities, long distances from markets, and the need for a cash income forced the farmers of Hardy and Pendleton Counties, in times before the development of motor highways and modern motor-truck transportation, to turn to the production of beef cattle. Even now, with railroad shipping from Moorefield in Hardy County, and from Petersburg in Grant County, this remains the largest enterprise providing a cash income for the area. Formerly all cattle ready for market were driven overland to Baltimore, Washington, Philadelphia, or Pittsburgh, but most of the cattle from Pendleton County are now shipped from Petersburg and those from Hardy County are shipped from Moorefield.

The production of beef cattle might be divided into two separate enterprises, breeding and feeding, with some overlapping of each on the other. On the smaller farms throughout the hilly and mountainous sections, beef cattle are raised because the rough character of the land makes it unsuited to the production of crops, whereas, on the other hand, such land makes excellent pasture land, especially for summer grazing. From such land cattle are sold as calves, 1-year-olds, or 2-year-olds, according to the ability of the individual farm to produce winter feed supplies for carrying the animals over to another grazing season. Calves and yearlings are bought by many farmers who have land that produces feed sufficient for wintering young animals but not for finishing them. These farmers, in turn, sell the animals to owners of large pasture areas in the adjoining hills or in the Allegheny Mountains to the west where they will be ranged for a summer and then sold as 2-year-old or 3-year-old feeders to farmers along the broad river bottoms where the principal crop is corn. Some of the cattle feeders own or rent pastures in the mountains, on which they range young or lightweight animals for a summer after having fed them one winter, holding them over for another feeding season in order to make heavy beef animals. Large numbers of cattle that are bred or summer ranged in the area, especially in Pendleton County, are driven to the Shenandoah Valley in Virginia

for finishing on grain, and they reach the local or eastern markets from there.

Cattle feeding is a specialized industry on many of the larger river-bottom corn-producing farms. Part of the corn is fed as silage and is supplemented with dried ear corn, corn fodder, and concentrates of cottonseed meal and mill feed. The feeding period ranges from 60 to 120 days. On some of the farms that maintain bluegrass sod on part of the land, cattle are given a final two or three months' finishing on grass, which is said to produce a more economical gain and improve the quality of beef. This additional time of holding over also distributes the sale of animals over a longer period, which often insures a more stable market.

Dairying, especially in Hardy County, has made considerable progress in the last five years. Formerly a small quantity of cream was shipped to creameries outside the State, now daily shipments of whole milk bring in an annual revenue of approximately \$300,000, according to estimates by the county agent. Grade herds of the leading dairy-cattle breeds are being established on some farms, but much of the milk is obtained from grades of the heavier dual-purpose cows. Calves that are not kept as additions to the herd are sold at an early age for veal. During the period of the survey a small creamery was established at Franklin, affording a local market for all surplus cream produced in the surrounding country. The distance from railroad shipping points makes it impractical for many farmers of Pendleton County to market whole milk. The more concentrated and stable product, butter, can be moved out by motor truck with little chance of loss through deterioration. Practically all milk and cream is brought to a central point by trucks that cover an established milk route each day, or, where cream is produced, two or three times each week.

The sheep-breeding industry, formerly carried on for the production of wool, is now based on the sale of lambs. Nearly all farms, regardless of size, maintain a flock of sheep. The sale of lambs brings in most of the revenue on a large number of farms, especially on some of the poorer ridge-land farms where pastures are sparse and become very short during the dry summer months. Lambs are sold to local buyers in late summer and early fall and are shipped from Hardy County by rail and hauled by truck from Pendleton County to markets, principally in Baltimore. A few lambs are bred for sale on the midsummer market. This practice necessitates special handling and housing through the late winter and increases the cost of production, but this is usually more than offset by the higher prices received. Most of the sheep are well-bred grades, and some are purebred animals of dual-purpose and meat-producing types.

The production of poultry and eggs is essentially a side-line industry that is practiced to a different extent on practically every farm. There is little or no uniformity of breeds on most farms. In the vicinity of Moorefield a number of flocks of White Leghorns are maintained for egg production. The eggs are marketed cooperatively once or twice each week in Baltimore or other points outside the State. Most of the chickens, eggs, and other poultry not sold locally are bought or bartered for by hucksters who make weekly rounds through all sections. They, in turn, sell on outside markets, largely in Baltimore, but some poultry and poultry products go to Harrisonburg, Va., and other markets.

Some hogs are bred or fattened on nearly every farm, principally for home use, those sold usually supplying local villages. Not enough hogs are raised for local needs, and some meat is shipped in.

The farming methods and management of the area are governed largely by the steepness of the land. On the smooth or rolling land, farm machinery and power equipment can be employed in preparing, planting, cultivating, and harvesting, but on the stony slopes and steep hillsides much of the work must be done by hand. The adaptations and limitations of the soils to crops have been recognized by the farmers and have been heeded to a great extent, although general farm crops are grown on almost all soils.

Corn is usually planted after a crop of hay or on land that has been grazed. The fields are plowed in winter or early spring to allow freezing and thawing to pulverize the soil, and the seed bed is prepared by disking and harrowing to the desired smoothness. On bottom land, terrace land, and smooth upland, corn is planted with a check-row planter, and on the steep and stony land it is drilled in. The fertilizer used is applied at time of planting. Corn is cultivated three or four times a season and is hoed and thinned by hand when there is need. The crop is cut by hand, shocked in rows to allow disking for wheat, and husked later. A part of the crop is used for silage, and this is cut about September 1.

Wheat usually is sown with a drill, the fertilizer being applied at the same time. If lime is to be applied, it is worked into the soil before planting time. Timothy is sown with the wheat, but clover is not seeded until the following spring. Wheat is harvested with a binder, except where the steepness and stoniness of the fields necessitates the use of a cradle. If a good stand of clover and timothy is obtained after wheat, the field may be kept in grass for two or three years, or until the yield declines or the field is infested with weeds, when the land is plowed again for corn.

On most of the farms no definite crop rotation is followed, although the crops usually are planted in the following order: Corn, wheat, and grass. The hay crop is harvested in July, and much of it is stacked in the field. Hay is seldom baled, but most of it is sold loose, by the ton or by the stack.

When oats are grown they usually follow wheat or grass. They are cut with a mower as hay or harvested in the same manner as wheat. A large part of the oats is fed in the sheaf. Buckwheat is usually seeded in July on newly turned sod land. On some of the droughty and less fertile upland soils, oats, or buckwheat, and rye take the place of corn and wheat in the rotation. On some of the bottom lands corn is grown successfully for two or three years and is then followed by wheat and grass. On some farms where it is necessary to have nearly all the land in corn or wheat every year, a practice is made of sowing sweetclover in the wheat and letting it make a good growth the following spring before it is plowed under in preparation for the corn crop. Little work is being done on maintaining and improving permanent pasture sods.

SOILS AND CROPS

Hardy and Pendleton Counties lie in a region of high rainfall, ranging around 35 inches, with a mean annual temperature ranging around 54° F. in the lowland belts and a little less than that on tops

of the high mountain ridges. The soils have developed under a forest cover consisting of hardwoods, except on the higher mountains where conifers are present. The dominant trees are oaks. Maple, chestnut, and beech are less numerous.

All the soils are podzolic or leached to greater or less extent, having undergone such development as has taken place in an acid medium. This is the case with the soils of the larger part of the area, not merely because of the humid climate and the forest cover under the influence of which the soils have developed but also because the soils are derived from rocks containing a low percentage of calcium compounds. Soils developing from limestones are present, but the area of their occurrence is relatively small, and even in such soils the carbonates have been removed from the surface soil. On the other hand the ruggedness of the relief, the occurrence of the soils on slopes practically everywhere, except where they consist of alluvial deposits, tends to decrease the effect of the podzolic process, or the operation of the high rainfall, by removing through erosion the surface material of the soils before it has become highly acid. Because of this universal activity of erosion, most of the soils are maintained in a youthful condition, and because of this they partake of the character of the rocks from which the material has been derived in each case. In detail, therefore, the soils, within the broad limits of their podzolic character, differ in character from place to place in accordance with the local character of the underlying rock.

Many of the soils occur as long irregular and broken bands of different widths paralleling the ridge and mountain tops and stream valleys. Others occur as widely scattered areas ranging in size from 10 acres to more than a square mile. The soils which have the more favorable surface relief, contain the largest amount of plant food, or are the easiest to cultivate, control the agriculture and govern the distribution of the farms.

Only about 30 per cent of the land in Hardy County and 34 per cent in Pendleton County is cleared or improved and used for crops, pasture, and orchards. Extensive areas on North, Shenandoah, and North Fork Mountains and the Allegheny Front and Fore Knobs are included in national forests. Such forested areas are held by the Federal Government for demonstration and experimental purposes to encourage the growing and protection of timber. The extensive forest lands, outside the national forests, include all the steep and rough mountains and steeper ridges and some lands that have a possible future agricultural value. These lands are held by individuals or groups of individuals or companies as a source of timber, tanbark, and other forest products. The future value of more than 50 per cent of all the land included in the present survey is dependent directly or indirectly on timber growth.

The agriculture of Hardy and Pendleton Counties is typical of much of the more remote sections of the central Appalachian Mountains. A large part of the farming operations is based on or centered around the livestock industry including the raising of sheep and cattle. The two principal reasons for this are: (1) Poor transportation facilities, or the absence of these, that make it necessary to market livestock on the hoof; and (2) the soils and climate are such that they are adapted to growing feed crops (grass and grain) necessary to the production and finishing of livestock. Corn, wheat, and hay, the

principal cultivated crops, are grown rather indiscriminately on the smoother lands, grazing areas being confined largely to the rough land. A direct relationship exists between the crops grown and the crop yields obtained and the several types of soils. This will be discussed in detail under the groups of soils and the individual types. In order to bring out the relationship existing between the various soil types and the agriculture of the area, the land has been divided into two broad groups, namely, forest land and agricultural land. The accompanying soil map shows the distribution and location of the different soils, and Table 5 gives their acreage and proportionate extent.

TABLE 5.—Acreage and proportionate extent of the soils mapped in Hardy and Pendleton Counties, W. Va.

Type of soil	Acres	Per cent	Type of soil	Acres	Per cent
Huntington fine sandy loam.....	19,392	2.4	Westmoreland gravelly loam.....	26,432	3.2
Huntington silt loam.....	2,112	.3	Elliber gravelly loam.....	32,000	3.9
Pope fine sandy loam.....	3,968	.5	Hagerstown silt loam.....	3,968	.5
Pope fine sandy loam, heavy phase.....	3,904	.5	Upshur gravelly silt loam.....	896	.1
Pope gravelly loam.....	6,656	.8	Lowell silt loam.....	768	.1
Moshannon gravelly fine sandy loam.....	1,344	.2	Frederick gravelly fine sandy loam.....	2,112	.3
Lindside silt loam.....	1,024	.1	Hagerstown stony silty clay loam.....	37,696	4.6
Lindside silt loam, heavy phase.....	1,664	.2	Westmoreland gravelly loam, stony phase.....	9,856	1.2
Atkins silty clay loam.....	1,280	.1	Upshur stony loam.....	10,112	1.2
Monongahela silt loam.....	13,760	1.7	Lowell stony silty clay loam.....	7,680	.9
Monongahela fine sandy loam.....	4,096	.5	Dekalb stony fine sandy loam.....	75,200	9.2
Dekalb shaly silt loam.....	93,184	11.3	Dekalb stony fine sandy loam, colluvial phase.....	20,544	2.5
Dekalb gravelly silt loam.....	33,408	4.1	Dekalb stony loam.....	51,328	6.2
Dekalb gravelly fine sandy loam.....	9,792	1.2	Meigs stony fine sandy loam.....	22,592	2.7
Dekalb gravelly loam, colluvial phase.....	8,832	1.1	Pope fine sandy loam, alluvial-fan phase.....	7,424	.9
Berks silt loam.....	960	.1	Rough stony land.....	241,984	29.5
Meigs gravelly fine sandy loam.....	37,824	4.6			
Lehew gravelly fine sandy loam.....	1,728	.2			
Westmoreland silt loam.....	25,600	3.1	Total.....	821,120	

AGRICULTURAL SOILS

The soils on the agricultural land, according to characteristics and surface features, fall into two general subgroups. The first subgroup includes soils on smooth surface relief, largely free of stone. These soils are alluvial, have light-brown or brown surface soils and little textural or color change throughout the profile, or from the surface downward; the second subgroup, comprised of soils on hilly relief, includes soils with gray, brown, or reddish-brown surface soils and pale-yellow or red loam, clay loam, or clay subsoils.

SOILS ON SMOOTH RELIEF

The first subgroup of soils, generally called bottom lands, might be called the Huntington group, since the agriculture on the Huntington soils dominates that of the whole group. This subgroup includes Huntington fine sandy loam, Huntington silt loam, Pope fine sandy loam, with a heavy phase, Pope gravelly loam, Lindside silt loam, with a heavy phase, Moshannon gravelly fine sandy loam, Atkins silty clay loam, Monongahela silt loam, and Monongahela fine sandy loam. Although these soils occur along the streams throughout the area, in some places as narrow strips and in other places along the larger streams in bodies more than a mile wide, they represent only 7.3 per cent of the total land area of the two counties. Owing to the smooth

surface relief on which they lie and their good productivity, they comprise the best and most highly developed farm land in the area. All these soils, except Monongahela silt loam and Monongahela fine sandy loam, are wholly or in part subject to periodic overflow. They are practically all cleared and are the dominant corn and wheat producing soils, produce a large tonnage of hay, and furnish some pasture.

Huntington fine sandy loam.—Huntington fine sandy loam is the most extensive soil of this group and is one of the best corn-producing soils in the area. Even with the natural high productivity and added deposits of fresh alluvium with each successive overflow on much of it, this soil will not stand continuous cropping to corn without materially lowering the yields. Its excellent physical condition and favorable surface relief allow the use of tractors and improved farm machinery.

The surface soil to a depth of 8 or 10 inches is brown or dark-brown mellow friable fine sandy loam. The subsoil to a depth of more than 3 feet is rather uniformly brown friable heavy fine sandy loam or loam and in places is silt loam. In places where the land lies above normal overflow, the soil from the surface downward may be somewhat lighter in color, with a slight compactness below a depth ranging from 10 to 15 inches. Some small waterworn gravel occur in much of this soil, the quantity and size of the gravel increasing immediately adjacent to the stream banks or where the bottoms are narrow and the streams are swift flowing. These gravelly spots are more marked where the stream channels are shifting at present or where old cut-off channels have been filled in, and where of sufficient size they are shown on the map by gravel symbols. In most places in which these small gravelly areas occur the soil is a little more sandy than typical and somewhat droughty, and crop yields are not quite so good as on most of the land. At the outer edge of the wider bottoms, areas of Huntington silt loam, too small to map separately, are included with Huntington fine sandy loam.

Huntington fine sandy loam constitutes the larger part of the overflow lands along South Branch Potomac, North Fork Potomac, and Moorefield Rivers and some of their larger tributaries. Only a few other small areas are widely scattered over Pendleton County.

All of this land is cleared, and about 60 per cent is planted to corn, 20 or 25 per cent to wheat, and the rest is in hay or pasture. Corn yields range from 25 to 50 bushels an acre, some farms reporting 60 or more bushels; wheat from 15 to 30 bushels; timothy hay from 1 to 1½ tons; and clover or mixed timothy and clover about 2 tons. Alfalfa is grown on a small acreage, and from three or four cuttings a year the yield is about 3 tons. On a few farms barley is grown instead of wheat, and it yields about twice as much an acre as wheat.

Wheatland receives an acre application ranging from 150 to 300 pounds of superphosphate, without which, according to statements by farmers, the grain heads do not fill well and the straw has a tendency to lodge. Most of the barnyard manure is applied to cornland before plowing. This is sometimes supplemented at planting time by applications ranging from 100 to 150 pounds of superphosphate or equal quantities of a complete fertilizer high in phosphate, but the use of commercial fertilizer for corn is not general. Where corn is cropped

two or three years in succession with only a wheat crop to break continuous corn production, sweetclover is sometimes sown in the wheat, and in the following spring after making a good growth it is turned under before the land is planted again to corn. The plowing under of second-crop clover and residues from grain and hay crops helps to maintain soil fertility.

Huntington silt loam.—The principal difference between Huntington silt loam and Huntington fine sandy loam is in the texture of both the surface soil and subsoil. The surface soil of Huntington silt loam to a depth of 10 inches is brown or dark-brown silt loam. The subsoil below this depth changes rather quickly to a slightly lighter brown color but gradually becomes heavier in texture until, at a depth of 2 feet beneath the surface, it is silty clay loam which extends downward to a depth ranging from 3 to more than 4 feet.

This soil occurs only in the wider bottoms of South Branch Potomac River in Hardy County, associated with Huntington fine sandy loam, most of it lying well back from the river along the outer edge of the bottoms or as intermediate bands between Huntington fine sandy loam and Lindsides silt loam.

Crops and farming practices on Huntington silt loam are the same as on Huntington fine sandy loam, but yields are slightly higher, corn yielding from 35 to 65 bushels an acre, wheat from 15 to 35 bushels, and hay from 1½ to 2 tons.

Pope fine sandy loam.—Pope fine sandy loam occurs only in Hardy County along Lost and Cacapon Rivers. This soil is not of great extent, but it is locally very important. In acre yields, it ranks second to the Huntington soils in the smooth-land group of soils. The crops grown and tillage practices are the same as on the Huntington soils.

The surface soil of Pope fine sandy loam to a depth of 8 or 10 inches is brown friable light fine sandy loam, changing quickly below to light-brown material with about the same texture, and this below a depth of 20 inches becomes heavy fine sandy loam or loam. Some areas of this soil have small waterworn gravel distributed throughout the surface soil and subsoil. Locally, near the stream banks the soil is more sandy, lighter in color, and in places gravel strata, or beds, are present at a depth ranging from 3 to 4 feet beneath the surface. South of Mathias the soil is more nearly a loam, but as it is not of sufficient extent to map as a separate soil type it is included with the fine sandy loam.

The usual crops grown on the Huntington soils are grown on Pope fine sandy loam and, in addition, some oats and soybeans. Corn yields from 25 to 45 bushels an acre, wheat from 12 to 20 bushels, oats from 20 to 40 bushels, timothy and clover hay from 1 to 1½ tons, alfalfa from 2 to 3 tons, and soybeans for hay about 1½ tons.

Pope fine sandy loam, heavy phase.—The heavy phase of Pope fine sandy loam is widely scattered over Hardy County and in Pendleton County occurs along small streams near Kline and Brushy Run. It is also associated with Pope fine sandy loam as strips along the outer edge of the wider Lost River and Cacapon River bottoms. Although it is widely distributed over the area, its total acreage is small. Soil of this phase, unlike the more extensive typical Pope fine sandy loam, has a high water table, subsoil drainage is deficient, and the land

warms up much more slowly in the spring. Some small seepy spots, too small to separate as a different soil type, are included in mapping. The largest areas of this kind are near the town of Lost River, along Mudlick Run in northwestern Hardy County, and along North Mill Creek in Pendleton County.

The 6 or 8 inch surface soil of the heavy phase of Pope fine sandy loam ranges from light-brown heavy loam to silt loam. It changes rather quickly to light-brown heavy silt loam or silty clay loam, which, at a depth ranging from 20 to 24 inches, becomes definitely light-brown silty clay loam. In places, below a depth ranging from 24 to 30 inches, the subsoil is mottled with rust-brown splotches.

This soil, as a whole, is better adapted to grass than to corn and wheat, although in many places it is the best land on the farms where it occurs, and for this reason much of it that is planted to corn and wheat would otherwise be in pasture or hay meadow. All the land is cleared, about 30 per cent being devoted to corn, 20 per cent to wheat, and the rest to hay or permanent pasture. Corn yields from 15 to 30 bushels an acre, wheat from 10 to 18 bushels, and hay about 1 ton.

Some commercial fertilizer, principally 16 or 20 per cent superphosphate, and lime are applied to wheat and clover.

Pope gravelly loam.—Pope gravelly loam, which is scattered widely over Hardy County and the eastern part of Pendleton County, may be considered a secondary agricultural soil, though locally some farms are almost wholly dependent on it as the corn and wheat producing soil. Occurring on narrow first bottoms of swift-flowing streams, much of this soil, if plowed, would be carried away by high overflow waters, so that only that part lying above normal overflow is cropped regularly. About 40 per cent remains in second-growth forest of white oak, hickory, maple, and some white pine, hemlock, and sycamore.

The surface soil to a depth of 8 or 10 inches is brown or light-brown gravelly loam or fine sandy loam. The subsoil is light-brown or yellowish-brown loam or, in places, yellowish-brown fine sandy loam. Bedded gravel is present in most areas of this soil at a depth ranging from 24 to 30 inches beneath the surface. The gravel consists of smooth water-worn sandstone and conglomerate fragments and smooth platy shale chips, which reach a maximum diameter of about 3 inches. The surface gravel is not sufficiently abundant to prevent the use of improved farm machinery where the land areas are of sufficient extent to allow its use. Some gravelly fine sandy loam areas, which are not extensive enough to map as a separate soil, are included with this soil as mapped.

About 50 per cent of the cleared land is used for corn, wheat, and timothy and clover hay, ordinarily in a loose 3-year or 4-year crop rotation system, and the remainder is in permanent pasture. Crop yields are only fair and in dry years are low, owing to the drying out of the soil because of excessive underdrainage. Corn yields from 15 to 25 bushels an acre, wheat from 8 to 15 bushels, and hay about 1 ton. Many home gardens are planted on this soil, most of them in the low-lying or slightly seepy places where a good moisture supply is available throughout the summer. Some superphosphate is applied to wheatland, and the small supply of barnyard manure is applied to hay meadow or cornland.

Moshannon gravelly fine sandy loam.—Moshannon gravelly fine sandy loam does not cover a large area and occurs only in the northern part of Hardy County. It occupies flood plains along small streams, mainly in association with the Lehew and Meigs soils which are derived from red sandstones and shales. The peculiar chocolate-red color of this soil distinguishes it from the Pope soils of this group, although its physical characteristics are much the same. It is a little more productive than Pope gravelly loam.

The surface soil is reddish-brown or chocolate-brown gravelly fine sandy loam which grades, at a depth of 7 or 9 inches, into similar or lighter-colored gravelly loam or heavy fine sandy loam. Bedded gravel underlies about 50 per cent of the soil at a depth ranging from 28 to 36 inches beneath the surface. Along North River, near the Hampshire County line, a few small areas of practically gravel free soil are included, as they are not of sufficient extent to separate as a different soil type.

About 30 per cent of this soil is planted to general crops, and most of the remainder is in hay meadow and pasture sod. Corn yields from 15 to 30 bushels an acre, wheat from 10 to 15 bushels, and hay from 1 to 1½ tons. Bluegrass provides good grazing on the sod land throughout most of the summer.

Lindside silt loam.—Lindside silt loam, which occurs only in Hardy County, is closely related to Huntington silt loam. Under moist field conditions, it is almost indistinguishable from the Huntington soil in surface appearance. Only two areas are mapped, one beginning at Moorefield and extending about 3 miles north in a strip about one-half mile wide, and the other 3 miles southwest of Moorefield in a body about one-half mile wide and 1 mile long.

The surface soil of Lindside silt loam is light-brown friable silt loam which, at a depth of 6 or 8 inches, grades into light-brown heavy silt loam. This, at a depth of 12 or 14 inches, changes rather abruptly into grayish-brown silty clay loam with faint yellowish-brown mottlings and some soft dark-brown iron concretions. At a depth of about 24 inches the material grades into light grayish-brown silty clay loam or silty clay, intensely mottled with gray, yellow, and dark rust brown, that extends to a depth ranging from 3 to 4 feet. During a large part of the year the water table is within a depth of 3 feet from the surface. The soil warms up later than the surrounding soils which have better subsoil drainage.

Crops and cultural methods are about the same as on the adjoining Huntington soils, but average yields are somewhat lower. Corn grows much slower in the spring, and wheat does not seem to develop normally, as it lodges considerably and is more subject to damage from red rust. Corn yields range from 20 to 40 bushels an acre, wheat from 10 to 25 bushels, and timothy and clover hay from 1 to 1½ tons.

Some lime and superphosphate are applied to wheatland.

Lindside silt loam, heavy phase.—Lindside silt loam, heavy phase, has a total area of 2.6 square miles and occurs principally in Pendleton County. It is poorly drained in both surface soil and subsoil and occurs as seepy strips, swales, or slight depressions within the Huntington soils on the wider bottom-land areas or as narrow seepy bottom lands along small streams having their origin in areas of soil derived in part from limestone. Its principal occurrence is along the

headwaters of Thorn Creek south of Johnstown in Pendleton County, and a small area is near Moorefield in Hardy County.

The surface soil of Linside silt loam, heavy phase, is dark grayish-brown granular silty clay about 6 inches thick, which changes abruptly to grayish-brown cloddy silty clay mottled with rust brown and some ochereous yellow. At a depth of 12 inches the surface soil gives way to steel-gray plastic clay, mottled with rust brown and ochereous yellow, which extends to a depth of more than 3 feet.

All the land is cleared, but its seepy, continuously wet, or poorly drained condition makes it unfit for cultivated crops. It is all in grass and is used principally for permanent pasture, although hay is cut from some small areas. The grass growth is principally of coarse wild varieties, but some bluegrass and timothy grow on spots where the water table is a few inches below the surface.

Atkins silty clay loam.—Atkins silty clay loam is the least extensive of the alluvial soils. It occurs at widely scattered places in Hardy County, the principal areas lying $2\frac{1}{2}$ miles north of Moorefield, 2 miles northwest of Old Fields, and 2 or 3 miles northwest of Wardensville. Only three areas occur in Pendleton County, one a mile east of Oak Flat, and the other two on Allegheny Mountain at the heads of Big Run and Seneca Creek.

The 3-inch surface soil of Atkins silty clay loam is light-brown or grayish-brown granular and friable silty clay loam. Between depths of 3 and 18 inches the soil material is steel-gray silty clay faintly mottled with brownish yellow, and from a depth of 18 inches to a depth of more than 3 feet it is steel-gray plastic clay, mottled with brown, rust brown, and ochereous yellow. On Allegheny Mountain the soil is not typical, the material to a depth of 12 inches consisting of brown silty clay loam in which the upper 2 or 3 inches is composed principally of organic matter. Between depths of 12 and 20 inches is grayish-yellow or yellow silty clay, mottled with ochereous yellow, gray, and brown; and between depths of 20 and 36 inches is pale-yellow clay or silty clay, mottled with gray and ochereous yellow.

All of this soil is in permanent pasture, the sod consisting principally of coarse wild grasses, with some timothy. The high water table insures sufficient moisture to sustain a good growth of grass throughout the entire summer.

Monongahela silt loam.—Monongahela silt loam and the closely related Monongahela fine sandy loam are characterized by their mottled almost water-impervious hardpan subsoils. The silt loam occupies high benches or river terraces, ranging from 25 to more than 150 feet above the present river flood bottoms. It occurs along all the larger streams of the area, the greatest development being on the South Branch Potomac River terraces near Old Fields, Moorefield, and Durgon, and along the entire length of Moorefield River.

The surface soil of Monongahela silt loam to a depth of 6 or 7 inches is grayish-brown or light-brown friable heavy loam or silt loam. This changes abruptly to pale-yellow or light yellowish-brown heavy silt loam that extends to a depth of about 14 inches where it grades quickly into pale-yellow or brownish-yellow compact silty clay loam, mottled with gray, brown, and reddish-brown, extending to a depth of about 26 inches. Between depths of 26 and 36 inches, the material is dull yellowish-brown very compact silty clay mottled with gray,

rust brown, and reddish brown. In places very dark brown or nearly black markings are present in this layer. Below a depth of 36 inches, the compactness becomes somewhat less, and the mottlings are about the same. In much of this soil gravel beds occur at a depth ranging from 4 to 10 feet below the surface.

Crop yields on this soil are much lower and sometimes not more than half as high as on the friable-subsoil members of the smooth-land group of soils. All the land is cleared, about 35 per cent being maintained in permanent pasture and the remainder used about equally for corn, wheat, and hay. Corn yields from 20 to 40 bushels an acre, wheat from 12 to 20 bushels, and timothy and clover hay about 1½ tons. Wheatland receives an acre application ranging from 200 to 300 pounds of 16 or 20 per cent superphosphate at time of planting. Small applications of lime are made at the time of preparing the land, at intervals ranging from three to five years, or larger quantities are applied at longer intervals. A fairly uniform 3-year rotation of crops is practiced by most farmers. If good stands of grass and clover are obtained, they may be cut for hay two successive years or pastured for a year after one crop of hay has been cut. Where heavy applications of lime, barnyard manure, and phosphates have been made, yields are greatly increased.

The heavy compact subsoil impairs underdrainage, causes late warming up in the spring, and in wet years the soil becomes water-logged and crops drown out. In dry years the upward movement of moisture is slow, the soil bakes, and crops burn badly. Pasture grasses usually make a good growth but are very short in dry seasons. Soybeans for hay are grown on a small acreage and yield about 1½ tons an acre.

Monongahela fine sandy loam.—Monongahela fine sandy loam is best developed near Wardensville in Hardy County and at Franklin and Upper Tract in Pendleton County. It covers a total area of 6.4 square miles. All the land is cleared, about one-third being in pasture and the remainder in crops of corn, wheat, and hay. Crops are not subject to such severe droughts or injury from water soaking as on Monongahela silt loam. The surface soil averages a little deeper, and the hardpan subsoil is at a correspondingly greater depth.

The surface soil to a depth of 8 or 10 inches is grayish-brown or yellowish-brown friable fine sandy loam. Below this depth the material changes abruptly to pale-yellow or light brownish-yellow friable fine sandy loam, which, at a depth ranging from 18 to 24 inches, grades into grayish-brown or yellowish-brown compact loam or heavy fine sandy loam that is mottled with gray and rust brown and extends to a depth of 32 inches. Between depths of 32 and 44 inches the material ranges from dingy brown, dull gray-brown, or brown heavy loam or silty clay loam, which is mottled with gray, rust-brown, and some dark, nearly black, material.

Crop yields are governed largely by the seasons, and extremes of either wet or dry seasons materially cut the yields. Corn yields range from 20 to 40 bushels an acre, wheat from 12 to 25 bushels, timothy hay 1 ton, and clover and timothy 1½ tons. In Pendleton County some barley, yielding about 35 bushels an acre, has been grown on this soil. During wet years wheat is subject to considerable damage from red rust.

SOILS OF THE HILLY UPLANDS

This subgroup of soils comprises 41.7 per cent of the total area of the two counties and includes Dekalb shaly silt loam, Dekalb gravelly silt loam, Dekalb gravelly fine sandy loam, Dekalb gravelly loam, colluvial phase, Berks silt loam, Hagerstown stony silty clay loam, Hagerstown silt loam, Westmoreland silt loam, Westmoreland gravelly loam, Westmoreland gravelly loam, stony phase, Elliber gravelly loam, Meigs gravelly fine sandy loam, Lowell stony silty clay loam, Lowell silt loam, Upshur stony loam, Upshur gravelly silt loam, Lehew gravelly fine sandy loam, and Frederick gravelly fine sandy loam. These soils occur as long continuous areas or broken narrow irregular strips and broad bands, paralleling the general trend of the mountains and ridges, or as widely scattered areas ranging in size from 10 acres to several square miles.

Within this subgroup are a few soils which, because of their extreme stoniness and other unfavorable characteristics, are used only for pasture, but most of the soils of the group are used for both cultivated crops and pasture. The stony soils of the hilly upland group include Hagerstown stony silty clay loam, Upshur stony loam, Lowell stony silty clay loam, and Westmoreland gravelly loam, stony phase.

All these soils lie on rolling or hilly relief. Surface drainage is excessive on most of them, and internal drainage is good. Gullying and sheet erosion are severe on much of the cultivated land and in many places on the sod land, where it is pastured too closely. The surface soils of the soils of this group range from gray or grayish yellow to reddish brown, and they are dominantly fine in texture, ranging from loam to silt loam and silty clay loam. Some of the less extensive soils are fine sandy loams. The subsoils range from yellow and buff to reddish brown and red in color, and in texture range from loam through silt loam and silty clay loam to silty clay. In all the soils of this group disintegrated rock or bedrock is present at a depth ranging from 15 to 40 inches beneath the surface.

The comparatively slight depth to bedrock in most of these soils limits their water-holding capacity, though this is somewhat offset by the prevailingly heavy friable subsoils and the high gravel or shale-chip content of the surface soils, that acts to some extent as a mulch to check evaporation. These soils are in general low in organic matter and are predominantly slightly acid. They respond quickly to applications of lime.

The soils of this group as a whole are not productive grain soils, but the necessity for growing a home supply of foodstuffs and winter feed for livestock results in a large acreage being planted to corn, wheat, hay, buckwheat, rye, and garden crops. The acre yield is in general low. The soils derived from limestones or other calcareous rocks are considered the best crop soils as well as the best pasture soils. Pasture grasses become short during protracted droughts or hot summers. Land with stony soils from limestone rocks is cleared for pasture because the derivation of the soils from rocks high in lime makes them productive for bluegrass.

Dekalb shaly silt loam.—Dekalb shaly silt loam is by far the most extensive soil in the hilly upland group of soils and the most extensive in the area, with the exception of rough stony land. It also includes the largest cleared acreage.

The 5 or 6 inch surface soil of Dekalb shaly silt loam is grayish-brown or yellowish-brown silt loam containing an abundance of somewhat flat shale chips scattered over the surface and through the soil. The material from a depth of 6 inches to a depth of 12 or 15 inches is yellow or pale-yellow friable silt loam containing less shale chips than the layer above. Below this and continuing to a depth of 18 or 20 inches the material is brownish-yellow silty clay loam with some markings or mottlings of brown and light red. Underlying this is the partly disintegrated and weathered shale showing different shades of yellow and brown with red markings. Bedded light-colored shale underlies most of this soil at a depth ranging from 24 to 30 inches.

From many fields long in cultivation, most of the original surface soil has been removed by erosion, leaving only 6 or 8 inches of brownish-yellow heavy silt loam or silty clay loam covering the partly weathered shale, and in some eroded fields gullies have cut down to the bedded shale. Many acres of this soil have been so reduced in plant-food content, by cropping and erosion, that the land has been abandoned for cropping purposes and is growing up in brush or is used for the sparse pasture it will produce.

Dekalb shaly silt loam occurs principally in large areas or in almost continuous unbroken belts, except where small streams have cut through and formed narrow alluvial strips. Its greatest development is on the valley ridges, fore knobs, and lower mountain slopes of the South Branch Potomac River Valley in Hardy County, and extending from Moorefield along Moorefield River through Hardy County and the entire length of Pendleton County, where it occupies principally the valley ridges and the lower slopes of South Branch and Shenandoah Mountains. Other large areas lie north of Upper Tract and near Wardensville, and a band averaging about 1 mile in width extends across Hardy County bordering the Lost River bottoms continuing northward along Sperry Run where Lost River turns eastward at Baker. The relief ranges from rolling to hilly. Surface drainage is excessive, and internal drainage is good.

About 30 per cent of the land is cleared, approximately 50 per cent of which is maintained as permanent pasture, and the rest is alternately planted in crops of corn, rye, hay, buckwheat, and some wheat. On many farms, after one or two crops of hay have been cut, the land is pastured one or two years before again being plowed for grain crops. Sod land is usually plowed in late spring for buckwheat, which is followed by corn, then by small grain, and then by grass again. Forested areas support principally second-growth hardwoods, small pine, brush, and brambles. Farm incomes are supplemented by the sale of tanbark, pulpwood, and crossties from these woodlands. Corn yields from 15 to 25 bushels an acre, rye from 8 to 15 bushels, buckwheat from 15 to 30 bushels, wheat from 10 to 15 bushels, timothy hay less than 1 ton, and timothy and clover from 1 to 1½ tons. Pasture sod, which usually ranges from poor to fair, is used principally for grazing sheep, and it consists of bluegrass, timothy, and wild grasses, with some orchard grass, clover, and redtop.

Wheatland generally receives an acre application ranging from 200 to 400 pounds of 16 or 20 per cent superphosphate and an application of lime every five or six years when clover is sown with wheat, to be used the following year as a hay crop. At the time of planting, corn

sometimes receives light applications of phosphate, a mixed fertilizer of phosphate and potash, or a complete fertilizer containing nitrogen, phosphorus, and potash.

Dekalb gravelly silt loam.—Dekalb gravelly silt loam is rather extensive in central Hardy County, extending in two parallel broken belts almost the entire length of the county from north to south. One fairly large area lies in the northeastern corner, and smaller areas are scattered through the eastern part. In Pendleton County, only a few fairly extensive areas lie northeast of Upper Tract, on Allegheny Mountain, and a few small widely scattered areas lie in the southeastern part. The best development of this soil is on the intermountain plateau east of South Branch Mountain in Hardy County. The relief ranges from gently to steeply rolling.

The surface soil of Dekalb gravelly silt loam, to a depth of 5 or 6 inches, is grayish-yellow or grayish-brown gravelly silt loam. This is underlain to a depth of about 15 inches by pale-yellow friable heavy silt loam, and between depths of 15 and 26 inches the material is brownish-yellow gravelly silty clay loam containing some reddish-brown and rust-brown mottlings. Below this is partly weathered shale and sandstone that extends to bedrock which occurs at a depth of about 30 inches. The gravel content of the soil consists of platy and angular sandstone fragments that are more resistant to weathering than is the softer shale from which most of the soil material is derived.

About 50 per cent of the land is cleared of its original forest growth. About half the cleared land is used for cultivated crops and hay, and the rest is in pasture. As a whole this soil is weathered somewhat deeper than Dekalb shaly silt loam, is less subject to erosion, and returns a little better crop yields. Pasture grasses thrive better through the summer than on Dekalb shaly silt loam.

Corn yields from 15 to 25 bushels an acre, wheat from 12 to 18 bushels, rye from 8 to 15 bushels, oats from 20 to 30 bushels, buckwheat from 20 to 30 bushels, timothy hay slightly less than 1 ton, and timothy and clover about 1½ tons. On the forested parts some good merchantable timber remains, but it is gradually being taken out.

Where this soil occurs on Allegheny Mountain, the surface soil is darker in color, the subsoil is yellowish brown, and bedrock is present at a depth of about 3 feet. This mountain, once heavily forested, was cut over and then burned annually for a number of years, which destroyed all forest growth on much of it. Such places are now grown up with blackberry briars, fern, and bracken or are in sod of bluegrass and "moonshine" grass that furnishes excellent summer grazing, principally for cattle.

Dekalb gravelly fine sandy loam.—Dekalb gravelly fine sandy loam is not extensive, but it is widely scattered over both Hardy and Pendleton Counties and is locally important. The largest areas are on the ridges comprising the lower part of Patterson Creek Mountain, on Flattop and Buck Mountains, and on Hunting Ridge in Hardy County; and along Little Fork and Thorn Creek, and near Franklin, Onego, and Upper Tract in Pendleton County. Practically all the land is cleared, and crops of corn, wheat, oats, and hay are produced.

The surface soil of Dekalb gravelly fine sandy loam is gray or grayish-brown gravelly fine sandy loam 6 or 8 inches deep. Below

this depth the material changes quickly to pale-yellow or brownish-yellow friable gravelly fine sandy loam that extends to a depth of 18 inches. Between depths of 18 and 36 inches the material is yellow or brownish-yellow slightly compact but friable loam, mottled with some gray and rust brown below a depth of 24 inches. Bedrock lies about 3 feet below the surface.

The sandy texture, together with the generally favorable surface relief, gentle slopes, and smoothly rounded ridge tops makes this an easy soil to cultivate. Yields range from fair to good, corn yielding from 20 to 30 bushels an acre, wheat from 12 to 20 bushels, oats from 25 to 35 bushels, and hay about 1 ton. The small amount of pasture established on this land ranges from fair to good, and it holds up well in summer. Some small commercial orchards are established on areas of this soil along the foot of Patterson Creek Mountain and are yielding good crops of high-quality fruit.

Some barnyard manure and phosphate are applied to this soil, usually on wheatland, and commercial orchards receive small applications of nitrate of soda.

Dekalb gravelly loam, colluvial phase.—The colluvial phase of Dekalb gravelly loam occurs in widely scattered small areas over both Hardy and Pendleton Counties. It is most extensive south of Moorefield extending to Durgon, where it lies above and grades into the river terraces, east of Moorefield and at the foot of South Branch Mountain near the Hampshire County line. It consists of talus material from sandstone and shale, occurring in narrow strips at the foot of steep mountain elevations.

The surface soil of Dekalb gravelly loam, colluvial phase, is grayish-yellow or grayish-brown friable gravelly loam to a depth of 5 or 6 inches. This material changes rather quickly to yellow or brownish-yellow gravelly silt loam that extends to a depth of 18 or 20 inches. Below this the soil is extremely variable, ranging from very gravelly loam to yellow or brown comparatively gravel-free heavy silty clay mottled with different shades of gray, yellow, and brown.

About 60 per cent of this soil is cleared, most of which is maintained as permanent pasture owing to the high water table that makes it warm up late in spring. Corn, wheat, and hay are grown on a small acreage. Yields are about comparable with those obtained on the other gravelly soils of the hilly upland group. Pastures are generally good throughout the summer.

Berks silt loam.—Berks silt loam is one of the less extensive soils of the hilly upland group, and it occurs only in Hardy County. The largest areas are north, east, and west of Moorefield. Owing to the generally smooth surface relief and friable surface soil, nearly all this land is cleared and planted to corn, wheat, and hay. Yields are a little higher than those obtained on the surrounding Dekalb shaly silt loam.

The surface soil of Berks silt loam is grayish-brown friable silt loam to a depth of 6 inches. Below this the material changes abruptly to pale-yellow friable silt loam that extends to a depth of 16 inches. Between depths of 16 and 28 inches is brownish-yellow slightly compact silty clay loam which breaks into medium-sized granules. Below this layer and continuing to bedrock, which occurs at a depth ranging from 32 to 40 inches, the soil material is very variable but in

most places is yellowish-brown plastic silty clay mottled with gray, yellow, and rust brown. North of Moorefield the surface soil material consists largely of remnants of old terraces resting on residual material derived from the underlying bedded shale.

Meigs gravelly fine sandy loam.—Meigs gravelly fine sandy loam is a composite soil, that is, it is composed of two kinds of material so intricately associated that it is impossible to show them as separate soils on a small-scale map. About 60 per cent of the included soil is dark chocolate-brown or reddish-brown gravelly fine sandy loam in the surface soil, reddish chocolate-brown gravelly loam in the subsoil, and disintegrated or bedded Indian-red sandstone and shale beneath. The light-colored or yellow soil included is yellowish-brown gravelly fine sandy loam in the surface layer, underlain by a pale-yellow gravelly fine sandy loam upper subsoil layer, below which is brownish-yellow or buff gravelly loam that extends to the underlying disintegrated and bedded gray sandstone and shale. In places an intermediate or mixed soil condition occurs, producing a brown or chocolate-brown surface soil over a yellow or brownish-yellow subsoil, or vice versa. The gravel consists of platy and angular gray or reddish-brown sandstone fragments.

In Hardy County this soil is developed in comparatively large areas or in long and almost continuous bands. The largest area is in Bean Settlement and with a few interruptions extends southward in irregular elongated areas to the southern boundary of the county. It occupies the more gently rolling top of South Branch Mountain and the smoother ridges on the east that form a rolling intermountain plateau. It occupies much the same position in this part of the county as Dekalb gravelly silt loam, but, as a whole, is not quite so steep, and on much of it the gravel content is lower.

It is very comparable to but is generally considered a somewhat more productive soil than the surrounding Dekalb soil. Practically all the cleared areas of this soil are used at times for cultivated crops. A fairly uniform system of crop rotation, including corn, wheat, hay and pasture, is followed. In some years buckwheat replaces corn and rye replaces wheat in the rotation. Very little of this land is maintained in permanent pasture, except on the high narrow mountain crests in southern Hardy County and along Shenandoah Mountain in Pendleton County. A few small areas in western Pendleton County are associated with limestone soils, and here the soil is in part derived from calcareous shale, but with these exceptions it is derived from lime-free rocks.

Corn yields from 20 to 35 bushels an acre, wheat from 10 to 18 bushels, oats from 25 to 35 bushels, rye from 8 to 15 bushels, buckwheat from 25 to 30 bushels, and hay about 1 ton. Acre yields of potatoes, grown for home use and local markets, are about 100 bushels. Pasture grasses consist principally of a mixture of timothy, redtop, and clover, that has been cut a year or two for hay. Where permanent pastures are maintained there is, in most places, a good bluegrass sod, with some white and other clovers. Forested areas, principally second-growth hardwoods and pine, supplement the farm income through the sale of tanbark, crossties, and pulpwood.

Lehew gravelly fine sandy loam.—Lehew gravelly fine sandy loam is a very inextensive soil and occurs only in Hardy County, princi-

pally in Bean Settlement. Other than the two comparatively large areas in this locality, only a few small patches are mapped. It is derived from the Indian-red noncalcareous shales and sandstones that give rise to the red material of the Meigs soils. The chocolate reddish-brown color of the surface soil is continuous downward to bedrock which occurs at a depth of about 30 inches, with a gradual change from fine sandy loam at the surface to silt loam in the lower part of the subsoil.

Cropping practices are the same as on the surrounding Meigs soil, and yields are about the same. Most of the land is in cultivation, pasture, or meadow.

Westmoreland silt loam.—Westmoreland silt loam is one of the best agricultural soils of the more extensive members of the hilly upland soils. It occurs in large bodies in western Hardy County on the rolling hills between the lower slopes of Patterson Creek Mountain and South Branch Potomac River. The only other occurrence in this county includes a few small areas in the eastern part. In Pendleton County, large areas occur in the eroded valley lying between the crest of North Fork Mountain and the River Knobs, and small areas are scattered throughout the county except on Shenandoah Mountain.

In Hardy County this soil occurs on gently rounded, though narrow, ridge tops with rather steep slopes, but a large part of the soil mapped in Pendleton County occupies narrow sharp-crested ridges separated by V-shaped valleys with slopes of nearly 45°. In general this is considered one of the best grass soils of the hill and ridge sections, and it is a good cropping soil where the slopes are not too steep.

In general characteristics Westmoreland silt loam is much like the Dekalb members of the hilly upland group of soils. It is derived in part from the same kind of rocks, but the larger part is derived from calcareous shales or from impure limestone interstratified with non-calcareous shales and fine-grained sandstone. Small included areas of soil are derived almost wholly from thinly stratified impure limestone that gives the material a buff or brown color.

The surface soil of Westmoreland silt loam is grayish-brown or yellowish-brown granular friable silt loam to a depth of 5 inches. Between depths of 5 and 12 inches is yellow or brownish-yellow heavy silt loam or silty clay loam, changing quickly to brownish-yellow silty clay loam that extends to the partly weathered shale lying at a depth of 16 or 18 inches below the surface. In places erosion has removed much of the surface soil, leaving a layer, from 6 to 12 inches thick, of brownish-yellow heavy silt loam or silty clay loam overlying the partly weathered shale.

About 90 per cent of the land is cleared, 75 per cent or more of which is maintained as permanent pasture, and the remaining 25 per cent is used mainly for corn, wheat, hay, and home-supply crops. Corn yields from 20 to 25 bushels an acre, wheat from 10 to 15 bushels, and timothy and clover hay from 1 to 1½ tons. Some small fields are planted to alfalfa which yields about 2 tons an acre from three cuttings. Pasture sod, consisting of bluegrass, timothy, orchard grass, and clovers, furnishes good grazing during about eight months of the year.

Little or no lime is applied to this soil because of the comparatively slight depth to partly disintegrated rock material that contains lime,

from which most plants can draw a sufficient supply. Some superphosphate is applied to wheatland, and barnyard manure is usually applied to cornland.

Westmoreland gravelly loam.—Westmoreland gravelly loam is derived largely from calcareous shales and thin-bedded impure limestone interstratified with fine-grained sandstone. It is widely scattered over Pendleton County, except on Shenandoah Mountain. It occurs in small areas or in long narrow irregular bands that parallel the general direction of the ridges. Its greatest development is west of North Fork Mountain. With the exception of a few small areas in the eastern part, it occurs only west of South Branch Potomac River in Hardy County, where it occupies long narrow bands as an intermediate soil between the lower shale ridges and the higher-lying mountain slopes. On Mill Creek Mountain it occupies a position between soils derived from pure limestone on one side and lime-free rocks on the other.

This is an important agricultural soil. Through central Pendleton County, where it has a more favorable surface relief than most of the surrounding soils, it is used to some extent for cultivated crops, but in other places it is used largely for pasture. The surface relief ranges from gently sloping to rolling and steeply sloping. Where it lies below steeply sloping Dekalb, Hagerstown, or Elliber soils, some of the rocks characteristic of these soils have rolled down over the surface.

The surface soil of Westmoreland gravelly loam is grayish-yellow, grayish-brown, or light-brown gravelly loam or silt loam to a depth ranging from 4 to 6 inches. Below this depth the material changes rather abruptly to pale-yellow or brownish-yellow friable gravelly silt loam that extends to a depth of about 15 inches. Below this is brownish-yellow gravelly silt loam or silty clay loam that extends to disintegrated rock or bedrock at a depth ranging from 22 to 28 inches.

About 80 per cent of the land is cleared, 60 per cent or more of which is maintained as permanent pasture. General-farm and home-supply crops are grown, and yields range from fair to good. Pasture holds well through the summer months. Corn yields from 20 to 25 bushels an acre, wheat from 12 to 20 bushels, oats from 30 to 35 bushels, and hay from 1 to 1½ tons. Phosphatic fertilizers are usually applied to wheatland.

Elliber gravelly loam.—Elliber gravelly loam is developed most extensively in central Pendleton County. Extending entirely through the county from north to south, the area in which it occurs is bounded on the west by Simmons, Ruleman, Castle, Peters, and Big Mountains and on the east by the valley slopes of Moorefield River. In Hardy County, its main occurrence is on Patterson Creek Mountain.

The surface soil of Elliber gravelly loam contains from 20 to 40 per cent of bluish-gray and whitish-gray chert gravel, together with some gray sandstone and light-weight yellow rock fragments. To a depth of 5 or 6 inches, the soil material is yellowish-gray or gray loam which changes abruptly to very pale yellow loam that extends to a depth of 12 or 14 inches, in which gravel is not so abundant as in the layer above. Below this and extending to a depth of 36 inches, or to bedrock at less depth, the material is yellow or light-buff gravelly loam or silt loam. This soil occurs at comparatively high elevations, cap-

ping many ridges and mountains, most of which are narrow with gently rounded tops and moderately steep or steep upper slopes.

In Grant County, which adjoins Hardy County, and in other previously surveyed areas in West Virginia, the Elliber soils are included with the Frankstown soils. In the latter, more precise definitions of the soils, the Frankstown series is confined to lighter-colored cherty soils which generally lie at lower elevations than the Elliber soils, where the average temperature is correspondingly higher and smaller quantities of organic matter are in the upper soil layers.

The extremely gravelly character of the surface soil allows practically all the rainfall to enter, and the open friable subsoil insures perfect subsoil drainage. Where this soil is cultivated, the gravel on the surface acts as a mulch that holds evaporation to a minimum and prevents severe damage from drought to crops, even in the driest years.

Although extensive in sections where it occurs, this soil is comparatively undeveloped for agricultural purposes. Only about 25 per cent of the land has been cleared, most of which is used in the production of corn, wheat, rye, buckwheat, and hay. The forested areas support a growth of large hardwood trees, principally red oak, white oak, chestnut oak, and many blight-killed chestnut trees. Cut-over areas support some good second-growth hardwoods, some white and yellow, or pitch, pine, and a heavy undergrowth of locust, chestnut sprouts, and laurel.

Crop yields, as a whole, are better on this soil than on any other of the more extensively mapped members of the hilly upland group of soils. Corn yields from 25 to 40 bushels an acre, wheat from 12 to 18 bushels, buckwheat from 25 to 30 bushels, rye from 10 to 15 bushels, and timothy and clover hay from 1 to 1½ tons. Pasture sod is hard to establish on land that has once been plowed because of the working downward of finer soil particles, leaving loose gravel on the surface to a depth of 2 or 3 inches. On this soil many of the farming operations are carried on by hand or with the simplest farm implements, as the high gravel content makes the use of improved machinery difficult.

In adjoining counties where this soil occurs, it has been developed rather extensively as an orchard soil, principally for apples, as the trees do well and return large yields of good-quality fruit.

Areas occupying the lower slopes, included with Elliber gravelly loam, consist mainly of talus material derived from mountains and ridges where the typical soil occurs. In these areas the relief is not quite so steep as that of the typical soil, and a larger proportion of the land is in cultivation. The gravel content is not quite so high, and consequently the land is more easily cultivated and more adapted to pasture sod. The largest areas mapped are near Kessel and in the northwestern corner of Hardy County at the foot of Patterson Creek Mountain. The largest areas in Pendleton County are on the lower slopes of Cave Mountain, in the northern part of the county, and of Horner Mountain 6 miles south of Franklin. The appearance of the surface soil is much the same as that of the typical soil, and much of the subsoil is essentially the same, but in places it is heavier, ranging from heavy silt loam to silty clay and in some places to clay. This heavy subsoil varies greatly in color, ranging from yellowish brown to reddish brown and in some places to red, mottled with

different shades of gray, yellow, and rust brown. In places the cherty gravel material ranges from only 18 to 24 inches in thickness and overlies bedded shale and sandstone that give rise to the Dekalb soils. Cropping practices and crop yields are the same as on the typical soil.

Hagerstown silt loam.—The surface soil of Hagerstown silt loam is light-brown or brown friable silt loam to a depth of 4 or 6 inches. The material changes rather abruptly to yellowish-brown, buff, or reddish-brown heavy silt loam or silty clay loam, that extends to a depth of 12 or 14 inches below the surface. Below this and extending to bedrock, which lies at a depth ranging from 24 to 30 inches, is yellowish-brown, reddish-brown, or almost red silty clay which is plastic when wet. In many places the 2 or 3 inch layer immediately above bedrock is buff or yellow, mottled with gray, red, and rust brown. Some small platy limestone fragments are distributed over the surface and through the soil.

This soil occurs mainly along the crest of Patterson Creek Mountain in Hardy County, in widely separated small areas. In Pendleton County it is widely distributed over all the area between Moorefield River and North Fork Potomac River. Its general occurrence is as comparatively small patches or areas of nearly stone-free soil within the more extensive areas of Hagerstown stony silty clay loam. This soil occupies the more gently rounded ridge tops, the smoother upper and lower slopes, and the saddlelike gaps between the high points of ridges. The most typical areas are 2 or 3 miles northeast of Riverton, 2 miles west of Fort Seybert, and in the Buffalo Hills.

This is not an extensive soil, but it is agriculturally important as it has the most favorable relief for cultivation in sections where it occurs. All the land is cleared, and most of it used in the production of corn, wheat, and hay. Yields are good, except in extremely dry years. Corn yields from 20 to 40 bushels an acre, wheat from 12 to 18 bushels, and timothy and clover hay from 1 to 1½ tons. Some alfalfa is grown, which yields about 2 tons an acre from three cuttings. Practically no commercial fertilizer is used on this soil, and the small supply of barnyard manure is applied to land to be planted to corn or wheat. Where used for pasture the land supports an excellent bluegrass sod. Protracted droughts and hot summers dry and bake the soil, thereby materially reducing the yields.

Upshur gravelly silt loam.—Upshur gravelly silt loam is one of the least extensive soils of the hilly upland group. It occurs only on Spruce and Allegheny Mountains in Pendleton County, its best development being on the southern end of Spruce Mountain.

This soil is derived from calcareous Indian-red shales and sandstone. The surface soil is dark chocolate-brown gravelly loam to a depth of 3 or 4 inches. Below this and continuing to a depth of about 10 inches is chocolate reddish-brown heavy loam or silt loam, which grades quickly into chocolate-red or Indian-red friable silt loam extending to a depth of 24 inches. Below this depth and continuing to bedrock is light Indian-red silty clay loam.

All the land is cleared, and most of it is in permanent pasture, with some in hay meadow. Bluegrass sod on this soil furnishes excellent pasture through the summer, and hay yields are good.

Lowell silt loam.—Lowell silt loam represents stone-free spots within areas of Lowell stony silty clay loam. It occurs on the lower

bench slopes of Spruce Mountain and on the Allegheny Front. It includes about equal proportions of yellow or buff and red soils, derived from Greenbrier limestone, and highly calcareous red shales of the same formation. The surface soil is heavy silt loam which quickly changes to silty clay loam, and the subsoil is silty clay or clay.

All the land is cleared, and the larger part is planted to corn, oats, and hay. Yields range from fair to good. Corn yields from 20 to 25 bushels an acre, oats from 25 to 35 bushels, and hay from 1 to 1½ tons. Most of the surrounding soils are rough and too steep for effective cropping. Consequently, this is an important soil on farms where it occurs.

Frederick gravelly fine sandy loam.—Frederick gravelly fine sandy loam is derived from two kinds of rock formation—sandstone, or quartzitic rocks, and limestone. The surface soil to a depth of 5 or 6 inches is yellowish-gray fine sandy loam. This is underlain to a depth of about 12 inches by pale-yellow or light-buff granular friable fine sandy loam. Below this is a gradational layer, 2 or 3 inches thick, where the soil changes to yellowish-red granular fine sandy clay and is underlain by brownish-red or nearly red granular clay which is plastic when wet.

This soil occurs in several bodies south of Macksville in the vicinity of Seneca Caverns. It is of very small total extent but is decidedly different from the surrounding soils and is locally important as a small-grain and hay soil. Corn yields are not so good as on the surrounding Hagerstown and Westmoreland soils, wheat and oats yield as well or better, hay not so well, and pastures are only fair.

A few areas of very stony soil, on account of their small extent, have been included in mapping with Frederick gravelly fine sandy loam and are shown on the map by stone symbols. The soil in these areas is really Frederick stony fine sandy loam. It is mapped only on the western benchlike lower slope of North Fork Mountain, east and northeast of Riverton. The soil consists principally of talus and outwash sandstone material deposited over limestone material from which the subsoil is derived. The surface soil is gray or grayish-brown stony fine sandy loam overlying a buff, yellow, or reddish-yellow upper subsoil layer. The lower subsoil layer is reddish-brown or red clay which is plastic when wet. The stones are of all sizes, including fairly large boulders of hard quartzitic sandstone.

All this land is forested, much of it remaining in large virgin white oak, with some chestnut, hickory, black walnut, maple, and black locust, and it is classed under the forest-land group of soils in this report.

Hagerstown stony silty clay loam.—Hagerstown stony silty clay loam is widely scattered throughout that part of Pendleton County lying between North Fork Potomac River and Moorefield River. It occurs in small patchy and large irregular areas nearly a mile wide and 2 or 3 miles long. The largest areas are in the Buffalo Hills from 4 to 6 miles northwest of Franklin, 2 miles west of Fort Seybert, south of Sugar Grove, and in a triangular area bounded by imaginary lines between Franklin, Brandywine, and Sugar Grove. In Hardy County, the principal occurrence of this soil is on the crest of Patterson Creek Mountain, extending as long narrow strips along the Grant County line.

About 90 per cent of this soil, although rough, stony, and occurring mainly on steep slopes, is cleared and used almost entirely for pasture. The soil material between the rocks is derived from limestone, and it produces excellent bluegrass, hence the preference for this soil as pasture rather than large areas of smoother lands on which pasture sod is much more difficult to establish. Little of the land has ever been plowed. After the timber was cut, cattle, sheep, and goats were turned on the land to graze and browse and to keep the brush growth down, so that pasture sod would obtain a foothold with little or no seeding.

The surface soil is light-brown, brown, or reddish-brown heavy silt loam or silty clay loam to a depth of 5 or 6 inches. It is underlain by buff or reddish-brown silty clay loam that extends to a depth of about 12 inches. Below this and extending to bedrock, which occurs at a depth ranging from 18 to 24 inches, is reddish-brown or dull-red silty clay or clay, which is plastic when wet. Steep land, that has been overgrazed or where the sod was not completely established after the land was cleared, has been severely eroded. Such places now have the reddish-brown silty clay loam or silty clay subsoil exposed, which in some places is only a few inches thick over bedrock. Many gullies through this land have exposed the bedrock. No pasture improvement program is in practice.

Westmoreland gravelly loam, stony phase.—Westmoreland gravelly loam, stony phase, is closely associated with the smoother Westmoreland soils lying on areas of smoother relief. Most of this soil occupies the higher-lying or steeper slopes, and some of it occurs as small scattered patches within the larger areas of smoother soil. It is best developed on the westward slope of North Fork Mountain, but it is widely scattered from north to south through the central part of Pendleton County, where it is associated with the Hagerstown and Dekalb soils. In appearance it is very similar to the Dekalb soils, but, being derived in part from impure limestone and calcareous shales, it is in general a better pasture soil than the Dekalb soils though not so good as the Hagerstown.

In pastured areas, the surface soil of Westmoreland gravelly loam, stony phase, is grayish-brown loam 5 or 6 inches deep. This changes abruptly to grayish-yellow or pale-yellow silt loam that extends to a depth of 12 or 14 inches, where it gradually becomes heavier, grading into silty clay loam, in many places with little or no change in color but in other places becoming grayish brown. Bedrock is present at a depth ranging from 20 to 40 inches.

Much of the stone that identifies this soil is from a stratum of rather resistant sandstone that occurs in the formation from which it is derived or that has rolled down or been brought down by water action from higher-lying Dekalb soils. Fragments of unweathered shale and sandstone occur throughout the soil profile. In places a large part of the soil is composed of colluvial material that has become mixed with the underlying soil which is derived from calcareous shale.

About 30 per cent of the land is cleared, all of which is used for pasture. A fair sod of bluegrass is established on most of it.

Upshur stony loam.—Upshur stony loam occurs only in Pendleton County along the Allegheny Front and Fore Knobs and on Spruce Mountain. The largest area, several square miles in extent, is around the head of Roaring Creek north of Onego. More than 50 per cent

of the land has been cleared. It is either in pasture sod or is brushy cut-over land that furnishes good grazing in the more open parts.

The surface soil of Upshur stony loam is chocolate reddish-brown heavy loam, and the subsoil is Indian-red silty clay loam or silty clay. Numerous reddish-brown sandstone fragments and an abundance of Indian-red shale chips are distributed over the surface and embedded in the soil. Some gray conglomerate sandstone gravel and bowlders, fallen from higher elevations, are scattered over some parts of it. Outcropping ledges of Indian-red sandstone and shale are common. Cool summers, high rainfall, and the calcareous character of the parent rocks from which the soil is derived combine to make this soil excellent summer range for cattle and sheep.

Lowell stony silty clay loam.—Lowell stony silty clay loam occurs only on the Allegheny Front and Spruce Mountain in Pendleton County. It is composed of a mixture of grayish-yellow silty clay loam, with a yellow or buff silty clay subsoil, and reddish-brown or Indian-red material, with an Indian-red subsoil derived from the Greenbrier formation of gray and reddish-gray limestone and highly calcareous red shales. Numerous gray conglomerate sandstone gravel and bowlders are scattered over the surface, and many ledges of the underlying rocks outcrop. About 65 per cent of the soil has a reddish-gray or Indian-red color.

Practically all the land is cleared and used for permanent pasture. It supports an excellent bluegrass sod and is considered one of the best pasture soils of the area.

SOILS OF THE FOREST LANDS

The soils of the forest lands include Dekalb stony fine sandy loam, Dekalb stony fine sandy loam, colluvial phase, Dekalb stony loam, Meigs stony fine sandy loam, the very stony areas of Frederick gravelly fine sandy loam (heretofore described), Pope fine sandy loam, alluvial-fan phase, and the areas of undifferentiated soils classified as rough stony land. These soils occupy more than half the area included in Hardy and Pendleton Counties. Their surface relief ranges from rolling to steeply sloping and mountainous. Surface drainage is excellent or excessive.

These soils do not produce better trees than other soils, but their relief and their stony character render them unsuitable for farming operations. A few small patches of the smoothest and most nearly stone-free land are cleared and converted into pasture land. Sheep are ranged for a short period in the summer on the more accessible areas of these soils. The food for these animals consists principally of browse, with some coarse grasses in the more open spaces.

Dekalb stony fine sandy loam.—Dekalb stony fine sandy loam is rather extensive in all parts of the area, occupying ridges with steep slopes, the steep upper mountain slopes, and some of the rounded mountain crests.

Under the usual 1 or 2 inches of leaf mold the surface soil is gray, almost white, or grayish-brown fine sandy loam. It is underlain by a pale-yellow or yellow fine sandy loam upper subsoil layer, and this, in turn, by a lower subsoil layer of brownish-yellow heavy fine sandy loam or fine sandy clay. Disintegrated or bedded massive sandstone is present at a depth ranging from 2 to 4 feet beneath the surface.

The stone content that identifies this soil is composed of the more resistant parts of the underlying rock from which it is derived and is in the form of gravel, large rock fragments, boulders, and outcropping ledges.

With the exception of a few patches of this soil, that are cleared and included in areas of smoother soils for pasture, it remains in forest. Some of it is still in virgin forest, but the larger part is recently cut-over land or supports a fair to good second growth of hardwoods.

Dekalb stony fine sandy loam, colluvial phase.—The colluvial phase of Dekalb stony fine sandy loam is talus material that has fallen from higher-lying sandstone formations, which in places has been modified by water action to some extent.

Like the typical soil, this soil is better suited to forest growth than to crops or pasture. The surface soil and upper part of the subsoil are very much the same as the corresponding layers of the typical soil, but the lower part of the subsoil is yellow or yellowish-brown compact loam or fine sandy clay, mottled with gray, ochereous yellow, and rust brown.

Dekalb stony loam.—The main difference between Dekalb stony loam and Dekalb stony fine sandy loam is one of texture. The yellow and brown color throughout the stony loam soil profile is a little more accentuated, that is, it does not have the leached appearance of the more sandy soil. The stony soil is best developed on the tops of the lower ridges and in fairly large areas on the middle slopes of the more massive mountains. It occupies an intermediate position, in both texture and location, between the lower silty, shaly, and gravelly soils and the higher stony sandy soils and rough stony land. The soil material is derived largely from the platy shales and thin layers of fine-grained sandstone, interstratified with harder sandstone that remains as unweathered fragments and blocks. As a whole this soil is weathered to a little more uniform depth, ranging from 30 to 40 inches, than the stony fine sandy loam, and it produces a better quality of timber.

Meigs stony fine sandy loam.—Meigs stony fine sandy loam is a mixture of chocolate reddish-brown and gray-brown or yellowish-brown soils that are too mixed for logical separation. The texture of the surface soil is very variable, ranging from loam and in places silt loam to fine sandy loam, with a subsoil correspondingly heavier than the surface soil.

This soil is developed mainly on South Branch Mountain in Hardy County and on Shenandoah and Spruce Mountains and the Allegheny Front in Pendleton County. It is easily identified by the mixture of red, brown, and gray sandstone blocks and fragments that are scattered over the surface and by the outcropping ledges of red sandstone. The steep and rough surface relief renders the land unfit for agricultural purposes. On Spruce Mountain and along the Allegheny Front, some of the underlying rocks are calcareous. The soil produces a fair or good hardwood timber growth.

Pope fine sandy loam, alluvial-fan phase.—Pope fine sandy loam, alluvial-fan phase, is the only alluvial soil in the area that is classed as forest land. It is developed along the small swift-flowing streams which rise in the higher mountains and occurs as alluvial terracelike

fans where these streams join the wider river bottoms. These terminal fans, which are above present overflow, are partly cleared, and grass grows in the open spaces between the trees. Along the courses of the streams the soil is subject to change at each successive overflow, but this does not materially injure the heavy growth of hardwoods, white pine, and hemlock, which grow on most areas of this soil. The soil is a fairly uniform light-brown fine sandy loam containing much gravel, many small stones, and cobbles.

Rough stony land.—Rough stony land includes steep, rough, and broken areas which comprise nearly one-third of the land area of Hardy and Pendleton Counties. Large bodies occur on South Branch and Shenandoah Mountains and in the eastern and northeastern parts of Hardy County. Smaller areas are scattered throughout the county. In Pendleton County the most extensive areas lie on the Allegheny Front and on Spruce, North Fork, and Shenandoah Mountains. Other areas, some of them 2 or 3 square miles in extent, are scattered throughout the county.

Much of this land has a very shallow soil covering between the rocks. Large stones, boulders, outcropping ledges, rock slides, and cliffs are common on most of it. Numerous small areas, that might have been mapped as stony soil types, are included with rough stony land because it was impractical to separate them, owing to their small extent.

All the rough stony land is in forest or in cut-over land. On the more favorable sites some fair to good timber grows, but many of the trees are small and of poor quality. The roughest parts of the land are bare or nearly so, or they support only scrubby jack oak, laurel, and huckleberry brush.

RECOMMENDATIONS FOR THE UTILIZATION AND IMPROVEMENT OF HARDY AND PENDLETON COUNTIES SOILS

Findings of the West Virginia Experiment Station³ are that most of the upland soils similar to those in Hardy and Pendleton Counties are acid, requiring lime for the best development of most crops; that there is a great deficiency of organic matter in all the soils; and that the available supply of essential plant-food elements, especially phosphorus, is low. To overcome these deficiencies, wholly or in part, it is necessary to inaugurate a definite program of crop rotation and soil improvement, which includes the use of lime, fertilizers, manure, and cover crops. The crops grown should include cash, supply, and soil-improvement crops. The cover crop might be the cash crop, for instance, small grain to be harvested.

If legumes are grown frequently in the rotation, or fresh manure is freely used, little or no nitrogenous fertilizer will be needed. Most legumes respond to applications of potash, especially on the more sandy soils. Truck crops in all parts of the State respond to the use of potash. Where legumes are grown and manure and lime are used, it is probable that little additional profit can be obtained from applications of fertilizer other than phosphates. If legumes are infrequently

³ DODD, D. R., GARBER, R. J., and ODLAND, T. E. CROP ROTATIONS FOR WEST VIRGINIA. W. Va. Agr. Expt. Sta. Circ. 50, 24 p., illus. 1928.

grown and manure applications are light, a complete fertilizer with a comparatively high phosphate content would probably give better results.

The tendency has been toward the exclusive use of superphosphate. A complete fertilizer analyzing 2-14-4, 4-10-4, or 4-12-4, is recommended for the average farm. The acre application to be used will depend on the crop grown, but for general field crops about 300 pounds an acre is recommended.

In determining crops that are to be used in the rotation it is necessary to select those best adapted to the individual farm, considered in regard to the soils and climate. Corn requires hot weather, plenty of moisture, and is therefore adapted to lower lands or valleys. Buckwheat, potatoes, and oats do well in a cool climate and are adapted to high elevations. Buckwheat, rye, and oats can be more successfully grown on shallow droughty soils than can corn. Steep lands should be kept in grass a greater part of the time. When selecting crops that are adaptable, it is necessary to select crops that are needed. There should be cash crops in connection with livestock feed crops, and home-supply crops. The kind and number of livestock kept will determine the kinds of feed to be grown.

Stockmen or dairymen, with a limited acreage of land suitable to crops, might follow a 2-year rotation to meet their needs, but when considered in regard to soil fertility the 3-year or 4-year rotation is recommended.

Table 6 shows crop rotations and soil-improvement and fertilizer practices that are adaptable to the soils of Hardy and Pendleton Counties. Any land in grass may be pastured for a year or more before again being plowed. Pasturing lengthens the rotation, making the growing of legume crops less frequent, thereby necessitating the increased use of such fertilizers as 2-14-4 or 4-12-4.

Serious overgrazing in early spring and during drought periods often causes bare spots in pastures which result in the leaching out of plant food and erosion of the surface soil, and many pasture sods become very poor or thin. In general, such conditions in pastures are disregarded, thereby opening the way for almost total loss of pasture unless the number of livestock is greatly reduced.

Results obtained by the experiment station⁴ show that a top-dressing of manure and lime, or fertilizer and lime, is usually necessary for the improvement of such pastures. The quantities of lime to be added should be determined by making an acidity test of the soil. Superphosphate applied at a rate ranging from 200 to 400 pounds an acre is recommended as generally applicable, and under certain conditions the use of a complete fertilizer or one containing phosphorus and nitrogen is advisable. Reseeding proved of no value except where lime and fertilizers had been applied. Where the land is not too rough the seed should be lightly harrowed into the ground. Pastures that have become so depleted of grass that not enough remains to reestablish the sod should be plowed, harrowed, and reseeded, applications of lime and fertilizer, or lime and manure, being made before the grass is seeded.

TABLE 6.—Crop rotations and soil-improvement and fertilizer practices for Hardy and Pendleton Counties, W. Va.

2-YEAR ROTATIONS					
Year	Crop	Cover crop	Manure	Fertilizer	Lime
First..	Corn.....	Rye and vetch seeded at rate of 1 bushel of rye and from 15 to 20 pounds of vetch an acre at last working.	None.....	400 pounds of superphosphate or 2-14-4.	None.
Second.	Soybeans.....	Rye alone, 6 pecks an acre.	6 tons on rye before plowing under.	200 pounds of superphosphate.	As needed or every third rotation.
First..	Corn.....	Red clover and timothy seeded at last working.	None.....	400 pounds of superphosphate or 2-14-4.	None.
Second.	Red clover and timothy hay.	Timothy.....	6 tons on sod after mowing.	None or 200 pounds of 6-8-6.	As needed or every third rotation.
3-YEAR ROTATIONS					
First..	Corn.....	Wheat for grain, or rye and vetch if oats follow.	None.....	400 pounds of superphosphate.	None.
Second.	Wheat or oats.	Clover for hay, either sweetclover or red clover, with or without timothy.	.....do.....	400 pounds of superphosphate or 2-14-4.	As needed (every other rotation here) or on sod after grain crop.
Third..	Clover.....	Second-crop clover or grass.	8 tons on meadow after mowing.	None.....	None.
4-YEAR ROTATIONS					
First..	Corn.....	Rye and vetch, seeded in corn at rate of 1 bushel of rye and 15 or 20 pounds of vetch an acre.	None.....	400 pounds of superphosphate.	None.
Second.	Soybeans.....	Wheat.....	.....do.....	200 pounds of superphosphate.	Do.
Third..	Wheat.....	Red clover or sweetclover and timothy for hay.	.....do.....	400 pounds of superphosphate or 2-14-4.	As needed (every other rotation).
Fourth.	Clover.....	.....do.....	12 tons on meadow before corn.	None.....	None.

SOILS AND THEIR INTERPRETATION

Hardy and Pendleton Counties lie along the eastern border of West Virginia and constitute a part of the Appalachian Mountain ridges. Pendleton County, along its western side, includes the steep and rough slopes leading up to the Allegheny Plateau, and the western boundary of Hardy County lies about 12 miles east of the Allegheny Front. The counties are included in that broad region of soils, lying westward from the middle Atlantic coast, designated as the gray-brown podzolic soil region. The lighter-textured soils, lying above an elevation of 2,500 feet, belong to the true podzols, or gray podzols of the North. These soils in forested places have well-defined gray layers under the covering of raw humus and are underlain by a yellowish-brown B horizon.

All soils of the area may be classed as light colored, and all have good or excellent drainage. The outstanding characteristic on which

⁴ ODLAND, T. E., WILSON, C. B., HENDERSON, H. O., and DEATRICK, E. P., PASTURE EXPERIMENTS. W. Va. Agr. Expt. Sta. Bul. 235, 32 p., illus. 1930.

the soils may be divided into groups for discussion as regards soil development, is the parent material, or geological formation, from which they are derived and to which they bear a close relation. Disintegrated or bedded parent rock is present at a depth ranging from 1 to 5 feet beneath the surface, and many outcrops occur on the steeper slopes.

Soil groups based on the characteristics of the underlying rocks or parent material are as follows: (1) Soils weathered or derived from noncalcareous shales and sandstones, that is, those that show no effervescence with dilute solutions of hydrochloric acid; and (2) soils weathered or derived largely from slightly calcareous or strongly calcareous shales and limestones of different degrees of purity. The first group may be termed the acidic-rock group of soils, and the second, the basic-rock group.

Until comparatively recent years the practice of periodically burning over much of the land prevented the accumulation of an appreciable quantity of organic matter. Beneath the shallow covering of forest litter, well-decomposed organic matter is mixed with the soil to a depth ranging from 1 to 3 inches, imparting to it a brown or dark grayish-brown color, but when the land is cleared and cultivated, the dark surface layer quickly disappears. When pasture sod is established without plowing the soil, the dark layer is preserved to some extent and under proper pasturing may be increased in thickness.

The forest growth consists largely of deciduous trees, with some juniper and conifers. Their distribution and best development seems to be influenced largely by the following three conditions: (1) Elevation, which might be interpreted in terms of climate; (2) soil, depth of weathering and water-holding capacity; and (3) lime content of the underlying rocks.

On the Hagerstown, Westmoreland, and Frederick members of the basic-rock group of soils, few if any of the conifers grow, white oak is the predominant tree, and red oak, black walnut, locust, and sugar maple are fairly abundant. Red cedar is abundant on parts of the Hagerstown and Frederick soils. The Lowell member of this group of soils, which occurs on high benches of the Allegheny Front, is well up toward the altitude limit for the growth of oak, and here sugar maple and chestnut are the dominant trees. Elliber, an upland member of the group, is derived from cherty limestone of low carbonate content and highly fossilized sandstone. The trees on this soil are more of the type which grow on soils of the acidic-rock group. The Huntington and Lindside soils, the alluvial members of the group, are cleared of timber, with little or no indication left as to the character of the tree growth except that it was all deciduous trees.

All the upland members of the acidic-rock group of soils support some conifers among the hardwood growth. On the crests of many of the Dekalb shaly soil ridges, Virginia scrub pine and yellow pine largely exclude the growth of other trees, although, as a whole, chestnut oak is the predominant tree. Without doubt this is owing to the better adaptability of pines to the shallow and droughty soils. This same condition and occurrence of tree growth is noted on Dekalb stony loam where it approaches more nearly to the character of rough stony land on the high mountain slopes and ridge tops. The middle mountain slopes support about equal quantities of white oak, chestnut oak, and other hardwoods, with considerable white pine, yellow

pine, and hemlock along the shaded draws. On the rough and stony steep slopes and on the ridge and mountain tops, where the soil covering is very thin and excessively drained, the vegetal growth is sparse and stunted, consisting of jack oak or ground oak, scrubby chestnut oak, scrub pine, laurel, and huckleberry.

Along the Allegheny Front and on top of Spruce Mountain the type of tree growth is distinctively different from that in any other part of the area. Climatic conditions resulting from the high altitude and greater rainfall are conducive to the growth of spruce, beech, hemlock, sugar maple, wild cherry, basswood, ash, and chestnut, many of which are much more common in States farther north. The Upshur soils occurring in this part of the area are in part derived from calcareous shales, and this is reflected somewhat in the increase of hardwoods growing on them, such as maple and beech. Large tracts of the Dekalb soils in this area once supported spruce to the exclusion of all other trees.

The parent materials from which the soils of Hardy and Pendleton Counties are derived include a wide range of geologic formations, rather closely associated and intricately mixed, owing to steep folding, faulting, and cutting through by drainage. The parent materials include noncalcareous fine-grained fissile shales, shales of thicker stratification, interstratified shales and thin-bedded fine-grained sandstone, thinly to thickly bedded sandstones and massive sandstone conglomerate, calcareous shales, interstratified shales and impure limestone, cherty limestone, and comparatively pure limestone. The sandstones and shales range from dark gray through different shades of brown to red. Soils from the red shales and sandstones retain largely the color of the parent material, and those from the light-colored rocks are yellow or brownish yellow. Most of the limestones are gray or dark gray, and they weather to brown, reddish-brown, or red soil material.

All that part of the area lying east of Moorefield River and east of South Branch Potomac River, below the junction of the two streams, contains comparatively little calcareous rock. Westward from this line, both calcareous and noncalcareous rocks occur in about equal quantities and are interassociated. The texture of all soils, except those derived from comparatively pure limestone, might be correlated almost directly with the texture of the parent rocks.

The grouping of soils on the basis of lime content in the parent material closely coincides with the distribution of the geologic formations as they have been mapped. The Dekalb, Lehew, and Meigs soils constitute the upland soil members of the acidic-rock group of soils. The Monongahela and Pope soils, the principal alluvial soils, terrace and flood bottom, respectively, are composed of wash from Dekalb and related soils, which has been deposited along watercourses. This group constitutes practically all the soils in the eastern one-fourth of Pendleton County and the eastern three-fourths of Hardy County, with areas ranging in size from 10 acres to 1 square mile, widely scattered over the rest of the two counties. Practically all the material classed as rough stony land is of acidic-rock origin and constitutes nearly one-third of the entire area.

Only two soils, Monongahela silt loam and Monongahela fine sandy loam, show a profile of any marked degree of maturity. They are

alluvial in origin, are derived from sandstones and shales, and occupy a high terrace position above the larger streams. The A₁ and A₂ horizons are, respectively, grayish brown and yellow, and they extend to a depth ranging from 12 to 18 inches. Below this the material grades quickly into the yellowish-brown hard compact material of the B horizon which contains gray, rust-brown, reddish-brown, and red mottlings. The material of this horizon seems to contain a rather large concentration of mineral salts that have a somewhat cementing character and have resulted in the formation of a thick hardpan layer rather than a zone of clay accumulation. When the compact layer is broken up the texture seems to be very little heavier than that of the material in the A horizons. The unchanged parent material is reached at a depth ranging from 4 to 6 feet and consists of stratified sand, silt, clay, and water-rounded gravel.

Tables 7 and 8 give the results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of Monongahela silt loam in Hardy County and of Monongahela fine sandy loam in Pendleton County.

TABLE 7.—*Mechanical analyses of Monongahela silt loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	<i>Per cent</i>
222957	Surface soil, 0 to 6 inches.....	0.5	1.5	2.2	13.0	14.2	44.3	24.4
222958	Subsurface soil, 6 to 14 inches.....	.7	1.6	2.3	11.9	14.4	46.5	22.5
222959	Subsoil, 14 to 26 inches.....	.6	1.2	1.8	12.1	13.2	40.4	30.8
222960	Subsoil, 26 to 42 inches.....	.2	1.0	2.8	16.9	12.2	25.4	41.5

TABLE 8.—*Mechanical analyses of Monongahela fine sandy loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	<i>Per cent</i>
223061	Surface soil, 0 to 9 inches.....	0.7	3.0	5.1	20.7	18.3	34.7	17.6
223062	Subsurface soil, 9 to 18 inches.....	1.0	3.6	5.6	20.2	16.1	34.8	18.6
223063	Subsoil, 18 to 32 inches.....	2.0	3.6	4.9	19.4	18.2	31.2	20.8
223064	Subsoil, 32 to 44 inches.....	1.5	3.3	5.3	20.5	19.3	29.5	20.7

All the residual upland soils of the area are immature, consisting of A and C horizons. They are developed in areas of moderately or steeply sloping surface relief. Erosion very nearly keeps pace with rock weathering, and the steep dip and shattered condition of the underlying rocks, combined with the comparatively high rainfall, allows thorough leaching of soluble materials. Practically all weathering processes operating on the soil are those that remove constituents which if allowed to remain, would result in the development of a mature profile.

Beneath the thin organic layer of the more sandy Dekalb soils is a shallow gray or leached layer that shows the beginning of a podzolic profile. The gray layer is underlain by pale-yellow subsurface material below which is a brownish-yellow layer of slightly heavier texture, that in most places extends to the partly disintegrated parent rock material or to bedrock. The slightly heavier texture is probably due

in part to the incipient B horizon and in part to the recently weathered unleached material. On narrow benchlike shoulders of some of the mountain slopes the podzolic processes are a little more in evidence, as in such places a true podzol profile is slightly developed; that is, beneath the gray leached layer is an incipient development of the coffee-brown layer, ranging from a trace to not more than 2 inches in thickness. Nowhere is it continuous for more than a few-feet radius about a given point.

The shale members of the acidic-rock group, being less resistant to weathering and erosion, have been worn down until they now occupy, largely, valley positions, and it is here that the heavier and less stony soils occur. With an increase of elevation the soils on the valley ridges and mountain slopes become correspondingly lighter in texture and increasingly more stony. The high slopes and mountain tops, which are composed of hard resistant sandstone, are predominantly rough stony land. On some of the broader mountain tops, where erosion is less severe, sandy soils have developed to a depth comparable to soils in any part of the area.

It is only a comparatively recent cycle of erosion that has exposed many of the basic rocks that give rise to the Hagerstown and Westmoreland soils, consequently they occupy no definite physiographic position other than the broad central part of Pendleton County and the western part of Hardy County at elevations ranging from 2,000 to 3,000 feet above sea level, where valley cutting is still very active. In this part of the area many ridges are capped by the more resistant cherty limestone that gives rise to the Elliber soils, and the Hagerstown and Westmoreland soils occur along the slopes and narrow valleys below.

In Table 9 are given the results of mechanical analyses of samples of the surface soil, subsurface soil, and subsoil of Elliber gravelly loam in Pendleton County.

TABLE 9.—*Mechanical analyses of Elliber gravelly loam*

No.	Description	Fine gravel	Coarse sand	Medium sand	Fine sand	Very fine sand	Silt	Clay
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	<i>Per cent</i>
223048.	Surface soil, 0 to 2 inches.....	6.0	5.3	2.7	8.2	13.8	50.2	13.7
223049.	Subsurface soil, 2 to 7 inches....	11.6	5.1	2.1	8.0	10.2	47.8	17.1
223050.	Subsoil, 7 to 17 inches.....	.7	2.9	5.0	20.4	18.0	32.4	20.6
223051.	Subsoil, 17 to 32 inches.....	8.3	5.6	2.0	3.3	10.3	49.1	21.4

The Dekalb soils, as mapped in West Virginia, include all soils weathered in place from the underlying gray noncalcareous shales and sandstones. Although it has been recognized for some time that considerable differences exist in the soils classed as Dekalb, they were not given different names in Hardy and Pendleton Counties. The differences, however, are reflected in the several soil types.

Dekalb stony fine sandy loam closely resembles the yellow podzolic soils of the southern Appalachian region, that are classed as Hartsells. The thoroughness of leaching of the surface soil and the depth of the leached layer is not so great here as in the true Hartsells region, nor has the B₁ horizon reached the same stage of development and oxidation.

Three miles east of Lost River, in Hardy County, on a nearly flat mountain crest, the profile of Dekalb stony fine sandy loam shows the following layers:

- (A₀) 0 to 2 inches, dark-brown loamy leaf mold containing considerable carbon residue from forest fires.
- (A₁) 2 to 5 inches, loose incoherent gray loamy fine sand.
- (A₂) 5 to 15 inches, yellow friable fine sandy loam.
- (B₁) 15 to 24 inches, yellow friable fine sandy clay.
- (B₂) 24 to 32 inches, brownish-yellow somewhat compact fine sandy clay.
- (C₁) 32+ inches, disintegrated and partly weathered sandstone.

In places where conditions have been more conducive to the accumulation of organic matter, the true podzolic profile is approximated on narrow benchlike positions. These areas are more typical of the recently established Leetonia series, which embraces the true podzols or gray podzols of the North.

On an upper mountain slope, 4 miles north of Franklin, in Pendleton County, the soil profile is as follows:

- (A₀) 0 to 3 inches, a dark-brown organic layer.
- (A₁) 3 to 5½ inches, gray incoherent loamy fine sand.
- (B₁) 5½ to 7 inches, dark-brown or coffee-brown fine sandy loam.
- (B₂) 7 to 18 inches, yellow friable fine sandy loam.
- (B₃) 18 to 32 inches, brownish-yellow slightly compact but friable heavy fine sandy loam.
- (C) 32+ inches, disintegrated and partly weathered sandstone.

The B₁, or brown layer, is nowhere continuous for more than a few square yards.

Contrasted with the foregoing profile is the profile of the heavier Dekalb soils derived largely from shales. These are immature soils which, in the gray-brown podzolic region, are recognized as the Muskingum soils. Dekalb shaly silt loam, 2½ miles southeast of Moorefield, which has numerous shale chips and fragments on the surface and throughout the soil, shows the following profile:

- (A₀) 0 to 1½ inches, brown loamy leaf mold.
- (A₁) 1½ to 8 inches, pale-yellow silt loam.
- (A₂ or B) 8 to 18 inches, brownish-yellow silty clay loam.
- (C) 18+ inches, partly weathered shale mixed with yellow clay extending to a depth ranging from 24 to 30 inches and underlain by disintegrated and bedded shale.

On the rounded ridges and smooth slopes of the Allegheny Plateau, along the western border of Pendleton County, is a third phase of the Dekalb soils, mapped as a gravelly silt loam, which closely resembles the true Dekalb. Formerly this land was heavily forested with spruce and hardwoods, such as maple, beech, and cherry. Annual burning over for a number of years after the timber was cut has reduced the organic layer from more than a foot in thickness to less than 3 inches at this time. The profile is about as follows:

- (A₀) 0 to 3 inches, a dark-brown organic layer.
- (A₁) 3 to 9 inches, brown heavy silt loam or silty clay loam.
- (A₂) 9 to 18 inches, yellow friable silty clay loam.
- (B) 18 inches to bedrock, which lies at a depth ranging from 30 to 40 inches, the material is yellow silty clay or clay.

This profile is comparable in its development to that of some soils in the New England States, which are termed brown podzols, as they have only a trace of the gray or leached layer in places.

No chemical analyses are available for West Virginia Dekalb and related soils. However, some soils from surrounding States, with profile developments comparable with those of the Hardy and Pen-

leton Counties soils, have been selected, and they reflect the processes and the extent of development that has taken place in the soils of the area.

A sample of Dekalb stony loam from Lycoming County, Pa., showing approximately the same profile development as that of the better-developed podzol profile of Dekalb stony fine sandy loam⁵ as described in Pendleton County, shows, by the high percentage of SiO₂ present, extreme leaching in the topmost 1½ inches. The next, or coffee-brown, horizon shows a decrease of 17 per cent of SiO₂, but a combined increase of nearly 100 per cent of Fe₂O₃ and Al₂O₃ that indicates it is a zone of concentration of colloidal material. Below this, the silica remains very nearly constant, and there is a slight increase of iron and alumina.

The analysis of another sample representative of the immature Dekalb (Muskingum) soil of the valley ridges, shows a decrease of only 6 per cent of silica between the surface soil and the subsoil and a correspondingly small increase of the iron and alumina ratio, indicative of a minimum amount of leaching or soil-development processes.

Hanceville silt loam, a southern Appalachian podzolic soil of the red and yellow soils region, shows much deeper and more severe eluviation than the soils of West Virginia or Pennsylvania. The high SiO₂ ratios, 84.03 and 82.45 per cent, for depths of 0 to 3 inches and 3 to 12 inches, respectively, show that leaching has been rather uniform to a depth of a foot or more. The percentage of silica at 12 to 36 inches, 61.02, is a drop of about 26 per cent in total amount, whereas the combined iron and alumina increases from 8.87 per cent to 28.52 per cent, which would indicate a more advanced development in the B horizon than in the soils farther north.

All types of the Dekalb series that occur at lower elevations, except Dekalb stony fine sandy loam, may be classed as immature soils that belong to the Muskingum group. None of the flood-bottom soils derived from Dekalb material shows any profile development. Monongahela silt loam and Monongahela fine sandy loam, river terrace soils, derived from sandstone and shale material of the Dekalb soils are the only well-developed or mature soils in the area. Just east of Upper Tract in Pendleton County, is an area of Monongahela fine sandy loam which is about typical for the area. The profile examined in a wheatfield is as follows:

- (A₁) 0 to 9 inches, yellowish-brown friable fine sandy loam.
- (A₂) 9 to 18 inches, brownish-yellow slightly compact but friable fine sandy loam, faintly mottled with gray.
- (B₁) 18 to 32 inches, grayish-brown compact fine sandy loam, mottled with gray and some rust brown.
- (B₂) 32 to 44 inches, dull yellowish-brown very compact loam or heavy fine sandy loam, mottled with gray, rust-brown, and some dark, nearly black, material.

A profile of Monongahela silt loam, as observed in Hardy County, 1 mile south of Old Fields on land in permanent pasture sod, shows the following layers:

- (A₁) 0 to 6 inches, light grayish-brown friable silt loam.
- (A₂) 6 to 14 inches, pale-yellow or light grayish-brown silt loam having a laminated structure.
- (B₁) 14 to 26 inches, yellowish-brown compact silty clay, mottled with gray, brown, and reddish brown, which breaks down to a coarse fragmental structure.

⁵ This soil has recently been redefined and recorelated as Leetonia.

(B₂) 26 to 42 inches, brown silty clay which is slightly compact, mottled with gray, yellow, rust brown, and reddish brown and breaks down to a medium fragmental structure.

The compact layer of the Monongahela soils, acting as a hardpan almost impervious to water, seems to be a concentration of mineral salts rather than a concentration of clay material. In many places in these soils no marked differences in the texture of surface soil and subsoil material exist.

The remaining members of the acidic-rock group are the soils of the Lelew and Meigs series. The Lelew soils are derived from chocolate-red or Indian-red shales and sandstone of the Catskill formation. The soil color is the same as that of the parent rock which occurs at a depth ranging from 20 to 40 inches beneath the surface. Table 10 gives the results of pH determinations of a sample of Lelew gravelly fine sandy loam collected in Hampshire County, W. Va., near the Hardy County line.

TABLE 10.—*pH determinations of Lelew gravelly fine sandy loam from Hampshire County, W. Va.*

[1½ cm³ soil, 1:2 soil-water ratio]

Sample No.	Soil type	Depth	pH
222828	Lelew gravelly fine sandy loam.....	Inches 0-1	3.80
222829	do.....	1-7	4.52
222830	do.....	7-24	4.67

These values are contrasted with the pH values of a typical sample of Upshur clay loam, derived from calcareous material, collected 3 miles west of Spencer, Roane County, W. Va., as shown in Table 11.

TABLE 11.—*pH determinations of Upshur clay loam, from Roane County, W. Va.*

Sample No.	Soil type	Depth	pH	Sample No.	Soil type	Depth	pH
36716	Upshur clay loam.....	Inches 0-3	6.62	36719	Upshur clay loam.....	Inches 36-48	8.27
36717	do.....	3-12	5.05	36720	do.....	48-72	8.12
36718	do.....	12-36	5.94	36721	do.....	96-120	8.03

The Meigs soils are a mixture of Dekalb and Lelew soils that occur in areas too inextensive and too closely associated to separate into their respective types.

The Elliber soils resemble the Frankstown soils in many respects, but they occur at higher elevations and have much darker surface soils than the Frankstown. Although the parent material is cherty, the pH values indicate a highly acid soil, as shown in Table 12.

TABLE 12.—*pH determinations of Elliber gravelly loam from Pendleton County, W. Va.*

Sample No.	Soil type	Depth	pH
223048	Elliber gravelly loam.....	Inches 0-2	4.62
223049	do.....	2-7	4.69
223050	do.....	7-17	4.78
223051	do.....	17-32	4.73

The Hagerstown and Westmoreland soils are the most important of the basic-rock group. They are developed largely on rolling or steeply sloping surface relief, where erosion very nearly keeps pace with rock weathering and soil-forming processes. As a result of the constant downward movement of the soil surface, they are among the youngest and most immature soils of the area. This is especially true of Westmoreland silt loam.

Westmoreland silt loam is derived largely from comparatively soft calcareous shales which weather almost completely, leaving no rock fragments to act as a check to erosion. Consequently it is a shallow soil, with the disintegrated limy shale material lying within 6 inches of the surface in many places. Rock fragments on the other Westmoreland soils tend to slow down erosion, consequently there is a little deeper accumulation of soil over the bedrock.

Of the two types of Hagerstown soil in the area, Hagerstown stony silty clay loam is by far the most extensive, and it is one of the more important pasture soils of Pendleton County. The surface soil, to a depth ranging from 5 to 8 inches, under virgin conditions is buff or light reddish-brown silty clay loam which is underlain to bedrock, lying at a depth ranging from 18 to 30 inches, by reddish-brown or almost red silty clay or clay. In some places just above the underlying limestone is a 1 to 3 inch layer of brownish-yellow clay that does not seem to be completely oxidized. Rock outcrops and ledges occur throughout areas of this soil. The buff or light-red color of the surface soil and the slightly heavier subsoil indicate the beginning of the operation of podzolic processes.

The Lowell and Upshur soils are derived, respectively, from limestone and calcareous shale, and they occur at high elevations on the Allegheny Front and Spruce Mountain. The yellow color of the Lowell soils is probably due to the lack of oxidizing forces at the higher elevations, that are operative at lower elevations where the Hagerstown soils occur. The Upshur soils are derived largely from red calcareous shales, and the color and texture of the soil is almost identical with that of the parent material. Although weathering is fairly deep, no marked evidences of soil maturity are apparent.

The bottom lands derived largely from soils of the basic-rock or calcareous group of soils include the Huntington and Lindside soils, both of which are subject to periodic overflow. The Huntington soils are well drained and show no profile or horizontal development. The Lindside soils have imperfect subsoil drainage, and the subsoils are mottled with gray, and are lighter colored than the surface soils. The heavy phase of Lindside silt loam occupies poorly drained depressions or narrow seepy bottoms. The surface soil is gray brown, and the subsoil is gray water-logged material containing mottlings of yellow and brown.

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