Series 1937, No. 3 Issued September 1941

Soil Survey

Greenbrier County West Virginia

By
A. J. VESSEL, in Charge, and M. E. SWANN
United States Department of Agriculture
and
H. M. FRIDLEY
West Virginia Geological Survey

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
In cooperation with the
West Virginia Geological Survey and the
West Virginia Agricultural Experiment Station

For sale by the SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C. Price 50 cents

This publication is a contribution from

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SOIL SURVEY OF GREENBRIER COUNTY, WEST VIRGINIA

By A. J. VESSEL, in Charge, and M. E. SWANN, Division of Soil Survey,[1] Bureau of Plant Industry, United States Department of Agriculture, and H. M. FRIDLEY, West Virginia Geological Survey

Area inspected by W. EDWARD HEARN, Inspector, District 2

United States Department of Agriculture in cooperation with the West Virginia Geological Survey and the West Virginia Agricultural Experiment Station

CONTENTS

COUNTY SURVEYED

Greenbrier County is in the southeastern part of West Virginia (fig. 1). The Virginia-West Virginia State line forms its eastern boundary. The county is very irregular in outline, as mountain ridges form the boundaries on the east and southeast and Meadow River is the boundary on the northwest. Its longest dimension is from east to west—about 51 miles. The maximum distance from north to south is

[1] The field work for this survey was done while the Division was a part of the Bureau of Chemistry and Soils.

about 41 miles. This is the second largest county in the State, comprising an area of 1,023 square miles or 654,720 acres. Lewisburg, the county seat, is in the south-central part of the county at the junction of two old and historic trails, namely, the Midland Trail, or James River and Kanawha Turnpike, now United States Highway No. 60, traversing east and west; and the Seneca Trail, now United States Highway No. 219, traversing north and south. Lewisburg is about 75 miles by airline southeast of Charleston and 165 miles west of Richmond, Va.

The western part of Greenbrier County lies in the Appalachian Plateaus and the eastern part in the Valley and Ridge province (fig. 2).

The Valley and Ridge province within this county has less relief than the Valley and Ridge province as a whole. It consists of several parallel mountain ridges of resistant rocks, alternating with parallel valleys formed from nonresistant rocks. With the exception of the Greenbrier Valley, which, in general, lies between the Greenbrier River and the Appalachian Plateaus, the valleys are narrow and rise in a series of steeply rounded hills to the main mountaintops. The parallel ridges in the eastern part of the Valley and Ridge province are composed chiefly of sandstone and shales of various ages and have been much folded in places.

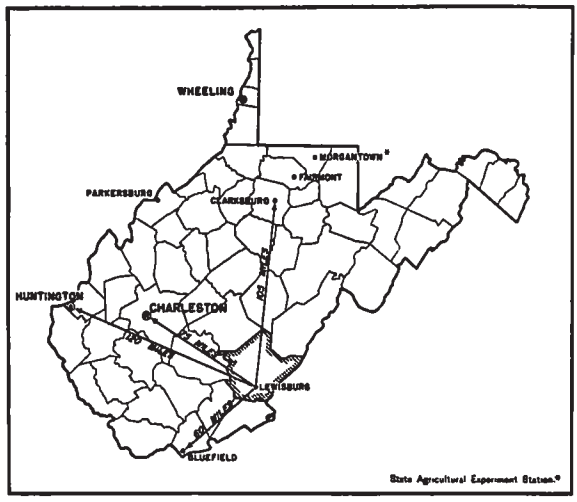

FIGURE 1.—Sketch map showing location of Greenbrier County, W. Va.

This folding has resulted in an exposure of limestone along Beaver Lick and Coles Mountains. Here, the ridges are as much as 3,000 feet above sea level. The major streams in this section parallel the mountain ranges, but the minor streams cut across the mountains at right angles. This presents a trellislike drainage pattern.

Most of Greenbrier Valley is underlain with limestone and is referred to by many as the limestone valley. The general relief is that of a broad rolling valley, which extends from northeast to southwest throughout the county. The valley is bounded on the east, west, and north by comparatively high mountains. Where limestone underlies the land, drainage is subterranean. Surface water reaches underground channels through sinkholes. The Greenbrier River and its tributaries have readily cut into the very thick horizontally bedded Greenbrier limestone, with the result that extensive lowlands have formed. For most of its course through the county, the Greenbrier River has carved its way entirely through the limestone and is now entrenched in resistant sandstone. Although the

immediate valley is somewhat gorgelike in many places, the river has built up several square miles of flood plain. The larger of the tributaries joining the river from the east, namely, Anthony and Howard Creeks, also have appreciable areas of alluvium along their courses, owing to local base-leveling.

The mountain masses of the Appalachian Plateaus are, in general, rather rounded, and they range in altitude from 3,000 feet above sea level in the southern part to 4,000 feet or more in the northwestern part of the county. The valleys are very narrow and afford little farming land. The slopes are steep and precipitous in places, rising from 1,000 to 2,000 feet to the smoother plateau remnants. Tribu-

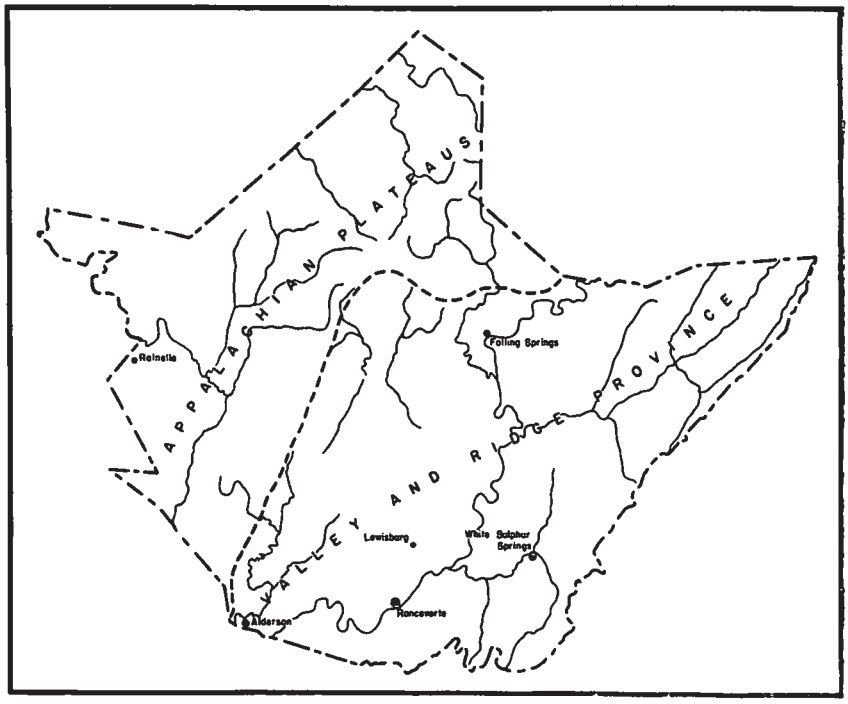

FIGURE 2.—Physiographic provinces and principal streams of Greenbrier County, W. Va.

taries of the Cherry River drain the northern part of the county. Big Clear Creek, Little Clear Creek, and other tributaries of the Meadow River drain the northwestern part. The type of drainage in this section may be called dendritic; the streams have no apparent structural guidance (see fig. 2). The southwestern part is drained by the Meadow River and its tributaries. Here there is a peculiar condition. A basin has formed near the headwaters of the river, and many square miles of flood plain have been laid down. Farther down its course, however, the Meadow River passes through a canyon-like valley.

Greenbrier County is in the great Ohio River watershed. There are three distinct drainage areas, as may be seen in figure 2. The

eastern part is drained by the Greenbrier River and its tributaries, the western part by the Meadow River and its tributaries, and the northern part by tributaries of the Cherry River. The Meadow and Cherry Rivers flow into the Gauley River outside the county. The Greenbrier River rises in northern Pocahontas County and flows southward through Greenbrier County into the New River outside of the county. The New and Gauley Rivers join to form the Kanawha River, which finds its way into the Ohio.

The elevation in Greenbrier County ranges from 1,520 feet to 4,372 feet above sea level. The lowest point, 1,520 feet (*13*)[2], is at Alderson, the point at which the Greenbrier River enters Monroe County. The highest elevations are in the rugged mountains of the north-central part. The altitude of some of the main topographic features, as taken from the United States Geological Survey sheets, are as follows: Grassy Knob, 4,372 feet; Cold Knob, 4,345 feet; Job Knob, 4,338 feet; Sugartree Bench, 4,276 feet; and Mikes Knob, in the extreme northern part, 4,243 feet. The highest elevation east of the Greenbrier River is 3,600 feet at a point in the extreme northeastern part. The limestone valley ranges in elevation from about 1,550 feet at Alderson to about 2,500 feet near Renick.

The altitudes of some of the principal towns, as obtained from the United States Geological Survey sheets, are as follows: Lewisburg, 2,084 feet; White Sulphur Springs, 1,879 feet; Ronceverte, 1,665 feet; Rainelle, 2,425 feet; and Rupert, 2,436 feet.

At one time a dense stand of hardwoods and conifers covered most of the county. The distribution of the trees comprising these two main groups depends on the character of the soils and the climate at various elevations. Hardwoods grow on the more productive and less acid soils, whereas conifers grow on the more acid soils and in general at higher elevations. As the elevation increases, the climate changes somewhat. Temperatures at the higher elevations average about 10° lower throughout the year, and rainfall is considerably heavier than in the valley. The most vigorous trees and the best species grow on the north and east exposures. This probably is due largely to the greater supply of moisture.

Originally, considerable spruce and hemlock, together with larger numbers of beech, birch, red maple, sugar maple, and black cherry or wild cherry (*Prunus serotina*), grew on the soils of the high plateaus in the northwestern part of the county. After the timber was cut, the hardwoods apparently were the first to reestablish themselves, practically to the exclusion of the conifers. Other trees growing at this elevation are hawthorn, staghorn sumac, downy shadblow or shadbush (*Amelanchier canadensis*), and mountain-ash. On the mountain slopes and flat ridge tops at somewhat lower elevations, black oak and northern red oak are the dominant trees, together with scrub oak, red maple, and dogwood. A further decrease in elevation brings into prominence hickory, tuliptree or yellow poplar, chestnut oak, pin oak, and some hophornbeam or ironwood. On the shallow or droughty soils, scarlet oak, pin oak, and scrub pine are abundant, together with some pitch pine. On the lower mountain slopes grow white oak, beech, birch, buckeye, American linden or basswood, witch-

[2] Italic numbers in parentheses refer to Literature Cited, p. 84.

hazel, some butternut or white walnut, and sassafras. Black walnut, shagbark hickory, pignut hickory, white oak, common locust or black locust, sugar maple, as well as some redcedar and tuliptree grow on soils underlain by limestone. In the narrow valleys of the eastern part of the county, stands of white pine and some hemlock are abundant. Only a few hundred feet up the mountain slope, as less moisture becomes available, the tree growth changes from white pine and hemlock to scrub pine, pitch pine, scarlet oak, and pin oak. Originally nearly pure stands of white pine grew on soils derived from sandstone and shale on the west side of the Greenbrier River. After the timber was cut, white oak and northern red oak, dogwood, and pitch pine came in. The cucumbertree grows in the narrow mountain valleys of the northern part of the county. Of the trees mentioned, the following occur at all except the highest elevations: Shagbark hickory, pignut hickory, pin oak, white oak, chestnut oak, tuliptree, dogwood, sassafras, witch-hazel, and thornbush. Areas bordering streams support a growth of river birch, American hornbeam or blue beech, sycamore, buckeye, black willow, and, to a small extent, silver maple and mountain magnolia or ear-leaved umbrella-tree.

Very few stands of virgin timber remain, and these are being removed rapidly. They are in the extreme northwestern part of the county, northwest of Williamsburg near Nunly and Old Field Mountains, and along North Fork Anthony Creek.

Some of the more common vines and shrubs that grow throughout the county are wintergreen or mountain teaberry, pasture rose, elder, grape, American or climbing bittersweet, shining or dwarf sumac, poison-oak, and greenbrier. Hazelnut, hazel or smooth alder, swamp azalea or white swamp honeysuckle, and silky dogwood or silky cornel grow in low or damp places. Dewberry, strawberry, huckleberry, black raspberry, and blackberry thrive on acid soils, most of which are sandy. Rhododendron, mountain-laurel, and azalea grow in the mountains and on rough stony areas in very acid soil. Hobblebush is common at high elevations.

Greenbrier County was established from parts of Montgomery and Botetourt Counties by an act of the Virginia General Assembly passed on January 12, 1778. The history of this county dates back to 1749, when Steven Sewell with Jacob Marlin came into "the Greenbrier Country" and settled in what is now Pocahontas County (*4*). It is related that Jacob Marlin was the first white man to enter the area that is now Greenbrier County.[3] Between 1758 and 1761 about 100 people settled on Muddy Creek and on the Big Levels, or Great Savanna, the site of Lewisburg. The Indians wiped out this settlement in the autumn of 1763. For 5 years the county was depopulated until peace was concluded with the Indians in 1765. The first permanent settlement was made by Col. John Lewis in 1768 on the present site of Lewisburg, then known as Lewis Springs. In 1774 Fort Union was built here, which name was later changed to Fort Savanna. In the same year the Indians again broke out in warfare and were finally subdued by Col. Andrew Lewis and his volunteer militia of 1,500 men, which was organized at Fort Union.

[3] From a memorandum by John Stuart, 1798. (Unpublished manuscript on file in the county clerk's office, Lewisburg.)

The 1930 census reports a population of 35,878, an average density of about 35.9 persons per square mile. This is an increase over the population reported in 1920, when it was 26,242. The population has increased steadily since 1880. In early years this trend probably was due to the growth of the lumber industry and settlement of farms; since 1920 it can be attributed mainly to the expansion of coal mining in the western part of the county.

The earliest settlers were principally Scotch-Irish. They established homes in the vicinity of Lewisburg. A few Germans settled throughout the limestone valley. Probably in the late nineteenth century Germans took up residence on Butlers Mountain. Several persons of Irish descent are in Raders Valley. The present population consists mainly of the descendants of these early settlers and some people who have been attracted to the county by the lumber and coal industries.

Lewisburg has been the county seat since 1778. It is the third oldest town in West Virginia. It takes its name from the Lewis family, who had large holdings in the Greenbrier Country grant. The population, according to the 1930 census, was 1,293, although it has increased considerably since. The town is situated in the midst of a rich farming, dairying, and cattle-raising section. It is the trading center for the rural inhabitants of a large part of the limestone valley. A creamery and a flour mill are located here.

White Sulphur Springs, in the southeastern part of the county, had a population of 1,484 in 1930. This town is in a valley surrounded by mountains. It is served by the main line of the Chesapeake & Ohio Railway. A Federal fish hatchery is located here.

Ronceverte, the largest town, had 2,254 inhabitants in 1930. The main line of the Chesapeake & Ohio Railway also serves this town, whose beginnings were due to the lumber industry, which began to boom with the construction of a railroad in 1872. At that time the largest mill in the State was located at Ronceverte. It continued to operate until 1908 (*5*). At present this town has a small sawmill, a creamery and storage plant, a roller flour mill, and a steam-generated electric power plant with branch lines extending to many parts of the county. Ronceverte also is an important livestock auction market, through which many of the cattle and sheep raised in the county reach eastern markets.

Alderson is in the extreme southwest on the Greenbrier River. The 1930 census reported 1,458 inhabitants, of whom 930 live in Greenbrier County and 528 in Monroe County. It is on the main line of the Chesapeake & Ohio Railway in the midst of an important cattle-raising section. Alderson, like Ronceverte, has a livestock auction market, and many beef cattle and sheep are shipped from here.

Renick is in the northern end of the limestone valley on the Greenbrier Division of the Chesapeake & Ohio Railway. This, as well as other local stations along the branch line, load some of the livestock that is shipped out. Rupert is an important town in the heart of the coal-mining and lumbering districts.

Other strictly farming communities not served by railroads are Williamsburg, Frankford, and Dawson. Almost all of the towns mentioned have some kind of flour mill.

The settlement and economic prosperity of Greenbrier County is intimately associated with the construction of railroads, which provided a means of marketing the early products, principally lumber. As early as 1869 White Sulphur Springs, famous as a health and vacation resort, was served by a railroad. The main line of the Chesapeake & Ohio Railway enters the eastern part of the county from Virginia and crosses the southern part in a southwesterly direction, following the Greenbrier River much of the way. A branch line, the Greenbrier Division, from the main line at Whitcomb, follows the Greenbrier River northward to Winterburn in Pocahontas County. At Durbin in Pocahontas County it connects with the Western Maryland Railway. The western part is served by a branch line owned jointly by the Chesapeake & Ohio Railway and the New York Central Railroad. This line began as a lumber railroad; now its principal traffic is coal and lumber. Its present roadbed within this county extends from Rainelle to Rupert with an extension along Big Clear Creek, serving the mines along Brown Creek and the mining towns, Anjean, Duo, and Clearco. An extension follows the Meadow River and Meadow Creek out of Rainelle to the mining communities of the extreme western part, namely, Bellburn, Leslie, Crichton, Quinwood, and Marfrance.

Motorbusses serve practically all the towns on the main roads. A commercial airport is located at White Sulphur Springs. Road building has progressed rapidly since the establishment of the State Road Commission in 1921. At present the county has about 127 miles of primary roads including two Federal highways. These highways, as well as a few State roads, such as the one from Alta to Alderson are hard-surfaced. There are more than 700 miles of secondary State roads. Some districts are still difficultly accessible, owing to inadequate roads. These districts are in the northern part of the county along the North Fork Cherry and South Fork Cherry Rivers, along North Fork Anthony Creek, and along Meadow Creek west of Allegheny Mountain. Some of these sections have been made a part of the Monongahela National Forest. Most of the secondary roads are kept in repair and passable the year around. In certain districts, however, particularly in the southwestern part of the county, some of the clay-surfaced roads become practically impassable to motor vehicles in early spring and during extremely wet periods.

Telephone and electric-light service are supplied only to the larger towns. Schools and churches are available to all rural communities. The school system is now under State supervision. Practically all of the larger towns have or are located near a 4-year high school. Students from rural sections are brought to these schools by bus or railroad. Lewisburg has long been known as an educational center. It has a women's junior college and an accredited military academy. The annual Greenbrier Valley fair is held here.

A number of summer camps, both for boys and for girls, have been established on the Greenbrier River.

From early times the mineral springs have attracted thousands of people and have become centers of social life; for instance, White Sulphur Springs, which is one of the best-known resorts in the East. Blue Sulphur Springs, in the southwestern part of the county, has been known for a long time and formerly attracted many health seekers.

Lumbering led all industries until about 1920, when coal mining surpassed it. Greenbrier County is generously endowed with all kinds of hardwoods. In the early days of settlement numerous mills were set up near large streams and railroads. Railroad sidings were built into the hollows, in order to get the timber from distant points. Timber was shipped by rail or floated downstream to these mills, where it was processed. Mention has already been made that Ronceverte as early as 1872 had the largest mill in the State. Another large mill was located at Spring Creek. Today there are several small or portable mills throughout the county. After the construction of the Sewell Valley Railroad in 1908, Rainelle became the most important lumber center. Its mills began operation after most of the other mills had exhausted their timber reserves. Possibly the world's largest hardwood manufacturing plant is in this town. Rough estimates place the uncut timber reserves of the major lumber company at about 35,000 acres. The annual rate of cutting is between 2,000 and 3,000 acres.

A considerable industry has developed for the utilization of the large quantity of limestone in the county. Numerous limekilns operate, many of which burn lime in quantities to sell to nearby farmers. The largest limestone quarries are at Renick, Lewisburg, Fort Spring, and Frazier. Their output is used primarily as railroad ballast and road-building material and secondarily as agricultural lime.

By far the most important industry at present is coal mining, which centers in the northwestern part of the county. Important mining communities are Charmco, Bellburn, Leslie, Quinwood, Marfrance, Anjean, Duo, and Clearco. In 1930 over 2 million tons of coal was produced, with a value of over 3 million dollars (*13*).

Although coal mining began about 1907, the county did not become an important coal-producing area until 1922, when several new mines were opened. The county ranked twenty-first in the State and jumped to fourteenth in 1936. Quoting from the Greenbrier County geological report of the West Virginia Geological Survey (*13, p. 363*):

> there appear to be 6 coals that have minable thickness and 24 others that are too thin, impure, or irregular to be of more than local value, * * *. In general, these coals are semibituminous, those northeast of Beech Ridge being on the dividing line in chemical composition between semibituminous and bituminous and those in the southwest part of the county approach the semianthracite classification.

In 1939 the summary of available coal reserves, according to the West Virginia Geological Survey, was 1,220,000,000 tons. For a comprehensive treatment of this subject the reader is referred to the geological survey previously cited.

CLIMATE

The climate of Greenbrier County is continental. The winters are not too severe and the summers not too warm. Hot spells are infrequent and last only for a short time. The nights during summer, even in the hottest weather, are cool. The delightful summer climate attracts many tourists and vacationists. Zero or lower temperatures prevail for only short periods during winter. The difference between the winter minimum and the summer maximum temperatures is considerable.

The mean annual rainfall at White Sulphur Springs is 38.80 inches, and it is well distributed throughout the year. The heaviest rainfall is in spring and summer, when it is needed by growing crops and pastures. Nevertheless, many pastures show a marked decrease in growth during the latter part of July and the early part of August. This is probably due to the generally high temperatures that prevail during this time. The rainfall given here is representative of the valley section. In the high mountainous section it is most abundant. Snow has fallen as early as October and as late as May. The average annual snowfall at White Sulphur Springs is 30.9 inches.

The driest year on record was 1930, the year of the great drought. Lack of rain reduced crop yields exceedingly and gave pastures a serious setback. During that year only 15.88 inches of rain fell, and the summer and fall were particularly dry.

Climatic data for the United States Weather Bureau station at White Sulphur Springs are given in table 1.

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at White Sulphur Springs, Greenbrier County, W. Va.*

[Elevation, 1,914 feet]

Month	Temperature			Precipitation			
	Mean	Absolute maximum	Absolute minimum	Mean	Total amount for the driest year (1930)	Total amount for the wettest year (1935)	Snow, average depth
	°F.	°F.	°F.	*Inches*	*Inches*	*Inches*	*Inches*
December	33.1	74	−34	3.10	1.45	2.79	6.4
January	32.1	70	−19	3.33	1.37	5.02	10.6
February	35.5	78	−6	2.63	1.55	2.10	6.3
Winter	33.6	78	−34	9.06	4.37	9.91	23.3
March	42.6	89	4	3.57	1.20	8.25	3.2
April	51.4	96	12	3.28	1.70	3.45	3.1
May	60.5	94	21	3.47	2.25	3.95	.1
Spring	51.5	96	4	10.32	5.15	15.65	6.4
June	68.0	98	35	3.98	.90	4.45	.0
July	71.6	101	42	3.92	1.30	8.40	.0
August	70.3	100	38	3.59	1.20	3.25	.0
Summer	70.0	101	35	11.49	3.40	16.10	.0
September	64.9	97	27	2.84	.45	4.20	.0
October	52.4	88	10	2.81	.80	1.25	.6
November	42.1	82	−1	2.28	1.71	4.50	.6
Fall	53.1	97	−1	7.93	2.96	9.95	1.2
Year	52.0	101	−34	38.80	15.88	51.61	30.9

The average date of the latest killing frost is May 12 and the earliest is October 8, giving White Sulphur Springs and vicinity a frost-free period of 149 days. The frost-free period is considerably shorter in the high mountain sections of the northern part of the county. White Sulphur Springs is situated 9 miles east of Lewisburg in a valley surrounded by high mountains. It can be seen that the average date of the earliest and latest killing frosts at Lewisburg, which is probably representative of the limestone valley section, tends to be earlier than at White Sulphur Springs. The average frost-free period for these two districts over this 6-year period, however, is about

the same. In the limestone valley, with its slight differences in elevation, cold air often settles in pockets during the night and causes frost, whereas the adjoining slightly higher areas may be free from frost.

Table 2 shows the variation in dates of the earliest and latest frosts between Lewisburg and White Sulphur Springs from 1931 to 1938, inclusive.

TABLE 2.—*Data from the United States Weather Bureau stations on killing frosts at Lewisburg and White Sulphur Springs, W. Va.*

Year	Lewisburg (Elevation, 2,250 feet)		White Sulphur Springs (Elevation 1,914 feet)	
	Last in spring	First in fall	Last in spring	First in fall
1931		Sept. 30	May 9	Oct. 17
1932	May 3	Sept. 25	May 29	Oct. 6
1933	Apr. 27	Oct. 26	Apr. 28	Oct. 19
1934	Apr. 27	Oct. 13	Apr. 28	Oct. 14
1935			Apr 17	Sept. 30
1936		Oct. 28	May 14	Oct. 28
1937	Apr. 17	Oct. 15	May 20	Oct. 8
1938	Apr. 11	Oct 8	May 13	Oct 8
Average	Apr. 23	Oct. 12	May 8	Oct. 12

The direction of the prevailing winds is westerly. The winds are stronger at the highest elevations. The Greenbrier Valley is practically free of dust. Hailstorms are uncommon.

AGRICULTURAL HISTORY AND STATISTICS

The first settlements in Greenbrier County were on Muddy Creek and in the vicinity of Lewisburg in the limestone valley about 1760. The first permanent settlement was made in 1768 where Lewisburg now stands. The first acre of corn was planted in 1768 near the site of Frankford.

The early settlers were pioneers and hunters who produced such crops as were needed for home use. Cattle raising began early in the agricultural development of the county and has continued to be the chief source of farm income. In early times tobacco was a fairly important crop, but it became practically negligible after 1900.

Following the construction of a railroad, lumbering became an important industry and source of income. The limestone valley and areas adjoining the Greenbrier River were the first to be cut over. Lumbering did not begin in the western part of the county until after the turn of the century. As lumber operations ceased in the eastern part, several lumber towns, particularly Neola, were abandoned. Much of this section is now a part of the Monongahela National Forest. Some of the remaining subsistence farmers derive a small cash income from the sale of pulpwood cut under permit on Government holdings.

Even in cut-over areas forests continue to be valuable to the individual farmers. In 1929 the value of all forest products, which include sawlogs, firewood, pulpwood, fence posts, railroad ties, poles, and piling, cut on farms for home use or sale amounted to $171,893.

As timber was removed from the land settlements grew up throughout the county. In general, very little change in the use of the land has taken place. The limestone valley always has been a livestock-producing section, probably because much of the land is best adapted to grazing. Economic considerations and the yields obtained govern to a large extent the crops grown.

The present-day agriculture consists principally of producing hay, corn, wheat, oats, and barley, raising cattle and sheep, and fattening beef cattle and sheep for market. Table 3 gives the value of the different classes of agricultural products and livestock in 1929, as reported by the Federal census.

TABLE 3.—*Value of agricultural products by classes in Greenbrier County, W. Va., 1929*

Crop	Value	Livestock products	Value
Cereals	$678,846	Dairy products sold	$253,037
Other grains and seeds	1,318	Poultry and eggs produced	482,357
Hay and forage	503,879	Wool and mohair shorn	50,763
Vegetables (including potatoes and sweet-potatoes)	108,881	Honey produced	4,099
Fruits and nuts	162,629	Total	790,256
All other field crops	2,766		
Farm garden vegetables for home use	195,193	Total agricultural products	2,615,661
Forest products cut on farms	171,893		
Total	1,825,405		

Table 4 gives the acreages of the principal crops from 1879 to 1934, as reported by the Federal census.

TABLE 4.—*Acreages of the principal crops in Greenbrier County, W. Va., in stated years*

Crop	1879	1889	1899	1909	1919	1929	1934
Corn:	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*
For all purposes					20,337	13,666	15,993
For grain	11,658	13,413	17,309	17,607	15,679	12,307	14,939
For other purposes					[1] 4,658	1,359	1,054
Wheat, threshed	7,786	7,646	12,899	7,515	14,208	6,102	8,325
Oats							
Threshed	6,382	8,688	2,234	2,897	4,381	3,841	1,907
Cut and fed unthreshed						1,170	1,488
Soybeans						219	464
Barley, threshed					8	30	434
Rye, threshed	331	396		234	91	40	39
Buckwheat	696	259		1,224	612	587	
Potatoes		376	579	777	617	748	932
All hay	13,549	19,801	22,710	24,263	24,498	25,552	22,663
Timothy and clover				21,998	21,213	23,298	17,717
Other tame hay				1,452	1,720	1,126	4,946
Wild hay				813	1,565	1,128	([2])
	Trees	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*	*Trees*
Apples [3]		48,677	110,527	97,176	97,562	101,437	75,246
Peaches [3]		6,558	17,632	14,184	48,404	22,156	18,971
Pears [3]		790	3,355	3,786	2,960	3,086	3,218
Cherries [3]		6,189	13,991	12,811	8,510	10,941	10,204

[1] For forage only.
[2] Included with other tame hay.
[3] Numbers of trees are for the years 1890, 1900, 1930, and 1935, respectively.

The leading crops, according to the 1935 census, arranged in the order of acreage, are hay, corn, wheat, oats, potatoes, and barley.

Wheat is the principal cash crop, whereas the other crops are fed to cattle, horses, sheep, and hogs. Potatoes are grown chiefly for home consumption.

Corn usually is planted on land that has been devoted to hay, pasture, buckwheat, or oats. It generally is drilled in with single-row planters, and fertilizer is applied at the time of planting. The crop is cut chiefly by hand, although a few farmers use binders. It is then shocked in rows to allow disking for wheat. A part of the crop is used for silage.

Wheat is sown with a drill, and the fertilizer is applied at the time of planting. Timothy is sown with wheat, but clover is not seeded until the following spring. Wheat is harvested with a binder, except in isolated sections where small fields of grain are cut by a cradle. If a good stand of timothy and clover is obtained after wheat, the field in some districts is kept in grass for 2 or 3 years, or until the yields decline. Where alfalfa is used in the rotation, the field is allowed to remain at least 3 years, or until the stands have become thin.

As wheat often freezes on the mountaintops, it is not grown so extensively as in the limestone valley, and buckwheat and oats take the place of wheat in the rotation. Buckwheat usually is planted in late June or early July and is followed by oats the following spring. Buckwheat is cut chiefly by hand, whereas oats for grain are harvested with a binder. Some of the oat crop is cut green and fed for hay, particularly in districts that are inaccessible to threshers. Rye is recommended as a cover crop when wheat or barley is not sown early enough in the season. Not much rye, however, is grown.

Hay occupies a larger total acreage than any other crop. This acreage increased steadily from 1879 until 1929, then decreased about 3,000 acres in 1934. Timothy and clover are the principal hay crops. It is significant to note the growing importance of alfalfa. In 1934 the total acreage was 396 acres, whereas in 1909 it was only 9 acres. Soybeans have become an important hay crop in the eastern part of the county. They are grown chiefly on soils developed from sandstone and shale or alluvial materials.

Since 1879 the total acreage in corn has increased, although it is not so large now as it was a decade or so ago, whereas the acreage in wheat has not changed much. In the last 25 years more corn is being used for silage, owing to the increasing demand for it in feeding rations. The acreage in oats and rye has diminished sharply. Oats are grown principally in the mountainous districts on soils developed from sandstone and shale. A significant production of barley was reported for the first time in the last census (1935) and this may become an important feed crop. The largest gain in the production of barley has been made in the limestone valley, mostly at the expense of the production of wheat. Buckwheat is grown in a small way, principally on the soils formed from sandstone and shale. It is a good crop for late planting. Most of the crop is fed on the farms.

Nearly all farms have small apple orchards that yield enough apples for home use. In addition, some farm orchards contain a few peach, pear, and cherry trees. The small individual orchards receive

no applications of fertilizer and little care. There is but one commercial orchard in the county. The total value of the fruit and nut crop in 1929 was $162,629.

Table 5 gives the number and value of livestock at intervals from 1880 to 1935.

TABLE 5.—*Number and value of livestock on farms in Greenbrier County, W. Va., in stated years*

Livestock	1880 [1]	1890 [1]	1900 [1]	1910		1920		1930		1935 [1]
	Number	*Number*	*Number*	*Number*	*Value*	*Number*	*Value*	*Number*	*Value*	*Number*
Cattle	18,236	15,919	22,138	22,420	$635,567	23,726	$1,403,575	22,195	$1,205,597	24,593
Horses	4,438	3,541	4,775	5,407	575,101	5,382	636,635	3,729	335,670	3,459
Mules	110	176	303	295	36,555	264	30,548	219	19,588	221
Sheep	14,839	25,213	35,164	43,641	149,592	21,883	229,107	51,396	405,282	31,852
Hogs	10,615	12,592	12,290	10,108	55,276	10,368	110,415	7,455	78,432	6,581
Chickens	90,970	[2] 35,435	72,873	[2] 94,753	[2] 40,557	[2] 121,786	[2] 126,519	117,073	101,854	132,549

[1] Value not reported. [2] All poultry.

In 1935 Greenbrier County led all other counties in West Virginia in the number of cattle. There were 24,593 head on January 1, 1935, an increase over the number reported in 1930. Almost two-thirds are beef cattle, and raising beef cattle is the principal agricultural pursuit. Grades of Hereford, Shorthorn, and Aberdeen-Angus are the chief beef breeds. Several of the cattle breeders maintain purebred herds. Owing to the extensive area of land suitable only for grazing and the limited area adapted to the production of grain, cattle are sold almost wholly as grass-fattened animals. This fact attests to the high value of pastures, many of which support fair to good stands of Kentucky bluegrass. Cattle are fed in winter only sufficiently to prevent loss of weight. Steers are commonly kept on dry feed consisting of hay, corn stover, and wheat straw, and very often this ration causes them to lose weight. In recent years many farmers have supplemented the dry feed with corn silage and some protein concentrates, such as cottonseed meal. This allows the steers to gain some weight during winter and to gain greater weight on grass the following summer. Most of the cattle are kept until they are 2 to 3 years old and are marketed off the grass in the fall. Cattle are sold through dealers or auction markets; all go to eastern markets.

Of the cattle reported by the 1935 census, 9,814 were cows. Dairy herds are mixed Holstein-Friesian, Jersey, Guernsey, and Aberdeen-Angus, together with some crosses of these and the dual-purpose and beef breeds. Several purebred herds, however, are kept for breeding purposes. Dairying is becoming of increasing importance in the limestone valley. Elsewhere farmers generally keep only a few cows to produce milk and butter for home use. In 1929 the value of dairy products sold was $253,037, most of which represents the value of milk and butterfat. Most of the milk is marketed through the creameries at Lewisburg or Ronceverte. Much of it is shipped to the coal-mining towns of the State. The total production of milk rose slightly from 2,503,479 gallons in 1929 to 2,685,068 gallons in 1934.

Sheep have been kept since the early days of settlement. The number of sheep and lambs rose to 51,396 in 1930 and decreased to 31,852 in 1935. The value of sheep represents about one-fifth of the total value of all domestic animals, and proceeds from the sale of lambs and

wool form an important part of the income of most farms. Most of the sheep are Southdowns, Shropshires, Hampshires, Dorsets, or Cheviots, which are considered dual-purpose breeds. Increasing demand for mutton, comparative ease of raising sheep, and increasing protection from dogs are factors in the expansion of sheep raising. Most of the sheep are allowed the run of the pastures during winter and are fed on roughage with little or no grain, except on the coldest days. Lambs are sold through a lamb pool, auction markets, or direct to packers. The lamb pool grades the stock before shipping. According to the county agent, about one-third of the county's supply of wool was pooled in 1936 and 1937, and the rest was sold by dealers directly to mills.

A few hogs are kept on nearly all farms to supply home needs. According to the 1930 census there were 7,455 hogs and pigs on the farms in 1929. In 1935 the number decreased to 6,581.

Most of the work animals are horses. In 1935 this county led all others in the State with 3,459 horses and colts. The number reported in 1930 was 3,723. In the better farming districts from 2 to 4 horses to a farm are common. Mules on farms numbered 221 in 1935.

Poultry is kept on nearly every farm for home use and to supply local markets. Some chickens, eggs, and turkeys are sold to nearby markets outside the county. In 1929, the 157,220 chickens raised and 958 229 dozens of eggs produced were valued at $482,357. In 1934, 160.904 chickens were raised and 766,976 dozens of eggs were produced.

The importance of livestock and livestock products as a source of farm income is apparent in the following tabulation of farm products sold, traded, or used by operator's family in Greenbrier County in 1929.

Crops[1] sold or traded	$163,712
Livestock sold or traded	983,525
Livestock products sold or traded	582,862
Forest products sold	129,963
Farm products used by operator's family	896,326
Total	2,756,388

[1] Including plants and flowers.

Lime has been applied to the land for the last two decades, chiefly in the limestone valley. Farmers in other sections farther removed from sources of lime find that the cost of transportation and condition of roads, as well as economic considerations, limit the practice of liming. Although the limestone valley is close to sources of lime, about 75 percent of the land is still deficient in lime. Most farmers recognize the necessity of lime for growing clover and alfalfa. Either burned or finely ground lime is obtained within the county from nearby sources. Burned lime is more popular because it reacts more rapidly with the soil. Because many farmers have high-grade limerock on their farms and can buy coal cheaply, they burn much of their lime in home-made kilns and thus obtain a more economical product than they can buy from commercial producers. From 1 to 1½ tons of burned lime or 2 to 3 tons of ground limestone is applied per acre. Heretofore pastures have received no lime.

According to the 1930 census, 69 percent of the farms reported the use of fertilizer in 1929 at a total cost of $61,958, or an average of $40.05 per farm reporting. Of the farms reporting in 1920, 75.9 per-

cent used fertilizer at an average cost of $46.75 per farm. Complete fertilizer is most commonly used on cultivated crops. On pastures and leguminous crops 20-percent superphosphate is used. Very little 16-percent superphosphate is used because it is more economical to buy 20-percent. Some farmers use 20-percent superphosphate on cultivated crops. The trend since 1930 has been toward the use of more concentrated fertilizers. Most crops receive an application of fertilizer ranging from 100 to 300 pounds per acre. The most common application is 200 pounds. The fertilizers commonly used for corn are 3–12–6,[4] 2–12–4, or 4–16–4. For wheat and other small grains 2–12–4, 2–14–4, and 20-percent superphosphate are most commonly used. Some use the same fertilizer on wheat as on corn. Potatoes on light-textured soils commonly receive from 100 to 500 pounds of 4–8–10, 2–12–8, or 4–12–10 complete fertilizer. A few farmers apply the recommended quantities of 1,500 to 2,000 pounds per acre. In spring wheat is top-dressed with manure, wherever available. Alfalfa receives 300 to 500 pounds of 20-percent superphosphate when seeded. Generally three cuttings of alfalfa are made each year. Soybeans receive 250 pounds of 0–14–6 or 150 pounds of 20-percent superphosphate.

The better farms are equipped with modern machinery. A representative outfit includes a grain drill, grain binder, mower, tedder, breaking plows, cultivators, disk harrows, drag harrows, land roller, corn planter, wagons, and manure spreader. Some of the larger farms have a tractor, a corn binder, a corn husker and shredder, hay loaders, and silage cutters. Threshing machines and hay balers are driven from place to place in the county or surrounding areas to thresh the grain and bale hay and straw. On nearly all farms where large numbers of cattle are fed and fattened, silos, sheds, or feeding barns are a part of the lot equipment. Silo fillers, corn huskers, and silage cutters are sometimes owned and operated by individuals or cooperatively by a small group of farmers. All farms are fenced, mainly with woven wire or barbed wire. On some mountain farms or pastures wooden rail fences are still in use. The pasture land is fenced and separated from crop fields.

The number of farms reporting the hire of labor in 1929 was 929, or 41 percent of all farms, and the amount expended was $168,953, an average of $181.87 for each farm reporting. Most of the farm laborers are white. Some of the labor is hired only as seasonal demand requires. The wages vary with the type of work. Most of the laborers on grazing farms are hired for the year and paid a monthly salary ranging from $30 to $50. Tenants hired on this basis generally are furnished a house and sufficient land to grow a supply of crops for their own use. Cows, chickens, and hogs are kept to supply the home with meat.

Farms range in size from a few to over 1,000 acres. According to the 1935 census, 18.5 percent of the farms included less than 20 acres, 60.6 percent ranged in size from 20 to 139 acres, and 16.1 percent from 140 to 379 acres. Of the remaining 4.8 percent, 15 farms included 1,000 acres or more. In the nonagricultural mountainous areas a few holdings cover thousands of acres. In the northern mountainous part, most of the land is owned by a few coal companies and lumber concerns. Much of the roughest land is now in Federal holdings.

[4] Percentages, respectively, of nitrogen, phosphoric acid, and potash.

According to the 1935 census, 50.0 percent of the county was in farms with an average size of 108.6 acres per farm. The improved land, which includes cropland and plowable pasture, constituted 28.9 percent of the farms, or an average of 31.4 acres. The nonwoodland pasture constituted 42.7 percent of the individual farm, or 46.4 acres.

The area in farms decreased from 76.1 percent of the county in 1880 to 59.6 percent in 1890 and reached a low of 45.8 percent in 1930. It increased slightly to 50 percent in 1935. The total number of farms was 1,506 in 1880, 1,872 in 1890, 2,242 in 1930, and 2,942 in 1935; their average size for these years was 323 acres, 203 acres, 130.6 acres, and 108.6 acres, respectively. From these figures it may be seen that the number of farms has increased steadily, chiefly by division of established farms. The improved land diminished from 129,111 acres in 1880 to 92,228 acres in 1935.

According to census data, most of the farms are operated by owners. Tenure of farms has not changed greatly from 1880, when owners operated 88.2 percent of the farms and tenants 11.8 percent, to 1930, when owners operated 88.1 percent, tenants 10 percent, and managers 1.9 percent. Tenancy did increase, however, between 1930 and 1935, when the proportion was 13.7 percent. The proportion of owner-operated farms accordingly fell to 85.4 percent and that of manager-operated farms to 0.9 percent in 1935. As a result of economic conditions in the last decade, some holdings were consolidated in the limestone valley with a resultant increase in the number of tenant operators.

In the limestone valley tenancy is uncommon. Most of the tenants are paid an annual wage to carry on the feeding of livestock and are also provided with a house and sufficient land to produce food for their own use. A few rent on a 50–50 basis. When the tenant furnishes all the equipment, horsepower, and labor, plus one-half the seed and fertilizer, he receives one-half of the total crop. When the landlord furnishes everything but the labor, the tenant receives one-third of the crop. This system of rental applies throughout the county.

According to the 1930 census, land represented 54.5 percent of the total value of farm property, buildings 27.2 percent, implements 4 percent, and domestic animals 14.3 percent. The average acre value of land and buildings on each farm was $41.96 in 1930 and $27.38 in 1935. The average value of land and buildings per farm in 1930 was $5,479 and $2,974 in 1935. The houses on the better farming lands are well built and modern. Most of them are of substantial wood construction, although many are of brick, particularly the oldest homes. These farms are all well kept. In the more remote mountain sections the houses are smaller and less well kept. The houses in the mining towns in the western part are more or less typical of mining communities.

SOIL-SURVEY METHODS AND DEFINITIONS

Soil surveying consists of the examination, classification, and mapping of soils in the field.

The soils are examined systematically in many locations. Test pits are dug, borings are made, and exposures, such as those in road or railroad cuts, are studied. Each excavation exposes a series of distinct soil layers, or horizons, called collectively the soil profile. Each horizon of the soil, as well as the parent material beneath the

soil, is studied in detail; and the color, structure, porosity, consistence, texture, and content of organic matter, roots, gravel, and stone are noted. The reaction of the soil [5] and its content of lime and salts are determined by simple tests. Drainage, both internal and external, and other external features, such as relief, or lay of the land, are taken into consideration, and the interrelations of the soil and vegetation are studied.

The soils are classified according to their characteristics, both internal and external, special emphasis being given to those features influencing the adaptation of the land for the growing of crop plants, grasses, and trees. On the basis of these characteristics soils are grouped into classification units. The three principal ones are (1) series, (2) type, and (3) phase. In places two or more of these principal units may be in such intimate or mixed pattern that they cannot be clearly shown separately on a map but must be mapped as (4) a complex. Areas of land, such as coastal beach or bare rocky mountainsides, that have no true soil are called (5) miscellaneous land types.

The most important of these groups is the series, which includes soils having the same genetic horizons, similar in their important characteristics and arrangement in the soil profile and developed from a particular type of parent material. Thus, the series includes soils having essentially the same color, structure, and other important internal characteristics and the same natural drainage conditions and range in relief. The texture of the upper part of the soil, including that commonly plowed, may vary within a series. The soil series are given names of places or geographic features near which they were first found. Thus Frederick, Frankstown, Dekalb, Moshannon, and Pope are names of important soil series in this county.

Within a soil series are one or more soil types, defined according to the texture of the upper part of the soil. Thus, the class name of the soil texture, such as sand, loamy sand, sandy loam, loam, silt loam, clay loam, silty clay loam, and clay, is added to the series name to give the complete name of the soil type. For example, Pope fine sandy loam and Pope silt loam are soil types within the Pope series. Except for the texture of the surface soil these soil types have approximately the same internal and external characteristics. The soil type is the principal unit of mapping and because of its specific character is usually the soil unit to which agronomic data are definitely related.

A phase of the soil type is recognized for the separation of soils within a type that differ from the type in some minor soil characteristic that may, nevertheless, have an important practical significance. Differences in relief, stoniness, and the degree of accelerated erosion are frequently shown as phases. For example, within the normal range of relief for a certain soil type, some parts are adapted to the use of machinery and the growth of cultivated crops and other parts are not. Even though no important differences are evident in the soil itself or in its capability for the growth of native

[5] The reaction of the soil is its degree of acidity or alkalinity, expressed mathematically as the "pH value." A pH value of 7 indicates precise neutrality, higher values indicate alkalinity, and lower values indicate acidity.

235197—41——2

vegetation throughout the range in relief, important differences may exist in respect to the growth of cultivated plants. In such an instance the more sloping parts of the soil may be segregated on the map as a sloping or a hilly phase. Similarly, soils having differences in stoniness may be mapped as phases even though these differences are not reflected in the character of the soil or in growth of native plants.

The soil surveyor makes a map of the county or area, showing the location of each of the soil types, phases, complexes, and miscellaneous land types in relation to roads, houses, streams, lakes, section and township lines, and other local cultural and natural features of the landscape.

SOILS AND CROPS

As has been stated, the agriculture of this county centers on livestock raising, including the raising and fattening of sheep and beef cattle and dairying. The primary reason for the importance of livestock is the large proportionate area of land suited only to grazing. Only enough plowable land is available to produce winter feed for carrying livestock through to the next grazing period. Livestock raising is carried on chiefly in Greenbrier Valley, however, and to a smaller extent in the southwestern part of the county on soils derived from red calcareous shales. Pastures in the limestone valley, which consist dominantly of Kentucky bluegrass, have a high carrying capacity. The fact that cattle can be fattened on pasture and shipped direct to market makes cattle raising more profitable under normal economic conditions than any other branch of agriculture that could be followed.

The limestone valley not only is the center of livestock raising but also represents the most highly developed agricultural district and contains the most productive soils.

In the low mountainous areas or on the soils developed from sandstone and shale material, farming is conducted on a subsistence basis. Some cattle are raised where nearby pasturage can be obtained. In general each farmer keeps a few cows, pigs, and chickens and raises enough crops to winter this livestock and feed his family. Cash income is small and is derived from whatever produce is grown in excess of the family's needs. Many families in this section depend on public works or some part-time employment for a small cash income.

In the western part of the county the chief agricultural soils are those of the flood plains and terraces. Large areas of these are poorly drained and, in their present state, are consequently better adapted to pasture than to cultivation.

The large areas of soils in the mountains are both steep and stony and are chiefly forested. Lumbering once was the important occupation. Coal mining has developed recently in some of those same areas. Some families grow garden crops for home use on small comparatively smooth areas.

The soils of this county belong to that broad group known as the Gray-Brown Podzolic soils. They have formed under hardwood forest in a moist temperate climate. The average annual rainfall of Greenbrier County is about 39 inches, and the mean average tempera-

ture is 52° F. Under such conditions leaching by rain water saturated with carbon dioxide is active during the greater part of the year. This leaching impoverishes the soils by removing the plant nutrients and leaves them acid throughout. The temperate climate is conducive to active decomposition of forest leaves, thereby leaving only a thin layer of organic matter on the surface of virgin soils. The combined action of these processes has resulted in soil that is low in organic matter and characterized by comparatively light colored—light-gray, grayish-yellow, or grayish-brown—surface soils and heavier textured yellowish-brown, brown, or reddish-brown subsoils. This does not mean that all the soils of this county are alike in fertility, color, depth, drainage, and other characteristics. Differences in soils exist because of the character of the parent materials, the lay of the land, drainage, and age. These differences are recognized in the number of soil series, types, phases, and other units mapped.

The soils have been classified or grouped according to their physical suitability for crop growing, grazing, or forestry, as determined by such soil or land characteristics as slope, susceptibility to and degree of erosion, drainage, stoniness or freedom from stone, fertility, character of parent material, and vegetation—in other words, any soil feature that affects the productivity, workability, or durability of the land. The following classes are recognized: First-class soils, Second-class soils, Third-class soils, Fourth-class soils, and Fifth-class soils. The soils of the first three classes are considered suitable for growing crops if favorably situated and under average economic conditions; the Fourth-class soils are considered generally best adapted to pasture; and the Fifth-class soils are generally suitable only for forest.

In the following pages the soils of Greenbrier County are described in detail, and their agricultural relationships are discussed; their distribution is shown on the accompanying soil map; and table 6 gives their acreage and proportionate extent.

TABLE 6.—*Acreage and proportionate extent of the soils mapped in Greenbrier County, W. Va.*

Soil type	Acres	Per-cent	Soil type	Acres	Per-cent
Frederick silt loam	17,728	2.7	Upshur silt loam	20,928	3.2
Frankstown silt loam	5,248	.8	Belmont silt loam	1,856	.3
Frederick cherty silt loam	9,984	1.5	Westmoreland silt loam	31,424	4.8
Elk silt loam	1,728	.3	Dekalb silt loam	23,616	3.6
Moshannon silt loam	2,048	.3	Upshur-Dekalb (Meigs) gravelly silt loams	11,776	1.8
Pope fine sandy loam	6,272	1.0	Atkins silt loam	9,600	1.5
Pope silt loam	5,632	.8	Pope gravelly silt loam	4,096	.6
Sequatchie loam	1,920	.3	Berks shaly silt loam	7,552	1.2
Holston loam	2,880	.4	Dekalb shaly silt loam	40,192	6.1
Monongahela silt loam	3,072	.5	Dekalb stony silt loam	76,160	11.6
Pickaway silt loam	1,728	.3	Dekalb stony fine sandy loam	20,352	3.1
Frankstown silt loam, hilly phase	8,192	1.3	Dekalb stony loam	44,864	6.9
Upshur silt loam, smooth phase	3,328	.5	Jefferson stony silt loam	2,752	.4
Westmoreland silt loam, smooth phase	6,720	1.0	Upshur silt loam, eroded phase	1,344	.2
Philo silt loam	1,600	.2	Upshur stony silt loam	22,912	3.5
Clymer loam	22,336	3.4	Upshur-Dekalb (Meigs) stony loams	12,544	1.8
Clymer silt loam	7,360	1.1	Elliber stony loam	3,904	.6
Upshur-Clymer (Meigs) silt loams	10,816	1.7	Rough stony land (Frederick-Hagerstown soil materials)	3,008	.5
Dekalb gravelly loam	15,616	2.4	Rough stony land (Dekalb soil material)	127,424	19.5
Dekalb fine sandy loam	9,152	1.4			
Frederick stony silt loam	21,760	3.3			
Frederick-Hagerstown stony silt loams	19,968	3.1	Total	654,720	
Elliber cherty loam	3,328	.5			

FIRST-CLASS SOILS

The First-class soils are the best farming soils of Greenbrier County. They are Frederick silt loam, Frankstown silt loam, Frederick cherty silt loam, Elk silt loam, and Moshannon silt loam.

These soils are in the cattle-producing areas in the limestone valley and are used to produce the feed crops needed to winter the cattle. All the crops grown in the county can be produced on these soils, and the highest yields are obtained. Productivity and use capabilities vary among these soil types, depending on content of plant nutrients, soil reaction, physical condition of the soil, moisture relations, and other factors. Thus, Moshannon silt loam, a soil of the flood plains subject to periodic flooding, is better adapted to the growing of hay and corn than to the production of small grains.

The principal crops grown on these soils are hay, corn, wheat, and barley. At one time oats were important, but they now occupy only a small acreage. They have been replaced largely by other crops that produce greater yields and have higher feeding values. Hay consists largely of timothy and clover or clover alone. Because much hay is needed, alfalfa has been introduced in this section.

Rotation of crops is general on these soils. A 3-year rotation of corn, wheat, and hay is most common. A few farmers practice a 4-year rotation, allowing 2 years for hay. The introduction of alfalfa necessitates longer rotations. Fields are allowed to remain in alfalfa at least 3 years—longer, if the stand does not become thin.

The parent material of these soils is the residue left after the solution of limestone, or it is alluvium that has been washed from limestone uplands. The several soils of the group differ in profile and in color but are similar in texture of the surface soils, all of which are silt loams. For this reason these soils cannot be plowed so soon after a rain as sandy soils. The surface of the upland soils, which are members of the Frederick and Frankstown series, ranges from gently sloping to rolling. The Elk and Moshannon soils are nearly level or undulating. External drainage is good but not excessive. Internal drainage is good, owing to the friable subsoils.

The soils in this group are medium acid in reaction. Some of them have been limed during the last decade. Most of the liming that was being done at the time of the survey, in 1936 and 1937, was on the soils of this group. These soils respond well to applications of lime and fertilizers, and the fairly heavy subsoil prevents these amendments from being rapidly leached from the soil.

Frederick silt loam.—Frederick silt loam, one of the most important agricultural soils, is developed from the weathered products of comparatively pure limestone. In places a small quantity of calcareous shale is included in the parent rock.

The land is undulating, gently rolling, or rolling and contains numerous sinkholes, or depressions. Surface drainage is good and takes place largely through the sinkholes into underground channels. Internal drainage is adequate, although it is slower than in Frankstown silt loam. This difference is probably due to the heavier texture of the subsoil.

The surface soil of Frederick silt loam to a depth of 6 to 8 inches is light-brown, brownish-yellow, or grayish-brown friable silt loam..

It is underlain to a depth ranging from 12 to 15 inches by brownish-yellow or reddish-yellow silty clay loam. The subsoil, which reaches a depth ranging from 36 to 50 inches, is light-red, yellowish-red, yellowish-brown, or light reddish-brown friable brittle clay or silty clay. It is underlain by red or reddish-brown friable silty clay or clay, streaked and mottled with yellow. Bedrock of pure limestone occurs at a varying depth.

In some fields red or yellowish-red eroded spots occur on the steeper places. Here, the surface soil is thinner and contains more clay than the surface soil of surrounding areas. A few small areas adjoining Frederick cherty silt loam have a thin scattering of chert on the surface or in the subsoil. This chert in no way interferes with cultivation. A few rock outcrops or stony areas less than an acre in size are included in mapping. Also included are a few small areas of Hagerstown soil, which has a reddish-brown or brown surface soil and a dark-red, dark-brown, or brownish-red subsoil.

Frederick silt loam occurs only in the limestone valley associated with the stony Frederick soils. The largest areas are near Renick and Williamsburg.

As the land lies favorably, most of it is in cultivated crops. Pasture occupies only a small total acreage because on most farms enough stony Frederick soil is available for that purpose. Corn, wheat, hay, and barley are the principal crops. Oats and soybeans are grown to only a small extent. Corn occupies about 25 percent of the cropland; wheat or barley about 25 percent; and hay, consisting of timothy and clover, about 50 percent. Corn yields 35 to 70 bushels an acre. Applications of fertilizer for this crop range from 150 to 300 pounds an acre of a 3–12–6 or 4–12–4 mixture or 20-percent superphosphate. The 200-pound applications are most common. Yields of wheat range from 15 to 35 bushels an acre when an application of 200 pounds of 2–12–4 or 2–14–4 fertilizer is used. Many farmers obtain from 30 to 35 bushels of wheat an acre. Where manure is available it is commonly used to top-dress wheat in the spring. Barley yields from 40 to 60 bushels. It receives the same quantity and kind of fertilizer that wheat does. Oats are not grown so much as they once were because yields generally are not high and the feeding value of this crop is lower than that of barley. Yields of oats range from 25 to 60 bushels an acre. Clover and timothy yield 1 to 2 tons of hay, although in exceptionally good years higher yields are obtained from some fields. Alfalfa produces from 3 to 4 tons of hay an acre from three cuttings. The land must be limed and must receive from 300 to 500 pounds to the acre of 20-percent superphosphate or 2–14–4 fertilizer.

Practically all of the farmers on this soil practice a system of crop rotation. A 3-year rotation of corn, wheat, and mixed timothy and clover is common. Some use the following 4-year rotation: Corn 1 year, wheat 1 year, clover 1 year, and timothy or timothy mixed with some clover the last year. Owing to the increasing popularity of alfalfa as a feed, the rotation systems are being changed. Using alfalfa as the hay crop, a 5-year rotation probably will be the most practical, and some may increase it to 6 years. Corn and wheat or barley, each for 1 year, are the other crops in this rotation.

In harvesting corn it is cut by hand or, to a limited extent, by a binder, and shocked in the fields. Much corn is used for silage, as

practically every good-sized farm on this soil has some dairy cows, and milk or cream is sold.

The chief management needs of this soil are control of run-off and erosion and increased productivity by the combined use of lime and fertilizers. Much of this soil has been limed, but many fields are still greatly in need of liming. In its virgin condition the soil is acid throughout. In a cattle-raising and dairying section such as this, much hay must be grown. The superiority of alfalfa and other legumes as feed and the higher yields obtained with less labor make the growing of alfalfa more popular. In order to grow alfalfa successfully, the soil must be nearly neutral in reaction. Erosion can be minimized by keeping the steeper areas out of cultivated crops or by strip cropping.

Frankstown silt loam.—Frankstown silt loam is an important agricultural soil. It occurs in the limestone valley on gently rolling or sloping relief (pl. 1, *A*). Hilly areas have been separated as a phase. This soil is developed principally from the weathered products of impure massive and platy limestones and to a slight extent from calcareous shale. Weathering of these limestones causes the lime to be leached out and leaves behind either a porous shale or a soft massive yellow or reddish-yellow rock, locally called soapstone. This rock breaks readily and disintegrates to form a porous subsoil. When the land was first settled, and even today in certain sections, particularly near Central School, much of this soft rock was on the surface or was embedded in the surface soil. Most of the limestone rock has been removed, and Frankstown silt loam now is practically free of loose stones. This is considered one of the most easily farmed soils underlain by limestone.

External drainage is good, owing to the sloping relief, and internal drainage is excellent, owing to the open permeable subsoil.

The 6- or 8-inch surface soil consists of grayish-yellow, grayish-brown, or light-brown mellow silt loam. In areas that have been in grass for some time the upper part of the surface soil is slightly darkened by organic matter. The upper part of the subsoil is light-yellow or light brownish-yellow heavy silt loam to a depth ranging from 14 to 18 inches. It is underlain to a depth ranging from 20 to 24 inches by yellow or light brownish-yellow somewhat compact but rather easily crumbled silty clay loam. The lower part of the subsoil to a depth ranging from 32 to 38 inches is yellow or brownish-yellow silty clay loam. The parent material is yellow or yellowish-brown silty clay loam or silty clay, which is streaked with red and black and contains fragments of so-called soapstone, that is, the residue left after solution of the limestone. Soft porous rock or limestone occurs from 40 to 70 inches below the surface. In places the lower part of the subsoil is yellowish-red or yellowish-brown silty clay loam or silty clay. When the soil is wet the red shade is very pronounced.

The most typical areas of Frankstown silt loam are in the vicinity of Central School, 3 miles northwest of Lewisburg. This soil occurs only in the limestone valley within a belt extending southwestward from Frankford nearly to the county line. Owing to the favorable lay of the land and the stone-free character of the soil, most of it is cultivated. Corn, wheat, timothy and clover, and barley are commonly grown. Oats and potatoes are grown to a very small extent. The

growing of alfalfa has been started in many places and is definitely on the increase. Corn yields from 40 to 75 bushels an acre, wheat 15 to 35 bushels, barley 40 to 60 bushels, oats 30 to 45 bushels, timothy and clover 1 to 2½ tons, and alfalfa 3 to 5 tons from three cuttings. Yields vary, depending on the season, the kind and quantity of fertilizer used, and the quantity of lime applied. Corn is fertilized with 150 to 300 pounds, generally 200 pounds, of 2–12–4, 3–12–6, or 4–16–4 fertilizer. Wheat, barley, and oats receive from 200 to 300 pounds of 2–12–4, 2–14–4, or 20-percent superphosphate. In order to grow alfalfa the land must be limed and generally from 300 to 500 pounds of 20-percent superphosphate applied.

A 3-year rotation was prevalent until the introduction of alfalfa, which extended the rotation to 5 or 6 years so that the land is left in alfalfa for 3 or 4 years. Corn and wheat are the other crops grown in the rotation.

This soil responds well to liming by returning higher yields. A considerable acreage was limed in the 5 years prior to 1937. The tendency in farming this soil is toward the use of larger quantities and greater concentrations of fertilizers. Obviously such a trend is influenced by economic factors and may readily be changed. Much of this land, however, is in the hands of a few well-to-do owners, and this situation tends to uphold such a trend.

Good internal drainage, owing to the permeable subsoil, makes it possible to work this land sooner after a rain than some of the soils with heavier subsoils.

Frederick cherty silt loam.—This is one of the important crop soils of Greenbrier County. It is associated throughout the limestone valley with Frankstown silt loam and Frederick silt loam. The parent material of Frederick cherty silt loam is derived from the Hillsdale limestone, which is cherty. It constitutes the basal member of the limestone formation. When this limestone weathers, the nodules of embedded chert are left throughout the profile and on the surface of the resultant soil.

The surface is gently rolling to strongly rolling, and run-off is adequate. Internal drainage is good, owing to the open character of the subsoil, caused by the presence of chert fragments.

The largest area of this soil is in the vicinity of Organ Cave in the southern part of the county. A discontinuous belt borders the sandstone and shale areas, mainly on the west side of the Greenbrier River. Large areas are on the east side of the river at its junction with Spring Creek and south of its junction with Howard Creek. A few bodies are near Asbury.

The 6- to 8-inch surface layer of Frederick cherty silt loam is grayish-yellow, grayish-brown, or light-brown friable silt loam. It is underlain to a depth ranging from 12 to 15 inches by brownish-yellow, reddish-yellow, or salmon-red heavy silt loam or silty clay loam. The subsoil to a depth ranging from 36 to 50 inches is light-red, yellowish-red, or brown friable brittle clay or silty clay. It is underlain by red or reddish-brown friable silty clay material that is streaked and mottled with yellow. Bedrock of cherty limestone occurs at a varying depth below the surface. Angular fragments of gray and reddish-brown chert, ranging in diameter from ¼ to 2 inches, are scattered over the surface and throughout the soil mass.

Included in mapping are small areas of a soil with a lighter colored subsoil than that of typical Frederick cherty silt loam. It is not feasible to separate these areas as they are intimately intermixed with areas of the typical soil. The following is a description of this included soil. The surface soil, to a depth of 6 or 8 inches, is grayish-yellow silt loam. This layer is underlain, to a depth of 14 or 16 inches, by light-yellow friable heavy silt loam. The upper part of the subsoil consists of yellow or brownish-yellow silty clay loam continuing to a depth ranging from 18 to 24 inches. It contains considerable brown and reddish-brown partly disintegrated chert fragments. The lower part of the subsoil consists of reddish-yellow or yellowish-brown heavy silty clay loam, which extends to a depth ranging from 36 to 48 inches. Below this is silty clay or clay material that is brown or red, streaked with yellow and containing embedded reddish-brown and gray chert. Bedrock of cherty limestone appears at a varying depth below the surface.

Most of this land is farmed. Corn, wheat, barley, and hay are the principal crops; oats and buckwheat are minor crops. In normal seasons corn yields from 40 to 60 bushels per acre, but acre yields of 80 bushels have been reported on well-managed land. Wheat yields from 15 to 30 bushels, averaging about 20 bushels. Barley yields from 40 to 60 bushels, oats 20 to 50 bushels, and buckwheat 20 to 30 bushels. Timothy and clover hay returns from 1 to 2 tons per acre. The seasons 1935, 1936, and 1937 were not favorable for hay. Some alfalfa is grown on well-limed land and yields from 3 to 4 tons per acre from three cuttings. Corn commonly is fertilized with 200 pounds an acre of 3–12–6 or 4–12–4 fertilizer. Wheat generally receives an acre application of 200 pounds of 2–12–4, 3–12–6, or 2–14–4 fertilizer. In spring some wheatfields are top-dressed with manure, whenever it is available. Oats and barley generally receive the same fertilizer treatment as wheat.

Soil fertility is maintained by a system of crop rotation. The most common is a 3-year rotation consisting of corn followed by wheat and then hay. Some farmers use a 4-year rotation of corn 1 year, wheat 1 year, and clover and timothy 2 years. Most of the corn is cut and shocked in the fields, and on some farms a part of it is used for silage.

This soil is not very susceptible to erosion, owing to its porous permeable structure and the favorable lay of the land. Chert fragments on the surface may also check run-off to some extent. Plowing and preparing the seedbed on this soil is more difficult than on soils free of chert fragments. A few areas contain so much chert that it interferes with cultivation. On the other hand, some included areas have only a small quantity of chert on the surface.

Elk silt loam.—This soil is developed on terraces, from old alluvial deposits. It is high above the normal stream overflow. The parent material consists of wash, principally from soils underlain by limestone and, to less extent, from the Upshur soils. The Elk soil as mapped in this county has a slightly purplish red cast and resembles in color the Upshur soils, but the purplish-red cast is not so pronounced as in Moshannon silt loam. The Elk and Moshannon soils are closely associated, occupying terraces and first bottoms, respectively, along the same streams.

Elk silt loam occupies nearly level to gently undulating land, and heavy farm machinery can be used successfully on it. External drainage, or run-off, and internal drainage are good. Practically all of the land is in cultivation. The 6- to 8-inch surface soil is light-brown, yellowish-brown, or light purplish-brown friable silt loam. In areas that have supported a grass sod for some time, the topmost few inches of soil is dark brown in places. The subsoil, which continues to a depth ranging from 30 to 50 inches, is yellowish-brown, brownish-yellow, or light-brown compact but friable silty clay loam. In places, the lower part of the subsoil is slightly mottled with gray and brown, especially where it is underlain by shale. Elsewhere, the material below the subsoil generally is more sandy. Some areas of a loam soil are included with this soil on the map.

The largest bodies of Elk silt loam are developed in Sinking Creek Valley near Williamsburg. This appears to be an old river terrace laid on top of Indian-red shales. Much smaller areas are on the stream terraces along Hughart Creek southwest of Williamsburg, along Big Clear Creek 2 miles north of Rupert, along Muddy Creek, and in a few other places. Small areas are along the Greenbrier River, especially near Frazier and Renick. One fairly large body at Vires School north of Williamsburg has considerable stone scattered over the surface, which interferes somewhat with cultivation. The total area is small.

Practically all of this land is cultivated. It is one of the most productive farming soils. Much of the land has been limed. Corn yields from 40 to 70 bushels per acre, wheat 20 to 35 bushels, barley 40 to 60 bushels, and oats 30 to 40 bushels. Hay consisting of timothy and clover yields 2 to 3 tons in a normal season and soybean hay 1½ to 2½ tons. Some alfalfa is grown but not extensively as yet. The fertilizer treatments are the same as for the Frederick and Frankstown soils of this class.

Moshannon silt loam.—This soil occurs only on the first bottoms of Spring Creek, Muddy Creek and its tributaries, Hughart Creek, Sinking Creek, Monroe Draft, and some of the small perennial drains originating in the Upshur soils. It is subject to periodic overflow. Wash from the Upshur soils, together with some wash from soils underlain by limestone, makes up the parent material. The color profile resembles that of the Upshur soils.

The 8- to 10-inch surface soil is reddish-brown or purplish-brown friable silt loam. It is underlain by brownish-red or Indian-red heavy silt loam that continues to a depth ranging from 24 to 36 inches. Below this, in places, the material is slightly heavier textured and faintly mottled with rust brown. Bedded gravel lies from 30 to 48 inches below the surface. Water-rounded gravel is scattered over the surface in some areas immediately adjacent to the stream.

Drainage is adequate for such crops as corn and hay. Surface run-off is slow, but internal drainage is fairly good. In some places the water table is high. Approximately 75 percent of the land is in pasture. Bluegrass and other desirable grasses form a dense sod in most of the pastures; in fact, the cover is denser than that of the best upland soils of the county. Corn does well, yielding from 40 to 80 bushels per acre. When fertilizer is used the usual application is 200 pounds of 20-percent superphosphate, although some farmers use a

complete fertilizer. Wheat and oats in normal years produce too much straw, which tends to lodge and reduce the yields of grain. Not much wheat is grown. Yields ranging from 10 to 20 bushels are common. Hay, consisting of timothy and clover, yields from 2 to 3 tons per acre. Only a small acreage of this land is limed.

SECOND-CLASS SOILS

The Second-class soils are, for one reason or another, somewhat less productive or otherwise less desirable for cultivation than the First-class soils. The class includes Pope fine sandy loam and Pope silt loam of the bottom lands; Sequatchie loam, Holston loam, and Monongahela silt loam of the terraces; and Pickaway silt loam, Frankstown silt loam, hilly phase, Upshur silt loam, smooth phase, and Westmoreland silt loam, smooth phase, of the uplands.

The Pope, Sequatchie, Holston, and Monongahela soils consist of or are developed from alluvial soil materials from shales and sandstones. Owing to the character of the parent rocks, these soils are less fertile than the First-Class soils. They are, however, nearly level, easy to work, and very responsive to fertilization, liming, crop rotation, and other good farming practices. Yields range from fair to good. Erosion is not a problem on most areas. The Monongahela soils are imperfectly drained in places.

The Pickaway and Frankstown soils are developed largely from the residue of impure limestones and are comparatively fertile. They are generally somewhat subject to erosion, however, especially Frankstown silt loam, hilly phase. Pickaway silt loam is imperfectly drained in places.

The Upshur and Westmoreland soils, which are developed largely from more or less calcareous shales, with some limestone in places, are moderately fertile but are subject to rather rapid run-off and erosion if not carefully handled.

Practically the same crops are grown as on the First-class soils. These crops are fed largely to livestock or are consumed in the home. As the soils are somewhat less fertile than the First-class soils, they need somewhat heavier applications of fertilizers. The more sloping areas need more careful handling to prevent excessive loss of water and soil by rapid run-off.

Pope fine sandy loam.—Pope fine sandy loam occurs on the narrow bottoms along fast-flowing streams. It is subject to flooding with each successive overflow. The parent material represents wash principally from the Dekalb soils, many of which are sandy. Although some areas occur in districts surrounded by upland soils underlain by limestone, it is probable that most of the alluvium originates from areas of the Dekalb soils farther upstream. The reaction is acid throughout.

The 8- to 10-inch surface soil of Pope fine sandy loam is brown or yellowish-brown loose fine sandy loam. The subsoil, which continues to a depth ranging from 36 to 48 inches, is light-brown, yellowish-brown, or brownish-yellow heavy fine sandy loam. Below this depth are stratified water-soaked sand and gravel. In places near stream banks the subsoil is light-brown loamy sand or loamy fine sand. Farther back from the stream and adjacent to the uplands, the texture of the surface soil, in places, is a loam.

The widest strips of this soil border the Greenbrier River, narrow strips border the Meadow River near Mill Creek Mountain and the North Fork Cherry and South Fork Cherry Rivers, as well as Big Clear, Little Clear, Muddy, Mill, Second, Spring, and Laurel Creeks.

The land is nearly level. Drainage is good to excessive for a soil in the first bottoms, owing to the open structure of the sandy subsoil. About 75 percent of the land is cultivated and devoted principally to corn and hay; the rest is in permanent pasture. Corn yields from 30 to 50 bushels an acre, and timothy and clover 1½ to 2 tons of hay. Some wheat, soybeans, and garden crops are grown. Generally, however, wheat produces too much straw. In a normal season wheat yields from 15 to 25 bushels an acre and soybean hay 1½ to 2½ tons. Much of the land has been cropped to corn year after year. This practice diminishes the yields. Corn commonly receives from 150 to 200 pounds of 3–12–6, 4–16–4, 2–12–4, or 20-percent superphosphate; wheat receives 125 to 200 pounds of 2–12–4. On many small farms little or no fertilizer is used.

Pope silt loam.—Pope silt loam occupies high first bottoms along streams draining the heavier textured Dekalb and Berks soils of the uplands. Narrow strips border the stream, on the one hand, and areas of Sequatchie loam of the terraces, on the other. Drainage is good. This represents the only smooth land of most of the small farms situated in these valleys (pl. 1, *B*). The surface soil is light-brown or brown friable silt loam and grades, at a depth of 6 or 8 inches, into light-brown or yellowish-brown heavy silt loam. This material is underlain at a depth of 12 or 14 inches by brownish-yellow or light brownish-yellow heavy silt loam. In places below a depth ranging from 24 to 30 inches the texture becomes lighter although the color remains about the same. A few faint gray mottlings are present in places. The soil rests on stratified sands, shale fragments, and gravel at a depth ranging from 36 to 50 inches.

The largest bodies of Pope silt loam lie along Anthony Creek and its tributaries in the eastern part of the county. Fairly large bodies along Sewell and Boggs Creeks join one along the Meadow River. The town of East Rainelle is situated at the junction of these two creeks. Smaller areas are near Rupert along Little Clear Creek, near Duo along Big Clear Creek, along Muddy Creek, along Little Clear Creek near Kuhn Glades, along the North Fork Cherry River, and along Howard Creek.

Practically all of this soil is in cultivation. It is planted to corn, wheat, hay, buckwheat, soybeans, and oats. Yields, fertilizer treatments, and lime requirements for this soil are about the same as for Sequatchie loam, with which it is farmed.

Sequatchie loam.—This soil occupies low terraces from 3 to 10 feet higher than the first bottoms occupied by the associated Pope silt loam. Unlike the Pope soils, Sequatchie loam is not subject to periodic overflow. The parent materials and color profile of these two soils are similar.

The surface soil of Sequatchie loam to a depth ranging from 12 to 18 inches is brown friable loam, which grades at a depth ranging from 24 to 34 inches into light-brown or yellowish-brown heavy loam. Below this layer is yellowish-brown clay loam. Some water-worn sandstone and shale fragments are present on the surface and

throughout the soil mass in some places. These fragments, together with a sandy material, occur in places at a depth ranging from 36 to 50 inches.

Some areas of a silt loam soil are included with this soil on the map. The included soil differs from the typical soil only in the finer texture of the surface soil. Near Trout a large quantity of stone scattered over the surface and throughout the soil mass interferes with cultivation of the soil. Such areas, indicated on the map by stone symbols, have a lower agricultural value than the stone-free areas.

Sequatchie loam occurs in narrow strips along the principal streams that originate in areas of the Dekalb soils, particularly Anthony and Howard Creeks, and near Trout, Alderson, and Ronceverte.

Practically all of this soil is cultivated and is devoted to the production of corn, wheat, hay, oats, buckwheat, soybeans, and some potatoes. A considerable acreage is in temporary pasture. The principal crops are hay and corn. Most farmers do not follow a strict rotation on this land and make little attempt to maintain the fertility by growing legumes and turning under green manures. Some farmers practice a 5-year rotation of corn, wheat, and hay, chiefly timothy, which is allowed to remain for 3 years. Others leave the land in hay as long as fair yields are obtained. Corn yields from 25 to 40 bushels per acre, wheat 12 to 20 bushels, oats 20 to 40 bushels, buckwheat 15 to 30 bushels, soybean hay 1 to 2 tons, and timothy hay 1 to 1½ tons. Corn, wheat, and oats generally receive from 150 to 200 pounds an acre of 2–12–4 or 3–12–6 fertilizer; buckwheat commonly receives less fertilizer than those crops—about 100 pounds.

The principal management needs of this soil are liming and building up soil fertility by the planting of legumes and turning under of green manures. This treatment will increase the yields of crops. Much hay is needed in these sections and can be obtained from legumes.

Holston loam.—Holston loam is developed from old alluvial deposits on terraces that lie well above the level of normal stream overflow. The parent material has been washed from soils underlain by sandstone and shale, principally from the Dekalb soils and apparently deposited over shale formations. In many places, Holston loam is associated with Monongahela silt loam, a less well drained soil, which also is developed on terraces, and with Pope silt loam on adjacent first bottoms.

The surface soil to a depth ranging from 4 to 6 inches is gray or grayish-yellow loose loam. It is underlain by light-yellow friable loam or heavy loam to a depth of 12 or 14 inches. Below this is light-yellow clay loam that continues to a depth ranging from 22 to 26 inches. This layer gives way, at a depth ranging from 30 to 44 inches, to compact silty clay loam that is light yellow mottled with gray and rust brown. The soil rests on gray or nearly white clay shales, the upper part of which contains rust-brown mottlings in places. Small flat angular fragments of sandstone are scattered over the surface in several areas near Neola. These fragments probably were washed from the adjacent shaly slopes.

Areas of this soil are along the Meadow River and its tributaries, especially near Rupert and Rainelle; along the Greenbrier River,

especially near Alderson and Frazier; along Howard Creek, especially near White Sulphur Springs; and along Sinking Creek.

The land ranges from nearly level to gently undulating. Run-off and internal drainage are adequate. Most of the soil is in cultivation. Rainelle, Rupert, and Charmco are situated on this soil. Corn, wheat, soybeans, and hay are the principal crops, and some truck farming is carried on. Corn yields from 20 to 40 bushels per acre, wheat 12 to 25 bushels, oats 30 to 50 bushels, soybean hay 1 to 1½ tons per acre, and other hay ¾ to 1½ tons. Corn and the small grains generally receive from 150 to 200 pounds an acre of 2–12–4 or 3–12–6 fertilizer. As the reaction is acid throughout, applications of lime are needed nearly everywhere on this soil.

Monongahela silt loam.—This soil is less well drained and occupies lower terraces than Holston loam, with which it is associated in many places. These terraces, however, are not subject to periodic overflow as are the flood plains. The parent material of this soil is washed mostly from the Dekalb soils and to a smaller extent from the Upshur soils. The color profile is not so light as that of the Holston soils. Large areas on the Meadow River and its tributaries are associated with the Atkins and Philo soils of the first bottoms. Here the water table often comes within a few feet of the surface.

The 6- to 8-inch surface soil of Monongahela silt loam is brownish-gray, grayish-yellow, or light-gray friable silt loam. It is underlain to a depth ranging from 12 to 16 inches by grayish-yellow or light brownish-gray friable silty clay loam. Below this and continuing to a depth ranging from 24 to 30 inches is light-yellow compact silty clay or silty clay loam mottled with gray and brown. The next lower layer consists of mottled light-gray, brown, and brownish-yellow silty clay or heavy clay. In places, at a depth ranging from 40 to 50 inches, the subsoil passes either into a lighter textured material consisting of sand and gravel, which occurs as a thin stratum over shale beds, or into gray and rust-brown mottled plastic clay. Included with this soil are small areas in which the soil is grayer throughout. The mottling occurs immediately below plow depth. This inclusion resembles the Atkins soil but definitely occupies terraces. One such body is at the east end of Williamsburg extending northward in a narrow strip; another is near Cornstalk.

The chief areas of this soil are on the terraces along the Meadow River and its tributaries, especially near Rupert, Kieffer, Oak Grove School, and Thompson School; along Sinking Creek near Williamsburg; along Anthony Creek near Brown School and Neola; along Meadow Creek in the northeastern part of the county; and along the Greenbrier River near Fort Spring and Keister.

The surface of this soil is nearly level to gently undulating, and heavy farm machinery can be used successfully. Surface drainage is slow, especially along the Meadow River and its tributaries, which often back up to the lower edge of this terrace. At such times, the water table is high. The heavy subsoil impedes internal drainage. In many places tiling would improve internal drainage.

Nearly all of this land is cultivated and planted to corn, wheat, oats, buckwheat, potatoes, soybeans, and hay. Corn yields 25 to 45 bushels, wheat 12 to 25 bushels, oats 30 to 40 bushels, buckwheat 20 to 30 bushels, potatoes 100 to 200 bushels, soybeans 1 to 1½ tons of hay,

and mixed timothy and clover 1 to 1½ tons of hay. Corn and the small grains usually receive acre applications ranging from 150 to 250 pounds of 2–12–4, 3–12–6, or 4–12–4 fertilizer. Few potatoes are grown, and generally these are not fertilized with the maximum quantities of fertilizer recommended by the West Virginia Agricultural Experiment Station.[6] The soil is acid throughout and is in need of lime.

Pickaway silt loam.—Pickaway silt loam occupies the smallest total acreage of the soils of the uplands underlain by limestone. As mapped in this county, the surface soil is light-gray or grayish-yellow mealy silt loam, 6 or 8 inches thick. It is abruptly underlain by light grayish-yellow or light-yellow slightly compact silt loam or heavy silt loam, which extends to a depth of 14 or 16 inches. The upper part of the subsoil consists of light-yellow or yellow moderately compact silty clay loam and continues to a depth ranging from 20 to 26 inches. The lower part of the subsoil consists of light-yellow compact silty clay loam or silty clay, mottled with gray, and reaches a depth ranging from 30 to 36 inches. This material gives way to brownish-yellow or yellow silty clay streaked with black, which becomes slightly plastic at the lower depths. Bedrock of siliceous limestone occurs from 3 to 5 feet below the surface. Dark-red or brown soft iron concretions about one-third inch or less in diameter are numerous throughout the subsoil. In flatter areas the subsoil is grayer and more highly mottled with brown beginning at depths of 12 to 15 inches below the surface. Included with this soil are small areas of a poorly drained soil that has a black or dark-gray silty clay loam surface soil from 6 to 20 inches thick. Below this layer is light-gray or olive-gray heavy plastic clay or silty clay highly mottled with brown. This inclusion would be separated as a Burgin soil if its area were sufficiently large. Pickaway silt loam is developed in well-defined sinks or slight depressions. As mapped, all gradations exist between the features of drainage and color. The main bodies are west of Lewisburg, northeast and northwest of Central School, and near Williamsburg. Smaller bodies are west of Mountain View School, west of Arbuckle School, northwest of Frankford, near Fearnster School, at Rapp School, and elsewhere.

The land ranges from undulating to gently sloping. External drainage is fair. Natural internal drainage is slow, owing to the compact and heavy subsoil. Much of this soil is tile drained.

About 80 percent of this soil is in cultivated crops, and the rest is in pasture. Corn, wheat, barley, timothy and clover (for hay), and alfalfa are the principal crops. Much of the land has been limed. Farmers have grown very little alfalfa on this soil, and it is not known how well alfalfa will survive. Corn yields from 35 to 45 bushels per acre, wheat 18 to 30 bushels, barley 35 to 60 bushels, and hay 1½ to 2 tons. These yields are obtained after the customary fertilizer applications are given. Higher yields of corn have been reported for a few fields that have had exceptional management or applications of larger quantities of fertilizer. Wheat yields in the spring of 1937 were unusually high. The average return was about 20 bushels an acre. Owing to the favorable relief, heavy machinery can be used on this land.

[6] See table 9 on fertilizer recommendations.

Frankstown silt loam, hilly phase.—This soil is similar to typical Frankstown silt loam, except that the relief ranges from strongly rolling to hilly, the slopes are steeper, and the surface soil is shallower in places. On the slopes the subsoil also is shallower and limestone rock outcrops are more common than on the typical soil. Drainage takes place through the numerous sinkholes and drains leading from these depressions into underground openings, which are common in the stony Frederick soils.

Included with this soil on the map are a few small areas of Lowell silt loam—too small to warrant separation. This included soil has a plastic subsoil, in contrast with the friable subsoil of the Frankstown soils.

This hilly soil is associated with typical Frankstown silt loam. The largest area occurs as a narrow continuous belt extending southward from Frankford past Maxwelton. Other bodies are north of Lewisburg, at Davis Stuart School, north of Alderson, and elsewhere throughout the limestone valley.

The steeper land is chiefly in pasture. The smooth areas on the crests of ridges are used for crops. The yields obtained are slightly below those of the typical soil. Fertilizer treatments are about the same on the two soils.

Upshur silt loam, smooth phase.—Areas of Upshur silt loam that lie favorably for cultivation, such as comparatively smooth bench-like middle slopes and the gentler lower slopes near streams, are separated on the map from the surrounding steeper areas as a smooth phase. The smoother land is adapted to the growing of cultivated crops. Because of the lay of the land, the soil material is thicker than typical Upshur silt loam. External and internal drainage are good. A few bodies near the border of the limestone area drain into underground streams and sinks.

The surface soil to a depth of 5 to 7 inches is light-brown or light purplish-brown friable silt loam. This passes into purplish-brown or purplish-red heavy silt loam or silty clay loam that reaches to a depth ranging from 10 to 14 inches. The lower part of the subsoil is purplish-red or Indian-red silty clay loam or silty clay, which becomes slightly plastic when wet. It is underlain at a depth ranging from 20 to 30 inches by Indian-red partly weathered shale. This grades into unweathered shale, which, in places, is calcareous at a depth ranging from 36 to 40 inches. The reaction of this soil is acid throughout. A few small smooth areas of colluvial soil composed of the same material are included in mapping.

This soil is everywhere associated with typical Upshur silt loam, chiefly near Henning, and from Grassy Meadows northeastward to Oak Grove School.

Nearly all of the land is cleared and planted to corn, wheat, hay, oats, buckwheat, and potatoes. Corn yields from 25 to 40 bushels per acre, wheat 12 to 25 bushels, oats 20 to 35 bushels, buckwheat 15 to 25 bushels, hay ¾ to 1½ tons, and potatoes 75 to 250 bushels. Land for corn, wheat, and oats commonly is fertilized with 150 to 200 pounds of 2–12–4, 3–12–6, or 4–12–4 complete fertilizer. Buckwheat commonly receives less—from 100 to 150 pounds of a complete fertilizer or 20-percent superphosphate; and potatoes more—from 200 to 500 pounds of 4–10–6. Most of the potatoes are grown for home use.

Westmoreland silt loam, smooth phase.—This soil differs from typical Westmoreland silt loam in having a more nearly level surface and a thicker surface soil. It is adapted to the growing of cultivated crops. The lay of the land ranges from gently rolling to rolling, and both external and internal drainage are adequate.

The 6- to 8-inch surface soil is light-brown, brownish-yellow, or light grayish-yellow friable silt loam. In some areas that have been in grass for some time, the topmost few inches of the surface soil is darker, namely, light grayish brown. The upper part of the subsoil, to a depth ranging from 12 to 20 inches, is brownish-yellow or light yellowish-brown silty clay loam. The lower part of the subsoil, to a depth ranging from 24 to 32 inches, is yellowish-brown, brown, or light reddish-brown friable heavy silty clay loam or silty clay. Below this is silty clay, which is yellowish brown or brown streaked with yellow. The underlying material consists of gray, grayish-green, or orange calcareous shale, together with some platy limestone in places, and the color of the profile varies according to the underlying soil-forming material. Where the gray shales predominate, the whole soil is more decidedly yellow than elsewhere.

This soil occupies the tops of ridges and smooth benches associated with typical Westmoreland silt loam on the slopes. The largest areas are in the vicinity of Friars Hill.

Practically all of this land is cultivated to corn, wheat, hay, barley, and some oats. Corn yields from 20 to 40 bushels per acre; wheat, under normal conditions, 10 to 20 bushels; oats, 20 to 35 bushels; and timothy and clover and soybeans, 1 to 1½ tons of hay. In a good season, as in the spring of 1937, average wheat yields of 25 bushels per acre were reported. Generally wheat on this land produces a good plump kernel and has a better than average weight per bushel. Barley has not been grown extensively. The above-mentioned yields are obtained with the use of fertilizer.

The chief management needs of this soil are liming and checking of erosion by cover crops. The silty texture of the soil makes it susceptible to surface erosion in places where there is an appreciable slope.

THIRD-CLASS SOILS

The Third-class soils are developed from the weathered products of sandstone and shale. These materials give rise to soils that are less fertile than the First-class soils. In this class are Philo silt loam of the alluvial bottom lands, and Clymer loam, Clymer silt loam, Upshur-Clymer (Meigs) silt loams, Dekalb gravelly loam, and Dekalb fine sandy loam, all of the uplands.

The farms on these soils are small, and less attention is given to cattle raising than on farms on the soils of the first two classes. Most of the crops are grown for home consumption.

Crops commonly grown are corn, hay consisting of timothy and some clover, soybeans, wheat, oats, buckwheat, and potatoes. Less wheat is grown on these soils than in the limestone valley. The yields of various crops obtained are not so high as on soils of the previous groups. The crop rotations used on these soils are not everywhere uniform. In places a 3- or 4-year rotation of corn, wheat, and hay is common. On some farms oats, buckwheat, and soybeans are included in the cropping program. In some sections of the county hay

A, General view of Frankstown silt loam in the valley, showing low mountains in background. Note the characteristic sinkhole topography. *B*, Narrow valley in eastern part of county, showing Pope silt loam on the flood plain and mountain background of Dekalb shaly and stony silt loams.

A, Alluvial soils in southwestern part of county. Philo silt loam in foreground; Upshur soils in background. *B*, Pasture on Frederick stony silt loam. Shallow sinkhole at right

is cut for 3 years or longer if the stand justifies it. On the sandy soils large quantities of buckwheat, oats, and potatoes are grown. Soybeans do well on the soils of this group. This legume does not require so much lime as alfalfa, and it makes good feed.

The soils of the uplands are characterized by light-gray or grayish-yellow surface soils and yellow or light-yellow friable subsoils. The relief of the soils in this group ranges from nearly level to strongly rolling. Surface drainage of the upland soils is fair to good, but it is slow on the nearly level soils developed from alluvial material. Internal drainage on most of the soils except Philo silt loam is good.

The texture of the soils in this group ranges from fine sandy loam to silt loam. The soils are strongly acid, or slightly more acid than the First-class soils. Some lime is applied but not extensively. The lighter textured soils do not hold lime or fertilizer so well as the heavier soils, so that it is more economical to lime more frequently and apply smaller quantities. These soils respond well to the addition of lime and fertilizers. The quantities and kinds of fertilizer applied vary from soil to soil; consequently, the treatments can best be discussed under the individual soil types.

Philo silt loam.—This soil occupies imperfectly drained areas on the first bottoms in association with areas of poorly drained Atkins and well-drained Pope soils. It is intermediate between the latter two soils in position and drainage. Its surface soil resembles that of Pope silt loam, whereas the lower part of the subsoil is typical of the Atkins soils.

The surface soil to a depth of 6 or 8 inches is grayish-brown or light-brown friable silt loam. It is underlain to a depth ranging from 15 to 18 inches by a grayish-brown, yellowish-brown, or brownish-yellow heavy silt loam, which may or may not have some faint mottlings of gray at the lower depths. This layer changes rather abruptly to grayish-yellow or yellow heavy silt loam or silty clay loam, intensely mottled with gray and rust brown to a depth ranging from 24 to 30 inches. Below this and continuing to a depth ranging from 40 to 48 inches is gray silty clay loam mottled with rust brown. This material passes into mottled gray, yellow, and rust-brown plastic clay, which usually is water-soaked. Included with the Philo soil, as mapped, are a few small bodies of a soil that is mottled with gray and rust brown immediately below plow depth. It resembles the Atkins soil in color profile but is better drained artificially. The crops grown and yields obtained are about the same as on typical Philo silt loam.

Philo silt loam occurs in a few small areas along tributaries of the Meadow River in the southwestern part of the county (pl. 2, *A*), especially near Grassy Meadows.[7] Smaller bodies are south of Hughart on Sinking Creek, and north of Crag. The total area is small.

The land is nearly level. Surface run-off is slow, and internal drainage is impeded by the underlying heavy clay. Much of the land is ditched to aid surface run-off. During normal crop seasons

[7] Philo silt loam adjoins Holly silty clay loam along Patterson Creek on the Greenbrier-Summers County line and along Buffalo Creek on the Greenbrier-Fayette County line, according to the soil survey maps of these respective counties.

yields are slightly below those on Pope silt loam, but during dry years they are slightly more. In wet years crop yields are low. Practically all of this land is cleared; more than half is in cultivated crops and the rest in pasture. Corn, wheat, and hay are the principal crops, and some buckwheat, oats, and soybeans are grown. The fertilizer requirements are about the same as for Pope silt loam or Sequatchie loam. The soil is acid throughout. Crop yields, particularly of clover and timothy, are increased greatly by liming.

Clymer loam.—Clymer loam is the most extensive member of this group. It is developed from weathered sandstone material and is distributed throughout all sections of the county, principally on the comparatively flat ridge tops and benches. In many sections it is associated with Dekalb gravelly loam, which occupies the steeper slopes. In some places Clymer loam caps ridges, whose slopes consist of Upshur, Upshur-Dekalb (Meigs), or Westmoreland soils. In general, Clymer loam occurs at higher elevations than the soils of the limestone valley. This is not true, however, in areas immediately west of the Greenbrier River.

The surface of Clymer loam is gently to strongly rolling, and nearly everywhere surface drainage is adequate. The friable subsoil allows good internal drainage. A few small comparatively flat areas, however, are not so well drained as the others.

Most of this soil is under cultivation. A few areas are in second-growth forest consisting of red oak, scrub oak, chestnut oak, sugar maple, red maple, hickory, pitch pine, scrub pine, and some white pine. At one time chestnut was the dominant tree, but now all but a few of the smaller trees have been killed by chestnut blight. Cleared areas or those left out of cultivation are quickly covered with blackberry and greenbrier vines. Huckleberries thrive on this soil.

The topmost inch or two consists of light-gray loose loam, which is underlain to a depth of 8 or 10 inches by light-yellow or light grayish-yellow friable loam. Below this layer is light-yellow, yellow, or light brownish-yellow heavy loam or light clay loam, extending to a depth ranging from 24 to 30 inches. The intensity of color increases slightly with increasing depth. This material is, in turn, underlain by yellow or brownish-yellow fine sandy loam or sandy loam mottled with grayish white. Bedrock of yellow or brownish-yellow sandstone lies from 36 to 40 inches below the surface. In places some pink sandstone is present at this depth.

Included in mapping are a few areas that have a very fine sandy loam surface soil. The subsoil is as heavy as that just described for Clymer loam. One such area is north of Fry School on Muddy Creek Mountain. A few areas of the silt loam are included with mapped areas of this soil. No agricultural difference exists between these included areas and the typical loam. In places where Clymer loam adjoins higher lying stony soils, some sandstone is on the surface, and such areas are designated on the map by stone symbols. One of these bodies is northwest of Wild Meadow Church on Howard Creek; another is north of Alderson near Blaker Mills.

The largest bodies of this soil are mapped on Muddy Creek Mountain, on Brushy Ridge extending north to Williamsburg, south of Clintonville, at Brushy Flat School, on Brushy Flat and Ballard Mountain, near Spring Creek, on the west side of the Greenbrier

River southeast of Maxwelton and Frankford, and along Meadow Creek in the northeastern part of the county. Smaller bodies are scattered over the county.

This soil is adaptable to most crops and responds readily to fertilizing and liming. A comparatively small acreage is limed, however, owing to the cost of hauling lime. At some of the higher elevations wheat does not do well because it freezes readily. Nevertheless, much wheat is grown, and the yields range from 12 to 25 bushels per acre. Corn yields from 20 to 40 bushels, oats 20 to 30 bushels, buckwheat 15 to 30 bushels, hay, principally timothy, about 1 ton in an average season, and potatoes 100 to 200 bushels. Potatoes generally receive from 200 to 400 pounds of 4–12–10 or 2–12–8 complete fertilizer. Some soybeans are grown. Apple trees do well. No large orchards are maintained, although there are a few trees on most farmsteads.

Clymer silt loam.—This soil is widely distributed throughout the county in association with the Dekalb soils, which occupy steeper slopes. The parent materials of this soil are weathered shale and fine-grained sandstone. Areas adjoining the Elliber soils contain some limestone materials or are affected by water draining from limestone areas, and many chert fragments are scattered on the surface. Where the soil lies at the mouths of mountain streams it includes some outwash material. Generally such areas have some flat sandstone gravel scattered over the surface.

The 6- to 10-inch surface soil of typical Clymer silt loam is light-yellow or grayish-yellow friable silt loam. In some wooded areas a thin layer of organic matter covers the surface. The upper part of the subsoil consists of light yellow or brownish-yellow silty clay loam and reaches to a depth ranging from 16 to 20 inches. The lower part of the subsoil consists of yellow or brownish-yellow heavy silty clay loam or silty clay continuing to a depth ranging from 24 to 30 inches. In places this layer contains some gray mottling. Partly weathered yellow or brownish-yellow shale underlies the subsoil. Some areas do not have so deep a soil, and here the partly weathered shale lies only 16 to 20 inches below the surface. Areas adjacent to or located at the mouths of streams emerging from Dekalb shaly silt loam have considerable shale and small angular sandstone fragments scattered over the surface.

Included in mapping are a few areas that have a loam surface soil. These areas have about the same agricultural value as typical Clymer silt loam but differ from it in that they have a lighter textured surface soil and subsoil. Here, the parent material is partly weathered sandstone instead of shale. The largest body of this lighter textured soil is at Hull School west of Alvon.

Another inclusion is characterized by the presence of a considerable quantity of angular sandstone and subangular chert fragments on the surface and throughout the profile. Such areas are indicated on the map by gravel symbols. The subsoil of this soil in most places is browner than in the typical soil. Both the surface soil and subsoil are lighter in texture. All these areas are at the base of Coles Mountain, either adjacent to or influenced by Elliber cherty loam. The sandstone and chert fragments throughout the surface soil and subsoil give these areas the appearance of having been developed from outwash and colluvial material brought down from the higher lying Elliber soil.

Clymer silt loam occupies comparatively smooth and gently sloping benches at the base of ridges and mountains and generally adjoins lower lying soils of the terraces and bottom lands. Some areas occur on the tops of low-lying ridges from 50 to 400 feet above the soils of the flood plain. The steep slopes of these ridges are included in mapping because they are so narrow that it is not feasible to show them separately. On these slopes there is a very shallow soil layer or practically no soil at all.

The land ranges from undulating to gently rolling, and external drainage is good. Internal drainage is slow in some areas but generally is adequate.

The principal areas of this soil are along Howard Creek and its tributaries, especially near White Sulphur Springs and along Anthony Creek and its tributaries, especially near Alvon and Neola, and northward to the county line. A few areas are near the Greenbrier River southwest and north of Caldwell, from Keister northward to Woodman, and near Julia. Smaller areas are scattered throughout the county.

The land lies favorably for tillage and, therefore, much of it is cultivated, in spite of the comparative poverty of the soil. Corn, wheat, hay, soybeans, oats, and potatoes are grown. When 150 to 200 pounds of 2–12–4 or 3–12–6 fertilizer are used, corn yields from 20 to 35 bushels, wheat 10 to 25 bushels, and oats 15 to 30 bushels per acre. Hay, consisting of timothy and redtop, produces ¾ to 1½ tons, soybean hay from 1 to 2 tons, and potatoes 75 to 150 bushels. Yields depend largely on soil management. There is no consistent practice, and only a comparatively small acreage has been limed.

Upshur-Clymer (Meigs) silt loams.—These soils consist of alternate narrow strips of Clymer silt loam and Upshur silt loam that are too closely associated for separation into their respective soil types. This complex occurs in many areas throughout the county, associated with Upshur silt loam. In cultivated fields the surface has a spotted red, grayish-yellow, and light-brown appearance. The 6- or 8-inch surface soil is silt loam or loam. The subsoil is reddish-brown, light purplish-red, or brownish-yellow silty clay loam and extends to a depth ranging from 20 to 24 inches. The underlying materials in the areas of Upshur silt loam are Indian-red shales and sandstones; whereas in the areas of Clymer silt loam the materials are partly disintegrated yellow or pink sandstones. The reaction is acid throughout, and even the underlying shales appear to be noncalcareous.

The land is gently rolling to rolling. External drainage is good, and internal drainage is adequate.

This complex is fairly extensive. The largest areas are along the Greenbrier River near Auto, Vago, Henning, and Lewisburg; near the headwaters of Meadow Creek in the northeastern part of the county; and in the southwestern part, especially near Sam Black Church and Clintonville. Smaller areas are in the north-central part northeastward from Williamsburg. Most of this soil is cleared and farmed with Clymer loam and the smooth parts of Upshur silt loam. It is adapted to growing corn, wheat, oats, buckwheat, and hay. Maximum yields cannot be obtained unless the land is limed and fertilized, and not much of it has been limed. Corn produces from 20 to 35 bushels, wheat 10 to 15 bushels, oats 20 to 30 bushels, and

buckwheat 18 to 25 bushels per acre. Ordinarily from 150 to 200 pounds an acre of a complete fertilizer, such as 3–12–6 or 2–12–4, are used.

Dekalb gravelly loam.—This soil occurs mainly on the tops of ridges and gentle mountain slopes, in association with the steeper and stonier Dekalb soils, or, in places where Clymer loam occupies the ridge tops, it occurs on somewhat steeper slopes associated with it. The parent material of the two soils is the same, but Dekalb gravelly loam is the shallower.

The 4- to 6-inch surface soil is grayish-yellow or light-gray friable loam. In wooded areas a thin layer of leafmold covers the surface. The upper part of the subsoil consists of light-yellow heavy loam to a depth ranging from 12 to 16 inches, and the lower part consists of yellow or light brownish-yellow silt loam. Partly disintegrated fine-grained sandstone underlies the subsoil at a depth ranging from 20 to 26 inches. In many places on hillsides the soil is even shallower than the typical soil described. In such places, disintegrated sandstone lies only 16 to 20 inches below the surface. Scattered over the surface and throughout the soil is a large quantity of angular gray sandstone fragments ranging from 2 to 5 inches in diameter. The gravel content is not sufficient to interfere with cultivation. On the tops of the higher ridges where this soil is mapped, areas that have not been cultivated are covered by a mat of organic matter several inches thick intermixed with mineral soil and gravel. Such areas when cultivated produce well until the organic matter is exhausted. The soil is acid throughout.

The land is gently rolling to hilly. External drainage, or run-off, is rapid, and internal drainage is good, owing to the friable subsoil.

This soil occurs chiefly in the northwestern part of the county, particularly on Mill Creek Mountain and Buck Knob; in the central part on Brushy Ridge; on the gentle mountain slopes on the east side of the Greenbrier River, particularly north of Anthony Creek; and in the northeastern part on Allegheny Mountain.

About one-third of the land is in cultivation; the rest is in woods and some pasture. Black oak, white oak, red oak, common locust or black locust, red maple, and sumac are the common trees, and a few chestnut trees still survive. More potatoes are produced on this soil than on any other soil of the county. Yields range from 100 to 300 bushels per acre, depending largely on the quantity of fertilizer applied. Applications of 1,500 to 2,000 pounds of a 4–8–10, 4–12–10, or 4–10–6 fertilizer are reported to result in yields of 300 bushels per acre. Corn yields from 20 to 35 bushels, wheat 10 to 20 bushels, oats 20 to 30 bushels, buckwheat 15 to 30 bushels, and hay, which is chiefly timothy, ¾ to 1¼ tons an acre. Some soybeans are grown. Apple orchards do well on this soil when planted on protected slopes. Each farm may have a few trees. Only a few acres of Dekalb gravelly loam have been limed. Liming increases all crop yields, and it improves the stand of clover.

Dekalb fine sandy loam.—In most places this soil is associated with Clymer loam, generally occupying slightly higher positions and somewhat steeper slopes. Its parent material is more sandy than the parent material of Clymer loam. It is not so deep as that soil. The 4- to 6-inch surface soil of Dekalb fine sandy loam is grayish-yellow friable fine sandy loam. In wooded areas the soil in the topmost few

inches is darker, being a gray fine sandy loam. The upper part of the subsoil is light-yellow or light brownish-yellow heavy fine sandy loam to a depth ranging from 12 to 15 inches. The lower part is light-yellow loam or fine sandy clay. Bedrock of yellow or brownish-yellow coarse-grained sandstone lies immediately below this layer at a depth ranging from 16 to 28 inches. In places the underlying rock is pink sandstone. Scattered over the surface in places where the soil is shallow are some small angular sandstone fragments.

About one-half of this soil is in second-growth forest of scrub oak, red oak, some chestnut, pitch pine, scrub pine, red maple, common locust, some hemlock, dogwood, and hickory. As the soil is acid, huckleberries, blackberries, and other briers thrive. Sumac and wild grape are common. Poverty oatgrass, together with such weeds as yarrow and ragweed, constitutes the principal pasturage.

The farms on this soil are small. Yields of crops are fair, and sufficient quantities are grown for home consumption. Potatoes yield well when fertilized with about 1,500 pounds per acre of a 4–10–6 fertilizer, though throughout this section only 200 to 500 pounds commonly is applied. Yields range from 75 to 150 bushels an acre. Corn returns 15 to 25 bushels, wheat 10 to 15 bushels, buckwheat 15 to 30 bushels, and oats 20 to 30 bushels per acre. Corn and the other small grains receive applications ranging from 100 to 200 pounds an acre of 2–12–4 or 3–12–6 complete fertilizer. In some sections successive crops do not receive successive applications of fertilizer, but several crops may be grown following one application.

The largest areas are mapped on the comparatively smooth ridges and benches on the east side of the Greenbrier River north of Anthony Creek, on Muddy Creek Mountain, and south of the Greenbrier River to the Monroe County line.

The surface is sloping to strongly sloping. External and internal drainage are good.

FOURTH-CLASS SOILS

Fourth-class soils generally are considered best adapted to pasture. The following soils make up this class: (1) Soils derived from limestone, including Frederick stony silt loam, Frederick-Hagerstown stony silt loams, and Elliber cherty loam; (2) soils derived from shale, including Upshur silt loam, Belmont silt loam, Westmoreland silt loam, Dekalb silt loam, and Upshur-Dekalb (Meigs) gravelly silt loams; and (3) alluvial soils, including Atkins silt loam and Pope gravelly silt loam.

Most of the soils in this class, however, are hilly. The most important pasture soils are those derived from limestone. Their importance is due to the high carrying capacity of the pasture grasses they support. These pastures contain a large proportion of Kentucky bluegrass and white clover, as well as other desirable species of grasses. The soils of this subgroup are less acid than the soils of the other two subgroups of Fourth-class soils.

The soils derived from shale have comparatively shallow surface soils but are not uniform in color. Owing to the character of the parent material and the hilly lay of the land, these soils are subject to severe sheet erosion if the sod is broken. Dekalb silt loam includes some smooth areas on the tops of ridges, which could be farmed successfully for subsistence crops.

Atkins silt loam is not sufficiently well drained to be farmed generally. Pope gravelly silt loam is used chiefly for pasture, and only a few small areas are farmed.

The following discussion is based on data obtained from the West Virginia Agricultural Experiment Station (*12*). Pasture, excluding woodland pastures, covers more than twice the area of cropland. The average number of acres required to pasture a cow or a 3-year-old steer is 5.1 acres for the county as a whole. Only about 3.7 acres of the soils underlain by limestone, however, are required for this purpose, whereas about 30 acres of woodland pasture are required.

The carrying capacity of a pasture depends on the species of grasses it contains and the density of their growth. A good pasture consists principally of the following desirable grasses and legumes: Kentucky bluegrass, white clover, redtop, timothy, hop clover, Canada bluegrass, orchard grass, and lespedeza. When a soil becomes acid to strongly acid in reaction and the plant nutrients, particularly phosphorus, are present in low concentrations, poor native grasses and weeds crowd out these desirable species. Consequently, many of the pastures are now supporting a sod of poverty oatgrass, broomsedge, and weeds, including cinquefoil, buckhorn plantain, oxeye daisy, yarrow, wild carrot, field sorrel, and ragweed.

Experiments show that the soils that are nearly neutral in reaction (have a pH value of 5.8 or more) and have plenty of available phosphorus will support a good sod of Kentucky bluegrass and white clover in a normal season. In this county 78 percent of the soils derived from limestone were deficient in lime in 1935. Field observations indicate that practically all of the other Fourth-class soils also need lime. In general, the State experiment station recommends that from 200 to 400 pounds of 20-percent superphosphate be applied every 2 years to pastures. On land that is intensively grazed, a yearly application of 100 to 150 pounds of a nitrogen fertilizer in the spring in addition is recommended. It must be remembered that neither lime nor fertilizer alone will suffice for maximum improvement of pastures, but the two must accompany one another. Land should be limed according to its needs, which can be determined by simple tests.

Frederick stony silt loam.—Frederick stony silt loam is the most important pasture soil of Greenbrier County (pl. 2, *B*). Its importance is due to its high carrying capacity and extensiveness throughout the limestone valley—the cattle-raising section of the county. It is closely associated with Frederick silt loam and the Frankstown soils.

The 4- to 6-inch surface layer of Frederick stony silt loam is grayish-brown, brownish-yellow, or light-brown mellow friable silt loam. It is underlain to a depth ranging from 10 to 14 inches by brownish-yellow or reddish-yellow silty clay loam. The subsoil is light-red, yellowish-red, or light reddish-brown friable silty clay or clay material streaked and mottled with yellow. Bedrock of pure limestone generally occurs at a depth ranging from 30 to 40 inches, but it outcrops in many places. The stony character is imparted to the land by numerous rock outcrops, by the stony slopes of the sinkholes, and to a small degree by loose stone on the surface. In a few places the land is so stony that it properly would be classified as smooth stony land were its area large enough.

Included in mapping are some areas of a Hagerstown soil, which has a reddish-brown, brown, or light brownish-red surface soil and a dark-brown, brownish-red, or dark-red subsoil. One large area of this included soil is in the south-central part of the county on a ridge 2 miles south of Weaver Knob, and one is in the northeastern part on the top of Beaver Lick Mountain.

Frederick stony silt loam is developed on crests and slopes of hills and ridges. The surface ranges from rolling to hilly, and numerous sinkholes dot the landscape. Drainage takes place through the sinkholes into underground streams.

A small acreage of this soil is in woodland. The trees commonly growing are black walnut, hickory, white oak, black oak, red oak, dogwood, sugar maple, common locust, some redcedar, ash, and tuliptree or yellow poplar.

Practically all of this land is in open pasture. Kentucky bluegrass thrives on it under proper soil conditions. At present much poverty oatgrass and weeds are growing. Once the lands is limed and sufficient available phosphate is present, Kentucky bluegrass, in a normal season, will crowd out the undesirable grasses and weeds and produce a good sod. The West Virginia Agricultural Experiment Station recommends an application of 300 to 400 pounds of 20-percent superphosphate every 2 years. (See table 9, p. 65.)

The principal desirable pasture grasses on this soil are Kentucky bluegrass, white clover, timothy, hop clover, redtop, Canada bluegrass, orchard grass, and lespedeza. According to a recent survey these grasses cover an average of 32.5 percent of the land, poor native grasses and weeds 43.6 percent, and the rest of the land, or 23.9 percent, is bare. The species included in the native grasses and weeds, together with the percentage of a perfect sod they constitute, are as follows: Poverty oatgrass (*Danthonia spicata*) 11.5 percent, broomsedge (*Andropogon virginicus*) 4.3 percent, sedges and rushes 1.8 percent, weeds 21.7 percent, and miscellaneous grasses 4.3 percent. The following are the most common weeds: Cinquefoil, buckhorn plantain, oxeye daisy, yarrow, wild carrot, field sorrel, and ragweed. The miscellaneous species of grass are foxtail, chess or cheat, paspalum, nimblewill, three-awn, and crabgrass.

Thus it may be seen that the average pasture is in a comparatively poor condition, and its carrying capacity is low compared with what it might be if a good sod of nutritious grass were maintained. Obviously, the biggest problem on pasture land is to improve the sod. The recommendations are for liming and the application of superphosphate. Generally from 300 to 400 pounds of 20-percent superphosphate applied every 2 years is recommended.

Frederick-Hagerstown stony silt loams.—This soils complex represents steep areas of Frederick stony silt loam and Hagerstown stony silt loam that are too intermixed to be separated into the component soils. The soil material is dominantly Frederick, but some Hagerstown soil is present. This condition arises on long steep slopes where successive layers of various parent materials, ranging from pure to siliceous limestone, with inclusions of calcareous shale, are exposed.

The Frederick soil in this complex differs from Frederick stony silt loam, as previously described, in having a steeper slope and a shallower surface soil and subsoil. It is not so good agriculturally.

The Hagerstown soil has a 2- or 3-inch brown, dark-brown, or brownish-red silt loam surface soil overlying a dark reddish-brown, brownish-red, or dark-red silty clay or clay subsoil. Limestone rock lies from 20 to 36 inches below the surface. Because of the heterogeneous character of the parent material, no great uniformity of soil or soil color can be expected over any large area. A mixing and blending of Hagerstown and Frederick soils is most common. In places where the parent material is shaly, some inclusions of a Frankstown soil are made.

These soils are associated in large areas throughout the limestone valley with Frederick silt loam and Frederick stony silt loam, which occupy less steeply sloping land. The relief is somewhat broken and steep. These soils occur on slopes leading to streams and in some places to sinkholes. Drainage is excessive, and the land is subject to erosion if the sod is broken.

The stone is mainly in the form of outcropping ledges and boulders of massive limestone, and small loose fragments are few. Some of the land is very stony and approaches the character of rough stony land. Small areas of soil between the rock outcrops, however, support a good growth of bluegrass and trees.

Much of the steepest land is wooded. The common trees are black walnut, hickory, white oak, black oak, red oak, common locust, sugar maple, ash, tuliptree, and redcedar.

Most of this soil is used for pasture. Its carrying capacity is not so great as that of Frederick stony silt loam. It cannot be pastured so heavily as that soil because erosion sets in where the sod is broken. Most of the pastures do not support a thick growth of bluegrass. They need lime and superphosphate, and the quantities applied are the same as those recommended for Frederick stony silt loam.

Elliber cherty loam.—This is an inextensive soil occurring in the eastern part of the county. The parent material consists of cherty limestones and chert beds. The surface is strewn with angular gray chert fragments ranging from 1 to 4 inches in diameter.

Elliber cherty loam has a 3- or 4-inch gray or grayish-yellow cherty loam surface layer. In some wooded areas a 3- or 4-inch mat of organic matter overlies this layer. The subsurface layer is grayish-yellow or pale-yellow loam to a depth of 8 or 10 inches. The upper part of the subsoil is yellow or brownish-yellow heavy loam. This material grades, at a depth ranging from 15 to 18 inches, into yellowish-brown or brown silt loam or clay loam, which forms the lower part of the subsoil. Below a depth ranging from 30 to 40 inches are partly disintegrated chert beds and cherty limestone. Scattered over the surface and throughout the soil mass is a large quantity of gray chert fragments ranging in diameter from 1 inch to 4 inches. The reaction is acid. In areas adjoining the Berks soil, the Elliber soil is heavier in texture than typical, being a silt loam, and in some places on Coles Mountain the soil is more nearly a fine sandy loam, as it is underlain by some sandstone.

The land is strongly rolling, and run-off is free. Internal drainage is good, owing to the porous and open character of the subsoil, caused by the presence of chert fragments. This soil occurs on the lower and gentler slopes in narrow strips paralleling the ridges of Coles Mountain, Beaver Lick Mountain, and Bobs Ridge. It is inter-

mediate in position between the lower lying Berks shaly silt loam and the higher lying steep Elliber stony loam.

Although its total area is small, Elliber cherty loam is an important soil for pasture, owing to the stand of desirable grasses it supports. The presence of lime in the parent material promotes the growth of bluegrass. The generally good sod contrasts sharply with the barrenness of the adjoining slopes occupied by Berks shaly silt loam. Not all of this land is in open pasture, but some is wooded. Applications of lime and superphosphate, as recommended in table 9, would improve the pastures.

Upshur silt loam.—This is an important soil for pasture in the southwestern part of the county. It is associated with Atkins and Monongahela silt loams, which occur on the bottoms and terraces, and the higher lying steep Upshur stony silt loam, which is suited only to forestry. It is developed from Indian-red or purplish-red shales that contain considerable lime, together with some interbedded red or gray fine-grained sandstone.

The land is hilly to steep. It is characterized by narrow low rounded ridges, which in many places break off into short steep slopes. External drainage or run-off is excessive, and internal drainage is satisfactory.

The 3- to 5-inch surface soil of Upshur silt loam is light-brown or light reddish-brown friable silt loam. In some areas that have supported a grass cover for some time, the upper part of the surface soil is slightly darkened by the accumulation of organic matter and has a very finely granular structure. The subsoil, if it exists at all, is very shallow, ranging in thickness from 3 to 8 inches, and consists of Indian-red or purplish-red silty clay loam. At a depth ranging from 8 to 12 inches the soil is underlain by purplish-red weathered shale material, which grades into unweathered calcareous shale at a greater depth. In places some limestone rock is present from 3 to 10 feet below the surface, and in a few places it outcrops on hillsides. The soil is acid throughout, even though the underlying unweathered brittle shales do contain some lime. As soon as the shales are weathered, the lime rapidly leaches away. In places erosion has entirely removed the soil material, exposing the underlying red shale.

Included in mapping is a small area 1½ miles southwest of Pembroke School that has considerable loose stone on the surface. The stone has been brought down from the higher lying Upshur stony silt loam.

Upshur silt loam is an extensive soil. The largest areas extend southwestward from Sam Black Church and Crawley to the Greenbrier-Summers County line. Numerous bodies are developed on the less steep slopes and ridges in the north-central part of the county along Spring Creek and its tributaries, and on the slopes of the headwaters of Sinking Creek. Other areas are along the Greenbrier River, especially near Henning and Lewisburg.

Some farm woods and wooded pasture are maintained. A few areas are used only for forest. The trees commonly growing are white oak, black oak, red oak, hickory, sugar maple, common locust, dogwood, scrub pine, some pitch pine, and some white pine in the narrow valleys.

The land is adapted to grazing. The principal grass is poverty oatgrass, although when the land is newly cleared or where there has been some influence of lime from the underlying shale, bluegrass makes a

good growth. At present the carrying capacity of the pasture land is not so high as it could be. Practically none of this land has been limed; it needs lime and superphosphate fertilizer in order to promote the growth of desirable grasses and legumes. Applications of 300 to 400 pounds of 20-percent superphosphate, made every 2 years, are recommended.

The control of erosion is a big problem in the management of this soil. The comparatively steep slope and the silty character of the soil make it susceptible to severe sheet erosion and gullying. Formerly many of the hillsides were cultivated, resulting in the loss of much of the surface soil. Some few acres still are cultivated. Most of the steeper areas, however, are being left to grow up in grass or forest. Where eroded areas are large enough, they have been shown on the map as the eroded phase of Upshur silt loam.

Belmont silt loam.—Belmont silt loam is a complex of soils derived from Indian-red calcareous shale intermixed with light-colored calcareous shale and small quantities of embedded limestone. It may be considered an Upshur-Westmoreland soil complex. No uniformity of color or profile exists, owing to the heterogeneous distribution of the parent material. In places a typical Upshur profile may be observed; a few hundred feet away there may be a Westmoreland profile. Owing to this close association, it is not practical to separate the areas into their respective soil types.

No one profile description is adequate to describe this soil. Over the gray calcareous shales and platy limestone material, the surface soil is light-brown or grayish-yellow silt loam from 4 to 6 inches thick. It is underlain by yellow or brownish-yellow silty clay loam or silty clay to a depth ranging from 12 to 20 inches. Below this depth is weathered shale material. Where underlain by purplish-red shales, the surface soil is purplish-red silt loam, from 4 to 6 inches thick. The subsoil, where developed, is purplish-red silty clay loam or silty clay to a depth ranging from 8 to 12 inches. Below this depth is the weathered and partly weathered Indian-red calcareous shale. These soils grade into each other and as a result no uniformity of color exists over any extensive area.

The Belmont soil is widely scattered throughout the county at lower elevations than the Dekalb soils and between these and the Frederick soils. The total area is small. The largest body is mapped on Falling Spring Mountain. Smaller areas occur on the slopes of Brushy Mountain, along Spring Creek near Esty, on Cold Knob Mountain, at Golden, at Dansie School, at Dawson, and near the mouth of Second Creek.

The land is hilly to steep and is used mostly for pasture. It supports a good stand of grasses consisting of bluegrass, white clover, timothy, and other desirable grasses, together with smaller amounts of poverty oatgrass and weeds. In productivity the Belmont soil rates higher than the Westmoreland soil. Liming and applying from 300 to 400 pounds of 20-percent superphosphate fertilizer would increase the carrying capacity of the pasture. The silty character of the soil and its steep slope subject it to severe erosion if the sod is destroyed either through cultivation or overgrazing.

Westmoreland silt loam.—This soil is developed from more heterogeneous material than most of the preceding soils of this group. Geographically, it occurs between the soils derived from compara-

tively pure limestone on one side and those developed from sandstone material at higher elevations. Intermixed limestone and sandstone materials give rise to the Westmoreland soil. In this respect the Westmoreland soil resembles the Belmont. In contrast to the Belmont soil, however, the Westmoreland has a distinctive lay of the land and some uniformity of profile.

The land is hilly to steep and is characterized in general by a series of low rounded knobs and ridges with short but rather steep slopes. A few mountain slopes are long. The predominant color of the soil on these slopes in areas that have been cleared is yellowish brown. Many such areas have had most of the surface soil removed by erosion, which has exposed the underlying greenish-gray or yellow shales.

The 4- to 6-inch surface soil is light-brown or brownish-yellow friable silt loam. It is underlain to a depth ranging from 12 to 20 inches by a yellowish-brown, brown, or light reddish-brown friable silty clay loam subsoil. The lower part of the subsoil to a depth ranging from 26 to 36 inches is brown clay streaked with red or gray. Some broken shale fragments are present in this layer. Below this are beds of greenish-gray or brownish-yellow shales that in places are calcareous. In some places gray platy limestone or massive impure limestone may occur. Elsewhere some sandstone material is present, which is closely associated with the calcareous shales. A few areas include a small quantity of purplish-brown shale. In areas adjacent to the stony Frederick soils, limestone may outcrop near the base of the slopes. A few very steep areas having considerable loose sandstone rock scattered over the surface are also included in mapping and are designated by stone symbols. The stones have rolled down from the higher lying stony Dekalb soils.

Westmoreland silt loam is very extensive in the central part of the county in the vicinities of Carroll Hill, Miller Ridge, Unus, Friars Hill, and Esty, and north of Alderson. Other bodies occur in the limestone valley along its western edge.

About 80 percent of this soil is in pasture, and the rest is in forest. The chief tree growth is sugar maple, common locust, red oak, black oak, chestnut oak, tuliptree, hickory, and some scrub pine. The pastures consist of poverty oatgrass and bluegrass together with other native grasses and weeds.

The chief management problem on this soil is the checking of erosion, which takes place when the sod is broken. Formerly the hillsides were cultivated, and much of the soil was washed away, but at present, crops are not grown on many of these hilly slopes. The second problem is to improve the carrying capacity of the pasture. On average areas it is estimated that only about one-fourth of the pasture sod consists of desirable grasses and legumes, such as bluegrass and white clover. In order to increase these desirable species, experiments by the State experiment station indicate that it is necessary to lime the land and apply superphosphate fertilizer. It is recommended that from 300 to 400 pounds of 20-percent superphosphate be applied every 2 years. (See table 9.)

Dekalb silt loam.—This is an extensive soil associated with Dekalb stony silt loam, but it occupies more gently sloping land.

The 4- to 6-inch surface soil is grayish-brown or grayish-yellow friable silt loam. In some wooded areas a thin layer of organic matter covers the surface, and when the land is plowed the organic matter

imparts a darker color to the surface soil. The subsoil to a depth ranging from 14 to 24 inches is yellow or brownish-yellow silty clay loam. This layer, in turn, is underlain by yellow, light-yellow, or brownish-yellow partly disintegrated clay shale and silty clay material to a depth ranging from 28 to 32 inches. Below this depth is unweathered clay shale and some interbedded fine-grained sandstone. Scattered over the surface in some places is rounded or angular sandstone gravel, which does not occur in sufficient quantity to interfere with cultivation. On the tops of ridges, at elevations of 3,000 feet or more, the surface soil in wooded areas is dark grayish brown to a depth of 6 or 8 inches. Platy sandstone fragments ranging in diameter from ½ to 3 inches are abundant throughout the soil. Some gravel is present on the surface in such localities. One gravelly area is in the northwestern part of the county on Peaser Knob.

By far the largest body of the soil is in the northwestern part of the county in the vicinity of Marfrance, and areas occur between the Meadow River and the South Fork Cherry River. Smaller areas are in the southwestern part west of the Meadow River, in the north-central part north of Brushy Flat, and east of the Greenbrier River, especially on Peach Orchard Ridge.

The land ranges from gently rolling to hilly. External drainage, or run-off, is adequate to excessive on the steep areas. The soil erodes readily if the surface sod is broken. Internal drainage is slow, owing to the heavy subsoil and the underlying shales.

Only a small fraction of the total area of this soil is in cultivation, and this is generally confined to the comparatively smooth ridge tops and benches that are readily accessible. Most of this soil is in second-growth forest consisting chiefly of red oak, white oak, chestnut oak, hickory, dogwood, red maple, some poplar, and pitch pine. Many of the forested areas, owing to the favorable lay of the land, could be used for pasture if needed. Much of this soil is in the coal-mining sections. Where cultivated, the yields are somewhat lower than on Dekalb gravelly loam. Corn yields from 20 to 30 bushels per acre, wheat 10 to 15 bushels, oats 20 to 25 bushels, buckwheat 15 to 25 bushels, and hay about 1 ton. These yields are obtained after the land has been fertilized with 150 to 200 pounds of 2–12–4 or 3–12–6 complete fertilizer.

Upshur-Dekalb (Meigs) gravelly silt loams.—Upshur-Dekalb (Meigs) gravelly silt loams consist of alternate narrow strips of Dekalb gravelly loam or Dekalb silt loam and Upshur silt loam or Upshur gravelly silt loam too closely associated for separation into their respective soil types.

The surface in areas where the sod is broken has a spotted red and light-yellow appearance. In such places the surface soil to a depth of 5 or 7 inches is pale-yellow or light Indian-red silt loam. It is underlain to a depth ranging from 12 to 20 inches by brownish-yellow silt loam or light purplish-brown silty clay loam. Brownish-yellow partly disintegrated sandstone or Indian-red shales and sandstone underlie the subsoil in most places. As this soil occurs on comparatively steep slopes, some colluvial shifting and mixing has taken place. The resultant soil has an Upshur surface soil with a Dekalb subsoil, or vice versa. Where the Dekalb material predominates, the texture generally is loam. In some of the eroded areas the soil is very shallow or entirely lacking, thereby exposing the Indian-red

shales. Gravel is scattered over the surface in various quantities depending on the degree of slope. The gravel consists of gray sandstone particles from the Dekalb soils or flat reddish-brown sandstone particles from the Upshur soils. In general, the Upshur soils have little if any gravel on the surface.

The land is everywhere strongly rolling, and external drainage, therefore, is adequate to excessive.

Large areas of this soil occur in the southwestern part of the county on the slopes of Spotts Ridge, on Hamilton Ridge, and on several small mountains west of the Meadow River; in the vicinities of Rupert and Kessler; and in the central part near Trout and east and south of Williamsburg. Smaller areas are along the Greenbrier River and elsewhere.

About one-third of the total area of this land is in forest. The principal trees are red oak, chestnut oak, maple, dogwood, scrub pine, and some pitch pine. Very little of the land is cultivated, and crop yields are low. Most of the land is used for pasture, although its carrying capacity is very low. The dominant native grass is moonshine or poverty oatgrass. No attempt is made to maintain the fertility of the pastures by liming and using superphosphate fertilizer.

Atkins silt loam.—Atkins silt loam occurs in large bodies, principally along the Meadow River and its tributaries. It is associated with the better drained Philo silt loam, which, however, occupies a slightly higher position on the first bottoms, and with Monongahela silt loam, which occurs on the terraces. The parent material of all these soils is similar, but the alluvium giving rise to Atkins silt loam apparently was laid down by slack waters.

The surface soil of Atkins silt loam to a depth of about 6 inches is gray granular silt loam. It is underlain to a depth ranging from 12 to 20 inches by gray silty clay loam that is highly mottled with rust brown. This layer, in turn, is underlain to a depth ranging from 36 to 42 inches by gray or yellowish-gray silty clay or plastic clay that is intensely mottled with rust brown, or, in places, contains many soft dark-brown concretions of iron. Below this depth are water-soaked clays. In marshy areas the water table is very close to the surface.

Atkins silt loam lies nearly flat, so that run-off is slow. Run-off is further impeded by the sluggishness and high water level of the Meadow River. The average fall of this stream has been calculated to be 3.8 feet per mile. The high water table and heavy clays underlying the subsoil of Atkins silt loam largely explain its poor internal drainage. The alluvial material is laid down over heavy clays and hard red shale, which occur at depths ranging from 10 to 12 feet below the surface.

In 1937 about 40 percent of this soil had not been cleared but was still in forest, some of which was virgin growth. The salable timber was being rapidly removed. Oak, hickory, ash, American hornbeam or blue beech, red birch, sycamore, some maple, and tupelo, or black gum, comprise the tree growth. In the uncleared state and, in many places, adjacent to the streams, Atkins silt loam is marshy or semiswampy. Such areas are shown on the map by marsh symbols.

Included with this soil are a few small areas of Melvin silt loam. The alluvial material of the Melvin soil is washed from upland

soils underlain by limestone. There is little agricultural difference between these two soils in their present state.

In addition to the large areas of Atkins silt loam along the Meadow River and its tributaries, small areas are mapped in the northern part of the county, especially on Laurel Creek and Improvement Branch; in the central part, especially west of Williamsburg; in the northwestern part on Meadow Creek; on Jericho Draft north of White Sulphur Springs; and elsewhere.

Atkins silt loam is locally termed crawfish land. Unless drained by open ditches, these areas support a growth of coarse grasses and sedges, which have a comparatively low nutritive value as pasture or for hay. Where the soil is better drained, fairly good pasture is obtained. Most of the land is maintained as meadow. It produces 1 to 1½ tons of hay, principally timothy and wild grasses. On a few well-drained areas corn and soybeans are grown. Good yields of corn can be obtained with applications of 200 pounds of 3–12–6 fertilizer. Acre yields of 35 to 65 bushels of corn and 1 to 1½ tons of soybean hay are reported.

Drainage is the greatest need on this soil. Although the land is inherently fertile, no great acreage in its present state is suitable for the growing of crops. The drainage problem is discussed in a special section of this report. After draining, the greatest need is liming, as the soil is very acid. Liming would result in good yields of crops and improve the quality of hay crops, which would then contain more clover.

Pope gravelly silt loam.—This soil differs from Pope silt loam in having a large quantity of flat water-rounded gravel scattered over the surface and some throughout the soil. The fragments are as much as 3 inches in diameter. In general, this soil is shallower than Pope silt loam. Stratified sand and gravel occur at a depth ranging from 24 to 30 inches. Like the gravel-free Pope silt loam, this soil is well drained. It is associated with Dekalb shaly silt loam and Dekalb stony silt loam, which are on the hills. Much of the gravel in this soil is composed of shale and sandstone fragments that have been brought down from the adjacent Dekalb soils.

Included in mapping are a few small areas in which the material is not a soil but merely creek gravel. One such area is at Alvon. A few small included bodies adjacent to streams may have a surface soil of loam texture.

Pope gravelly silt loam is mapped principally along the small streams in the narrow intermountain valleys and immediately adjacent to some of the larger streams in the eastern part of the county. Smaller areas are in the north-central part, especially on Spring Creek, Robbins Run, and Roaring Creek; in the southwestern part on Snake Run; and elsewhere.

Most of the land is maintained in permanent pasture. Generally it is too gravelly to farm profitably. A few small areas are planted to garden crops, corn, and wheat. Yields are generally much lower than on Pope silt loam, probably partly because no fertilizer or only small quantities are used. The land is best suited to permanent pasture.

FIFTH-CLASS SOILS

The Fifth-class soils comprise more than half of the total area of Greenbrier County. These soils are too steep, broken, stony, or

unproductive to be profitably used for agriculture and are considered to be most suitable for forest. A few areas are comparatively smooth, but the surface is strewn with stony fragments, large boulders, and rock outcrops. The soils and land types included in this class are as follows: Berks shaly silt loam, Dekalb shaly silt loam, Dekalb stony silt loam, Dekalb stony loam, Dekalb stony fine sandy loam, Jefferson stony silt loam, Upshur silt loam, eroded phase, Upshur stony silt loam, Upshur-Dekalb (Meigs) stony loams, Elliber stony loam, rough stony land (Frederick-Hagerstown soil materials), and rough stony land (Dekalb soil material).

These soils are very shallow; the surface soils, except in the few comparatively smooth areas, directly overlie the parent material. Some areas that have been cleared are severely eroded, and the underlying shales are exposed. In general, a thin layer of well-decomposed leafmold covers the surface of wooded areas. At the heads of some hollows the accumulation of organic matter is much thicker than elsewhere. In general, it is recognized that the northern and eastern slopes have a thicker mat of organic matter and support a more vigorous growth of trees than the southern and western slopes.

Practically all of this land is in second-growth forest consisting chiefly of hardwoods. A few virgin tracts remain, but they are being cut rapidly. The tree growth is varied, depending largely on the elevation and on the depth and moisture-retaining capacity of the different soils. The trees growing on any particular soil are enumerated under the description of the soil type. Many of the forested areas are now a part of the Monongahela National Forest, and the United States Forest Service protects the forested tracts from fires.

Berks shaly silt loam.—This soil occurs only in the eastern part of the county in almost continuous narrow belts on the lower mountain slopes and low rounded hills. On the one hand it borders the streams or the narrow bottom lands along them, and on the other it adjoins Dekalb shaly silt loam, which occupies a higher position. The parent materials of these two soils differ. The Berks soil is derived from finely laminated dark- and light-colored shales, which give rise to a browner soil throughout, compared with the Dekalb soil. Dekalb shaly silt loam, on the other hand, is developed from the weathered products of somewhat thicker gray and yellow shales, together with some thin strata of fine-grained sandstone. The shale fragments scattered on the surface of Berks shaly silt loam are smaller and softer than those on Dekalb shaly silt loam.

The 3- to 5-inch surface soil is pale-yellow, light reddish-brown, or brownish-yellow silt loam. It is underlain to a depth of 8 to 12 inches by silty clay loam that is yellowish brown or brownish yellow tinged with red. Incompletely weathered reddish-yellow, light-gray, or yellowish-brown shale underlie the subsoil. Scattered over the surface is a large quantity of soft fragments of reddish-brown or gray shale, most of which are less than 1 inch in diameter. Here and there on steep areas the shale fragments are large. Severe erosion has exposed the underlying shale in some places. Included in mapping are areas underlain by black carbonaceous shale that weathers to light-colored soil material.

The slope is steep, and run-off is rapid. Much of the surface soil and even the subsoil, in cleared areas, have washed away.

Practically all of this land is in forest. The predominant trees are black oak, red oak, scrub oak, pitch pine, scrub pine, and dogwood. Some hemlock and white pine grow in the narrow valleys and on the lower slopes. Some of the hillsides have been cleared for pasture, but, owing to severe erosion, the land has reverted to forest.

Dekalb shaly silt loam.—This is an extensive soil on the steep slopes and narrow ridge tops in the eastern part of the county.[8] It is associated with Berks shaly silt loam and with Dekalb stony silt loam, which occupies more rugged land. The geological material of Dekalb shaly silt loam is gray, yellowish-brown, or brown shale, together with some thin strata of fine-grained sandstone.

The 5- or 6-inch surface soil is grayish-yellow or brownish-yellow silt loam. A thin layer of organic matter formed by the decay of leaves covers the surface in wooded areas. The subsoil to a depth of 12 to 20 inches is light-yellow or brownish-yellow silty clay loam containing, in places, some fragments of shale. Below the subsoil and continuing to a depth ranging from 30 to 36 inches is brownish-yellow or yellowish-brown partly decomposed shale that has retained its original bedding planes. The underlying stratum consists of hard unweathered shale, together with some thin layers of hard sandstone.

The land is moderately steep. Numerous drainageways have cut far back into the slopes, resulting in a series of narrow ridges and spurs. Excessive run-off has removed much of the surface soil and, in places, has exposed the underlying shales in areas that are not protected by a grass or forest cover. Elsewhere, ledges of brown or dark-gray shale or platy sandstone outcrop in places.

Scattered over the surface and throughout the soil mass is a large quantity of soft shale fragments and some hard platy sandstone chips. The sandstone fragments range in diameter from ½ to 4 inches.

Very few farms are situated on this soil. Some land on the ridge tops is smooth enough to be farmed, although, in general, these areas are too small and inaccessible to be desirable for farming. The soil is shallow and more or less droughty. Most of the land has been bought by the Federal Government to be made a part of the Monongahela National Forest. A few cattle and sheep are grazed in places where sufficient range is available, generally in the narrow bottoms and the heads of the numerous hollows, where the land is not so steep.

Practically all of this land is in second-growth forest. The present stand of trees, which is only fair, consists of white oak, red oak, chestnut oak, dogwood, hickory, silver or soft maple, scrub pine, and some pitch pine. On the lower slopes where more moisture is available, considerable white pine grows. Forestry seems to be the best use to which the soil should be put.

Dekalb stony silt loam.—Dekalb stony silt loam occupies the second largest area of the soils or land types in the county. The parent material is derived from brownish-yellow shales and fine-grained sandstone. The surface is steep and broken, except for a few comparatively smooth areas on the tops of ridges. Excessive run-off removes much of the surface soil in areas not protected by a grass or forest cover.

[8] The soil map of Pocahontas County shows Clymer silt loam adjoining Dekalb shaly silt loam in Greenbrier County. These two soils merge into each other almost imperceptibly. Formerly the Clymer soils were included with the Dekalb soils. In this survey, Clymer silt loam has been confined to comparatively level areas having a fairly deep soil.

The 4- to 6-inch surface soil beneath a thin layer of well-decomposed leafmold is grayish-yellow or grayish-brown friable silt loam. The subsoil to a depth ranging from 10 to 20 inches is light-yellow or brownish-yellow silty clay loam or silty clay. Below this is yellow or yellowish-brown partly weathered shale extending to a depth ranging from 24 to 36 inches. Bedrock consisting of shales and massive sandstones underlies this layer. Scattered over the surface are varying quantities of stone consisting of flat sandstone blocks in places and large rock outcrops in others. On ridge tops and in wooded areas at high elevations, there is generally more organic matter on the surface, and the surface soil to a depth of 4 to 8 inches is dark-brown silt loam.

Dekalb stony silt loam occurs on steep mountain slopes, principally on the east side of the Greenbrier River, where it is associated with Dekalb shaly silt loam and rough stony land (Dekalb soil material), and in the northwestern part of the county near Bellburn, Brown Creek, and the headwaters of Brown Creek and Big Clear Creek, where it is associated also with Dekalb silt loam, which occupies less steeply sloping areas. In addition to the areas on steep slopes, numerous bodies occupy ridge tops at elevations ranging from 3,000 to 4,000 feet above sea level, such as those on Pollock Mountain, Smokehouse Ridge, Little Clear Creek Mountain, Rockcamp Ridge, and in the vicinities of Big Bull Hill, Ellis Knob, Sugar Knob, Rockcamp Knob, Fork Mountain, and Cherry Low Place.

Very little of this land is cleared and cultivated, because it is too stony, and its best use is for forestry. Good timber, chiefly second growth, is now growing. Red oak, white oak, chestnut oak, and hickory are the dominant trees in most places, and common locust, dogwood, red maple, tuliptree, chestnut, and pitch pine are less common. Scrub pine is fairly abundant on the shallow soils of the eastern part of the county. White pine and hemlock occupy the lower slopes and hollows where there is more moisture. On ridge tops at high elevations sugar maple, beech, birch, and cherry seem to predominate. The undergrowth consists of hawthorn, sumac, mountain-laurel, and brambles.

Dekalb stony fine sandy loam.—This soil is associated with Dekalb stony loam and, in places, with Dekalb fine sandy loam. The parent material is derived from massive or thick-bedded coarse-grained sandstones. The relief everywhere is steep and broken.

On the surface in wooded areas is a thin layer of well-decomposed leafmold or organic matter. This is underlain to a depth of 4 or 5 inches by light grayish-brown or grayish-yellow loose fine sandy loam. The subsurface layer continues to a depth of 10 or 12 inches and consists of yellow or light-yellow friable fine sandy loam. Below this and continuing to a depth ranging from 14 to 24 inches is the subsoil of light-yellow or brownish-yellow heavy yet friable fine sandy loam or heavy fine sandy loam. This layer rests on bedrock of coarse-grained light-colored massive sandstones. The depth to bedrock varies; in many places the bedrock lies near the surface. Numerous broken rocks and a few large boulders are scattered over the surface. Included in mapping are a few small areas of soil that have a purplish-red fine sandy loam surface soil overlying dark-red sandstones. These areas occur on Beaver Lick Mountain.

Dekalb stony fine sandy loam lies on steep slopes of hollows leading to the Greenbrier River, Meadow River, and Meadow Creek in the northwestern part of the county. Large areas also occur on Kates, Coles, Beaver Lick, and Muddy Creek Mountains and on the west slope of Big Ridge. Smaller bodies occur elsewhere throughout the county.

Practically all of this land is in forest consisting of red oak, white oak, chestnut oak, together with some chestnut, pitch pine, and hemlock. Huckleberry, rhododendron, and mountain-laurel make up the undergrowth. The steep slope and stoniness limit the use of this land to forestry.

Dekalb stony loam.—This soil differs from Dekalb stony silt loam in texture only. The parent material of Dekalb stony loam contains more sand than the parent material of the stony silt loam and practically no shale. A slightly greater thickness of surface soil and more friable subsoil probably explain the slightly better stand and growth of timber on the stony loam as compared with that on the stony silt loam.

Except in a few small areas on ridge tops, the land is steep and broken. Surface run-off is rapid, owing to the slope of the land. Internal drainage is good, owing to the pervious subsoil, and sheet erosion, therefore, is not so severe as on the stony silt loam.

The 5- or 6-inch surface soil is grayish-yellow friable loam. Dark-brown leafmold, ranging in thickness from a thin layer to several inches, covers the surface. The subsoil, wherever it exists, is yellow friable heavy loam to a depth of 12 to 15 inches, where it gives way to brownish-yellow heavy loam or silt loam. In most places bedrock occurs at a depth ranging from 26 to 30 inches, but in steep areas it is very near the surface. Scattered over the surface is a large quantity of loose sandstone and boulders.

This soil occurs in all parts of the county. The largest area is on the slope of Allegheny Mountain, which borders the State of Virginia. Large tracts are mapped in the extreme northwestern part in the vicinity of Keester Ridge. Other areas are on the east side of the Greenbrier River; in the western part on the slopes of Sims, Goddard, Little Sewell, and Big Clear Creek Mountains; and elsewhere. The total area is large.

This stony soil generally is not suitable for cultivation, although some of the smoother areas can be farmed. A small acreage is used for cattle range. Most of the land is in forest consisting of some chestnut, red oak, white oak, chestnut oak, tuliptree, beech, locust, hickory, dogwood, hemlock, and pitch pine. The undergrowth is mountain-laurel, rhododendron, brambles, and huckleberry.

Jefferson stony silt loam.—This soil is associated with Dekalb stony silt loam and occupies the lower slopes and benchlike positions at the base of the mountains. The parent material is derived from shale, fine-grained sandstone, and in places consists of colluvium from the adjacent steep stony Dekalb soils. Owing to its proximity to these stony soils, Jefferson stony silt loam also is stony.

The 10- or 12-inch surface soil of Jefferson stony silt loam is pale-yellow or grayish-yellow silt loam. It is underlain by yellow or light brownish-yellow silty clay loam or silty clay to a depth ranging from 24 to 30 inches. Below the subsoil is partly disintegrated yellow clay shale intermixed with fine-grained sandstone. On the surface and embedded in the soil are many gray sandstone rocks and some boulders,

which have been brought down from the higher lying stony soils. These rocks are so numerous that they interfere with cultivation.

The land ranges from gently sloping to rolling. External drainage in most places is good, but internal drainage on the smoother areas is slightly impeded by the heavy-textured subsoil.

This is not an extensive soil. The largest areas are on the lower mountain slopes leading to the Meadow River near Rainelle. Bodies occur on the lower slopes leading to Meadow Creek in the eastern part of the county, leading to Big Clear Creek and its North Fork, and in other places.

Most of this land is in forest consisting of beech, maple, white oak, dogwood, hickory, tuliptree, pitch pine, and scrub pine. Areas are being cleared and used for home sites because they are near coal mines. Garden vegetables can be produced if the stones are removed from the land. The generally high stone content makes it impractical to farm this soil.

Upshur silt loam, eroded phase.—The eroded phase designates areas of Upshur silt loam that are too severely eroded to be used any longer for agriculture. Most of this land is hilly to steep. In general, 75 percent or more of the surface soil has been removed by erosion, and in places the underlying red shales are exposed. Some small bodies, where better farming practices have prevailed, are not so severely eroded as others, but it is not practical to separate them on a small-scale map. In addition to surface erosion, numerous gullies are present, ranging in width from 1 to 4 feet, in depth from 6 inches to about 6 feet, and in length from 50 to 300 feet or more. In places these gullies run the full length of the slope. The gullies should be checked by appropriate means and planted to fast-growing trees and shrubs. Pitch pine is a desirable tree for these droughty soils. A few attempts are being made to control erosion, although in most of the areas erosion and gullying continues unchecked. Keeping the land out of pasture may prevent, at least, further waste. Forestry probably is the best use for this soil in its present condition.

The principal bodies are south of Ronceverte. Isolated areas are near the Little Clear Creek bridge on United States Highway No. 60, east of Grassy Meadows, and 2 miles northeast of Lewisburg. The total area is small.

Upshur stony silt loam.—This soil includes areas of Upshur soils that are too steep or both too steep and too stony to have significant agricultural value. They are best adapted to forestry. Most of this soil occurs on the upper and middle mountain slopes at an elevation ranging from 2,500 to over 3,500 feet above sea level. The land is steep and broken by numerous drainageways that have cut deeply into the slopes. Included are a few small, comparatively smooth, benchlike areas, which cannot be separated conveniently and shown in a different classification.

Upshur stony silt loam is very shallow. The surface soil is dark purplish-brown or Indian-red friable silt loam, from 2 to 5 inches thick. In wooded areas it is covered with a thin layer of dark well-decomposed leafmold. Directly below the surface soil is partly weathered Indian-red clay shale which merges into unweathered brittle clay shale or into fine-grained reddish-brown sandstone. The shale in places is calcareous. Narrow belts of gray impure limestone outcrop on some of the steep slopes, and in such places the soil is lighter colored

than typical. Scattered over the surface are varying quantities of red and brown flat sandstone blocks ranging in diameter from 5 to 12 inches. Some gray sandstone rocks and boulders from the higher lying Dekalb soils or rough stony land are also present. Numerous outcropping ledges of red or brown laminated sandstone are common on the steepest slopes. Included with this soil on the map are steep areas in which the soil carries little or no loose stone on the surface and is developed principally from shales.

An almost continuous belt of this soil extends from the Summers County line northwest of Alderson to the Pocahontas County line northwest of Renicks Valley. The largest areas are on the slopes of Bennett and Cold Knob Mountains and on the slopes of Chestnut Ridge. The large area in the southwestern part of the county, along the slopes that lead to Kitchen Creek, Sawmill Hollow, and Snake Run, contains less loose stone on the surface than those mapped farther north. A few small areas are in the west-central part near Boggs Creek and in the northeastern part east of the Greenbrier River.

Only a few areas of Upshur stony silt loam are used for pasture. After the timber is cut on areas underlain by calcareous shale, Kentucky bluegrass and other native grasses start growth. The land should not be pastured too heavily, owing to its steepness. Once the sod is broken, erosion rapidly removes the surface soil. It is primarily for this reason that the soil is considered best suited to forest.

Practically all of this soil is in forest supporting a good growth of hardwoods—principally beech, sugar maple, sweet, or black, birch, white oak, black oak, red oak, hickory, walnut, tuliptree, and cherry. Some of this is virgin forest from which the trees are rapidly being removed.

Upshur-Dekalb (Meigs) stony loams.—Upshur-Dekalb (Meigs) stony loams comprise a complex of Upshur stony silt loam and Dekalb stony loam or Dekalb stony silt loam too closely associated for separation into their respective soil types. No one description would suffice for this complex. Colluvial shifting and mixing has resulted in a soil that has a Dekalb surface soil and an Upshur subsoil, or vice versa. In some places the soil is developed from a mixture of light-colored shale, red shale, and variegated sandstone, which results in a profile that is neither true Upshur nor Dekalb. Here, the soil has a light-brown, yellowish-brown, or yellow surface soil and a light-brown or light reddish-brown subsoil. In places the texture of the surface soil is silt loam.

The stones present are principally light-colored sandstone blocks and fragments that have broken off from the higher lying ledges and rock outcrops. They are strewn over the surface, especially in the hollows. In places, principally in ravines and hollows, large gray sandstone rocks or boulders have rolled from the higher lying stony soils or rough stony land, although there are only a few stones on intervening slopes. In places where the ravines open out on benches this rock and earth mixture spreads out for some distance.

This soil complex occurs in all parts of the county. The largest areas occupy the slopes at the headwaters of the tributaries of Muddy Creek and the Meadow River, especially Sewell and Little Clear Creeks. Bodies are along Roaring Creek, along Spring Creek, on Miller Ridge, at Ronceverte, and elsewhere.

The land is steep and broken. A few areas on benches near the mouths of hollows are comparatively smooth, but they are small and extremely stony. Some are cleared for pasture and garden crops. Most of the land is wooded with a few chestnut, chestnut oak, red oak, hickory, maple, dogwood, scrub pine, and some pitch pine. The best use for this soil is forestry.

Elliber stony loam.—This soil is mapped only in the eastern part of the county along the steep slopes of Beaver Lick and Coles Mountains. It occurs in discontinuous narrow belts adjoining Berks shaly silt loam or the Dekalb soils. The parent material is cherty limestone and chert beds. Chert remains persist in the form of angular white, gray, brown, and red fragments, ranging in diameter from 1 to 5 inches, which are scattered over the surface and throughout the soil mass. In addition large stones or blocks of the same material are strewn over the surface, giving the land a very stony appearance.

The 10- to 14-inch surface soil of Elliber stony loam is grayish-yellow or light-gray cherty loam. A 2- to 4-inch black mat of organic matter covers the surface in wooded areas. The subsoil is brownish-yellow or yellow heavy loam or silt loam, extending to a depth ranging from 24 to 36 inches, where it rests on partly disintegrated chert beds and cherty limestones. Siliceous limestone outcrops in many places on the steep mountain slopes.

Included in mapping are a few small areas of soil that have an 8- or 10-inch dark reddish-brown silt loam surface soil and a light-brown or reddish-brown friable silty clay loam subsoil. This inclusion resembles the Hagerstown soils in color and is closely associated and intermixed with Elliber stony loam. The surface is strewn with the same pink and brown cherty stones and blocks that characterize Elliber stony loam.

The land is steep and broken. Run-off tends to be excessive. Internal drainage is good, owing to the open porous structure of the subsoil imparted by the cherty fragments. Fortunately most of the surface is protected by a forest cover, and the land is best suited for forestry. The dominant trees growing on it are hickory, common locust, walnut, sugar maple, maple, white oak, black oak, hemlock, pitch pine, and some white pine.

Rough stony land (Frederick-Hagerstown soil materials).—Areas of thin stony soils over limestone, which are too steep, stony, or rough to be classified with the agricultural soils of the county, are designated as rough stony land (Frederick-Hagerstown soil materials). Active erosion has kept pace with weathering and soil development, so that very little soil material has formed between the rocks and little soil development has taken place. Where soil material is present, it resembles the subsoil of the Frederick soils in color and consistence. In a few places it is much darker—brownish red or reddish brown—and resembles the Hagerstown soil. The stone consists of a mass of limestone rock, and in places ledges of rock are exposed. A few more gently sloping areas that are too stony to be classified otherwise are included with this land type. Several such areas are north of Frankford.

This rough stony land occupies small areas in the limestone valley, mainly narrow strips along the Greenbrier River, especially near

Fort Spring and Falling Spring, and along Spring Creek and its tributaries.

Practically all of this soil is in woodland. The common trees are black walnut, hickory, white oak, black oak, red oak, common locust, dogwood, sugar maple, redcedar, ash, and tuliptree.

Rough stony land (Dekalb soil material).—This classification includes large areas of land that are too broken, steep, or stony for farming. It occupies 19.5 percent of the land area of the county.

Most of this land occurs in the northern part at elevations of 3,000 feet or more and in some places over 4,000 feet. At the high elevations that probably mark the remnants of an old plateau, the slopes are more gentle than those generally included in this classification. This is true of the top of Fork Mountain and nearby ridges. However smooth these sections may be, they are probably the stoniest. Scattered over the surface are huge blocks and boulders of gray sandstone and conglomerates, some of which are more than 6 feet in diameter. Loose rock also is abundant. The upper and lower mountain slopes adjoining these areas are strewn with rocks and boulders that have broken off from the rock masses in higher lying areas.

Large bodies also occur in the eastern part of the county on the strongly folded geological formations, along the precipitous slopes on the east side of the Greenbrier River, and on the slopes leading to Meadow Creek. Numerous widely scattered smaller bodies occur throughout all parts of the county, associated with the Dekalb and Upshur soils. This rough stony land includes dominantly Dekalb material, together with some Upshur and Lehew materials. Along the upper slopes of Beaver Lick Mountain the sandstones are red. The ridge tops are capped with gray sandstones. In the northeastern part along Spice, Davy, Red, Kincaid, and Slabcamp Runs, rough stony land is mapped on the Catskill formations, which give rise to the red soils of the Lehew series.

At the highest elevations beech, birch, maple, cherry, and some hemlock are the dominant trees. Spruce grew here at one time, but it has been cut. Even though the land is rough, sufficient soil exists to promote the vigorous growth of trees. Other trees growing at this elevation are the hawthorn, staghorn sumac, serviceberry or shadbush, and mountain-ash. The undergrowth consists chiefly of mountain-laurel, rhododendron, ferns, and hobblebush. Cut-over areas soon become overgrown with berry briers. The lower mountain slopes support a growth of hardwoods, principally red oak and chestnut oak, together with some hickory, tuliptree, and ironwood.

Rough stony land is not suitable for farming and should be left in forest. Much of this land is now a part of the Monongahela National Forest.

PRODUCTIVITY RATINGS

Table 7 lists the soils of Greenbrier County in alphabetical order and shows the estimated average yields of the more important crops under prevailing cropping practices.

In table 8 the soils are rated according to their ability to produce the more important crops of the county and according to their carrying capacity for livestock when devoted to pasture. Difficulties in working or conserving the soil modify the order of some ratings.

TABLE 7.—*Estimated average acre yields of the principal crops on each soil in Greenbrier County, W. Va.*[1]

Soil (soil types, phases, complexes, and land types)	Corn	Wheat	Barley	Oats	Buckwheat	Timothy hay	Red clover	Alfalfa	Soybean hay	Potatoes	Permanent pasture	
											Present practices	Recommended practices[2]
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Tons*	*Tons*	*Tons*	*Tons*	*Bushels*	*Cow-acre-days*[3]	*Cow-acre-days*[3]
Atkins silt loam[4]											68	[5]85
Belmont silt loam											60	75
Berks shaly silt loam												
Clymer loam	30	14		30	25	1			1.5		56	70
Clymer silt loam	25	14		25	25	1			1.5		56	72
Dekalb fine sandy loam	22	12	25	25	20	.75			1	[6]150–300	30	38
Dekalb gravelly loam	25	12		25	25	1			1	[6]150–300	50	62
Dekalb shaly silt loam											5	
Dekalb silt loam											45	60
Dekalb stony fine sandy loam												
Dekalb stony loam											5	
Dekalb stony silt loam											5	
Elk silt loam	50	25	45	35		3	3	3	2	150–300	85	95
Elliber cherty loam											65	75
Elliber stony loam											5	
Frankstown silt loam	50	25	50	40		2	2	4	3	275	80	100
Frankstown silt loam, hilly phase	40	20	40	30		1.5	1	2.5	2		65	80
Frederick cherty silt loam	45	22	50	35		2	2	3.5	2		75	90
Frederick silt loam	50	25	50	40		2	2	4	3		80	100
Frederick stony silt loam											74	90
Frederick-Hagerstown stony silt loams											48	70
Holston loam	30	18		35	25	1.5			1.25		65	80
Jefferson stony silt loam											8	
Monongahela silt loam	30	15		33	25	1.5			1.5	150	70	85
Moshannon silt loam[4]	50	20		30		3	3				90	100
Philo silt loam	35	15				1.5					75	90
Pickaway silt loam	38	20		38	25	1.5	1.5	[7]	2		70	80
Pope fine sandy loam	45	18				2			3		85	100
Pope gravelly silt loam											73	88
Pope silt loam	35	15		30	25	1.3			2		75	90
Rough stony land (Dekalb soil material)												
Rough stony land (Frederick-Hagerstown soil materials)												
Sequatchie loam	33	18		30	25	1.3	.5		1.75		73	90
Upshur silt loam											50	65
Upshur silt loam, eroded phase												
Upshur silt loam, smooth phase	30	16	35	30	25	1.5	1.25		1.5		70	88
Upshur stony silt loam[7]											10	

Upshur-Dekalb (Meigs) gravelly silt loams											45	58
Upshur-Clymer (Meigs) silt loams	30	12		30		1			1.25		55	68
Upshur-Dekalb (Meigs) stony loams											5	
Westmoreland silt loam											60	75
Westmoreland silt loam, smooth phase	35	18		35	30		1.5	1.25		1.5	70	88

[1] These estimates are based on prevailing practices of management that generally include a 3-year rotation of corn, grain, and hay; manuring; and the addition of about 200 pounds of complete fertilizer. Lime is commonly used on soils in the limestone valley.

[2] Recommended practices refer to liming and the application of superphosphate.

[3] Cow-acre-days is a term used to express the carrying capacity of pasture land. As used here it is the product of the number of animal units carried per acre multiplied by the number of days the animals are grazed without injury to the pasture. For example, the soil type able to support 1 animal unit per acre for 360 days of the year rates 360, whereas a soil type able to support 1 animal unit on 2 acres for 180 days of the year rates 90. Again, if 4 acres of pasture support 1 animal unit for 100 days, the rating is 25.

[4] These soils are subject to overflow.

[5] Partial drainage is provided.

[6] Potatoes are fertilized with 1,500 pounds of 4–10–6 for these yields.

[7] These soils, if cleared, will provide some pasture.

[8] Alfalfa has been grown recently on Pickaway silt loam, but its survival is questionable; insufficient data for a yield figure.

TABLE 8.—*Productivity ratings of the soils of Greenbrier County, W. Va.*

Soil (soil types, phases, complexes, and land types) [1]	Crop productivity index [2] for—												General productivity grade [3]	Remarks concerning fertility, drainage, workability, and erodibility	Land classification [4]
	Corn	Wheat	Barley	Oats	Buckwheat	Timothy hay	Red clover	Alfalfa	Soybean hay	Potatoes	Pasture: Present	Pasture: Recommended			
Elk silt loam	100	100	110	70	----	150	150	75	80	[5] 75–150	85	95	1 (90–100)	Comparatively fertile; easily worked; slightly erodible.	First-class soils (good to excellent cropland).
Moshannon silt loam	100	80	----	60	----	150	150	----	----	----------	90	100		Fertile; occasionally flooded; easily worked; slightly or not at all erodible.	
Frankstown silt loam	100	100	125	80	----	100	100	100	120	135	80	100		Fairly fertile, easily worked and responsive to good management; slightly erodible.	
Frederick silt loam	100	100	125	80	----	100	100	100	120	----------	80	100		Fairly fertile; easily worked and responsive to good management; moderately erodible.	
Frederick cherty silt loam	90	90	125	70	----	100	100	85	80	----------	75	90		----do----------	
Pope fine sandy loam	90	72	----	----	----	100	----	----	120	----------	85	100	2 (80–90)	Fairly fertile; occasionally flooded; easily worked; slightly or not at all erodible.	Second-class soils (fair to good cropland).
Pickaway silt loam	75	80	----	75	100	75	75	----	80	----------	70	80	3 (70–80)	Fairly fertile; slowly drained internally; easily worked and responsive to good management; very slightly erodible.	
Pope silt loam	70	60	----	60	100	65	----	----	80	----------	75	90	4 (60–70)	Medium to low fertility; occasionally flooded; easily worked and responsive to good management; slightly or not at all erodible.	
Sequatchie loam	65	70	----	60	100	65	25	----	70	----------	75	90		Medium to low in fertility; seldom flooded; easily worked and responsive to good management; slightly or not at all erodible.	
Holston loam	60	70	----	70	100	75	----	----	50	----------	65	80		----do----------	
Monongahela silt loam [6]	60	60	----	65	100	75	----	----	60	75	70	85		Medium to low in fertility; slowly drained; rather difficult to work in places; slightly or not at all erodible.	
Westmoreland silt loam, smooth phase	70	70	85	60	----	75	60	----	60	----------	70	90		Fairly fertile; sloping and subject to erosion if clean cultivated.	
Upshur silt loam, smooth phase	60	65	85	60	100	75	60	----	60	----------	70	90		----do----------	
Frankstown silt loam, hilly phase	80	80	100	60	----	75	50	60	80	----------	65	80		Fairly fertile; mostly hilly, steep, and subject to erosion if clean cultivated. Only smoother areas cultivated.	

Philo silt loam [6]	70	60	---	---	---	75	---	---	---	---	75	90	5 (50–60)	Fairly fertile; flat, imperfectly drained, and occasionally flooded; difficult to work and low in productivity on wetter areas or in wet years.	Third-class soils (poor to fair cropland).
Clymer loam	60	55	---	60	100	50	---	---	60	---	55	70		Rather low in fertility; responsive to liming and fertilization; rolling surface; subject to erosion if clean cultivated.	
Clymer silt loam	50	55	---	50	100	50	---	---	60	---	55	70		---do---	
Upshur-Clymer (Meigs) silt loams	60	50	---	60	---	50	---	---	50	---	55	70		---do---	
Dekalb gravelly loam	50	50	---	50	100	50	---	---	40	[5] 75–150	50	60		Low in fertility; responsive to fertilization; sloping to hilly and subject to moderate erosion if not covered by vegetation.	
Dekalb fine sandy loam	45	50	60	50	80	35	---	---	40	[5] 75–150	30	40	6 (40–50)	---do---	
Frederick stony silt loam	---	---	---	---	---	---	---	---	---	---	75	90	7 (30–40)	Fairly fertile; responsive to fertilization and liming; but very stony, uneven, and impracticable to cultivate.	Fourth-class soils (pasture land).
Pope gravelly silt loam	---	---	---	---	---	---	---	---	---	---	75	90		Medium to low in fertility; very gravelly and hard to work	
Atkins silt loam	---	---	---	---	---	---	---	---	---	---	70	85		Medium to low in fertility; low, flat, poorly drained, and frequently flooded.	
Elliber cherty loam	---	---	---	---	---	---	---	---	---	---	65	75	8 (20–30)	Fairly fertile; responsive to liming and fertilization; but strongly rolling and subject to erosion if not covered by vegetation.	
Belmont silt loam	---	---	---	---	---	---	---	---	---	---	60	75		---do---	
Westmoreland silt loam	---	---	---	---	---	---	---	---	---	---	60	75		---do---	
Frederick-Hagerstown stony silt loams	---	---	---	---	---	---	---	---	---	---	50	70		Fairly fertile; but stony, broken, steep, and impracticable to cultivate; subject to erosion if sod is broken.	
Upshur silt loam	---	---	---	---	---	---	---	---	---	---	50	65		Fairly fertile; but hilly to steep and difficult to work; subject to severe erosion if not covered by vegetation.	
Dekalb silt loam	---	---	---	---	---	---	---	---	---	---	45	60		Low in fertility; but responsive to liming and fertilization; rolling to hilly and subject to severe erosion if not covered by vegetation.	
Upshur-Dekalb (Meigs) gravelly silt loams	---	---	---	---	---	---	---	---	---	---	45	60		---do---	

[1] The soils are listed in the approximate order of their general productivity under the average current practices, the most productive first.

[2] The soils of Greenbrier County are given indexes that indicate the approximate average production of each crop in percentage of the standard of reference. The standard represents the approximate average acre yield obtained without use of amendments on the more extensive and better soil types of the regions in which the crop is most widely grown.

[3] This classification indicates the comparative general productivity of the soils under dominant current practices. Refer to text for further explanation.

[4] This is a general classification to indicate the physical suitability of the soils for crop growing, grazing, or forestry. It should be understood that the croplands will support fair to excellent pasture and that practically all of the land will support trees.

[5] The number on the left indicates the average yield; that on the right indicates the yield obtained by application of 1,500 pounds an acre of 4–10–6 fertilizer.

[6] The indexes given for crop yields on Monongahela silt loam and Philo silt loam refer to yields obtained on the better drained areas in years when rainfall is not excessive.

TABLE 8.—*Productivity ratings of the soils of Greenbrier County, W. Va.*—Continued

Soil (soil types, phases, complexes, and land types)	Crop productivity index for—												General productivity grade	Remarks concerning fertility, drainage, workability, and erodibility	Land classification
	Corn	Wheat	Barley	Oats	Buckwheat	Timothy hay	Red clover	Alfalfa	Soybean hay	Potatoes	Pasture				
											Present	Recommended			
Jefferson stony silt loam	----	----	----	----	----	----	----	----	----	----	10	----	10 (0–10)	Low in fertility; very stony and difficult to cultivate.	Fifth-class soils (forest land).
Upshur stony silt loam	----	----	----	----	----	----	----	----	----	----	10	----		Steep, stony, and shallow; subject to rapid erosion if not covered by vegetation.	
Elliber stony loam	----	----	----	----	----	----	----	----	----	----	5	----		----do----	
Upshur-Dekalb (Meigs) stony loams	----	----	----	----	----	----	----	----	----	----	5	----		----do----	
Dekalb stony loam	----	----	----	----	----	----	----	----	----	----	5	----		----do----	
Dekalb stony silt loam	----	----	----	----	----	----	----	----	----	----	5	----		----do----	
Dekalb shaly silt loam	----	----	----	----	----	----	----	----	----	----	5	----		----do----	
Upshur silt loam, eroded phase	----	----	----	----	----	----	----	----	----	----	----	----		Steep, shallow, and severely eroded.	
Berks shaly silt loam	----	----	----	----	----	----	----	----	----	----	----	----		Steep, shaly, and shallow; subject to rapid erosion if not covered by vegetation.	
Dekalb stony fine sandy loam	----	----	----	----	----	----	----	----	----	----	----	----		----do----	
Rough stony land (Frederick-Hagerstown soil materials)	----	----	----	----	----	----	----	----	----	----	----	----		----do----	
Rough stony land (Dekalb soil material)	----	----	----	----	----	----	----	----	----	----	----	----		----do----	

NOTE: Absence of an index shows that the crop is not grown on the particular soil type.

The ratings compare the productivity of each soil for each crop to a standard of 100. The standard represents the approximate average acre yield of the crop obtained without the use of amendments on the more extensive and better soils of the regions where the crop is grown principally. A rating of 50 indicates that the soil type is half as productive for the specified crop as are soils with the standard index. Small areas of unusually productive soils or soils given amendments, fertilizers, or special treatment, such as irrigation, often return larger crop yields than the standard; and under such conditions ratings above 100 are given.

The following tabulation sets forth the acre yields that have been established as standards of 100. These figures represent average long-time yields of crops of satisfactory quality.

Corn	bushels	50
Wheat	do	25
Barley	do	40
Oats	do	50
Buckwheat	do	25
Potatoes	do	200
Timothy hay	tons	2
Red clover	do	2
Alfalfa	do	4
Soybean hay	do	2½
Pasture	cow-acre-days [1]	100

[1] The term "cow-acre-days" is used to express the carrying capacity or grazing value of pasture or range lands. It is the product of the number of animal units supported on an acre of pasture multiplied by the number of days the animals are grazed without injury to the pasture. For example, a soil type able to support 1 animal unit per acre for 360 days of the year rates 360, whereas another soil type able to support 1 animal unit per 2 acres for 180 days of the year rates 90. Again, if 4 acres of pasture support 1 animal unit for 100 days the rating is 25.

The principal factors that determine the productivity of land are climate, soil, slope, drainage, and management. Consideration must be given to all these factors in setting up productivity ratings for soil types and an attempt made to evaluate their influence. Crop yields over a long period of time offer the best available summation of the combined effect of the factors, and they are used as guides in establishing ratings wherever they are available. When such data are lacking, the indexes represent estimates based on observations, experience, and interviews.

The indexes in this table represent yields obtained under prevailing current soil-management practices. Current practices on the soils of the uplands and terraces of Greenbrier County are considered to include the use of available manure, moderate applications of commercial fertilizers, and more or less definite crop rotations. On the soils of the bottom lands, such as the Moshannon, Pope, and Philo soils, comparatively little fertilization or crop rotation is regularly practiced. These latter soils are stronger than those of the uplands and will produce fairly good crops without the use of the more intensive practices, although they doubtless would return larger yields if better practices were used.

Natural drainage of Monongahela silt loam and Philo silt loam is imperfect, and artificial drainage is provided in places. The yields given in the table are for the better drained areas in years when rainfall is not excessive. Under poorer drainage conditions, the land is harder to work and yields are considerably lower.

The order of rating of the soils depends principally on their general productivity under current soil-management practices. The general productivity is indicated in the column headed "General productivity grade." This is based on a weighted average [9] of the crop productivity indexes for each soil, using the approximate proportionate acreage of the various crops as the basis for the weighting. If the weighted average is between 90 and 100 the soil is given a grade of 1; if it is between 80 and 90, a grade of 2 is assigned; and so on.

Some variation in the order of rating was made because of soil features that affect, favorably or unfavorably, the productivity, workability, and durability of the soil. These are brought out in the column headed "Remarks concerning fertility, drainage, workability, and erodibility." These features all affect the suitability of the land for crop growing, grazing, and forestry and, together with the productivity ratings, are used as the bases for the grouping of the soils included in the column headed "Land classification."

Productivity rating tables do not present the relative roles that soil types play in the agriculture of a county but rather indicate the productive capacity of each type. Total agricultural production of a soil type depends on its extent and geographic distribution quite as much as on its actual productivity.

Economic considerations play no part in determining the productivity indexes; they are meant to refer to production of each crop or groups of crops. The indexes, therefore, cannot be interpreted into land values except in a very general way. The value of land depends on distance from market, the relative prices of farm products, and a number of factors in addition to the productivity of the soil.

LAND USES AND SOIL MANAGEMENT

A general grouping of soils or land classification is made in the sections entitled "Soils and Crops" and "Productivity Ratings." [10] The soils are grouped in five classes according to their relative suitability for crop growing, grazing, and forestry, as follows: First-class soils—good to excellent cropland; Second-class soils—fair to good cropland; Third-class soils—poor to fair cropland; Fourth-class soils—pasture land; Fifth-class soils—forest land.

The First-class soils occupy only about 5.6 percent of the county, the Second-class soils about 6.1 percent, and the Third-class soils about 10.2 percent. The total acreage of soils of the first three classes, comprising land that is considered suitable for crop growing,

[9] The weights in percentage given the crop indexes to arrive at the general productivity grade of the soils on which crops are grown were as follows:

	Percent
Corn	30
Wheat	15
Barley	1
Oats	4
Buckwheat	1
Hay (clover and timothy)	35
Alfalfa	1
Soybean hay	1
Potatoes	2
Pasture	10

In the instance of soils for which only a pasture rating is given, a weight of 30 percent was given to that rating.

[10] A somewhat similar classification is contained in a publication entitled Land Classification in West Virginia Based on Use and Agricultural Value (*14*).

is 143,360 acres, or 21.9 percent of the county. The Fourth-class soils, which are not considered suitable for cropping but are suitable for pasture, occupy 148,352 acres, or 22.7 percent. The Fifth-class soils, which are not considered suitable for cropping or pasture but which will support a forest growth, comprise about 363,008 acres, or 55.4 percent of the county.

It should be understood that most of the soils of the first three classes will produce fair to excellent pasture and all are capable of supporting a tree growth. The area of land that can be used for crop production is small, however, and it is generally considered desirable to use a large proportion of it for crops. As it is generally more profitable to use land suitable for pasture for that purpose rather than for forest, the latter use is confined largely to land that is rough and steep and includes shallow stony soils of comparatively low fertility.

CROPS AND ROTATIONS

Aside from the nearly level areas of soils on the bottom lands and terraces, most of the best farming land is gently rolling upland subject to erosion whenever a heavy rain occurs. As a rule heavy downpours are uncommon in the limestone valley, and soils developed from limestone are not so erodible as those developed from sandstone and shale. The relief, however, subjects the soil to erosion if it is planted to cultivated crops year after year. A rotation system that includes a winter cover crop and a hay crop for 1 or more years would minimize losses from erosion and still allow the land to be farmed.

Because the undulating surface of the limestone valley slopes in various directions, contour strip cropping is impracticable, but a modified form of this method, known as field strip cropping, is recommended by the Soil Conservation Service at Lewisburg. This consists of planting common cultivated crops in more or less uniform parallel strips alternating with close-growing crops. The strips are laid out crosswise of the general slope but not parallel to the true contour. In this way free run-off can be checked by the cover crop. It is not practicable to terrace the slopes in this section because it is preferable to leave the fairly steep areas in sod. Some diversion ditches are built on fairly steep slopes that are in pasture. These ditches conserve moisture and reduce run-off. In a cattle-raising section where much hay is needed, these areas can be left in pasture or seeded to clover or soil-conserving crops.

Three-year rotations have been most common, owing to the need for so much corn to feed the livestock. The more progressive farmers, however, are beginning to realize that legume crops, such as alfalfa, clover, or soybeans, have a high feeding value and can replace a part of the corn. As alfalfa produces good yields at a lower cost than most feed crops, it is becoming increasingly popular. The fields produce for 3 years or longer. The change to alfalfa is a very desirable one, as this crop reduces surface run-off and enriches the soil. The result is that the rotation systems are being changed to 5-year or longer periods, depending on how long the alfalfa stands continue to produce. The growing of alfalfa in this county by many farmers, however, is still in the experimental stage.

The growing of leguminous crops should be extended in order to build up the nitrogen supply of the soils and to produce forage crops with a high content of protein. On well-drained soils, which can be limed profitably, alfalfa is the best legume to grow. It will produce annually more hay per acre than any other legume and at a moderate cost per ton. It should be grown in a regular crop rotation that allows about 3 or 4 years for the legume. A rotation suited to the limestone valley is as follows: Corn, 1 year; wheat or barley, 1 year; alfalfa, 3 years. The alfalfa is seeded in the spring on the grainfield. The land is limed according to requirements determined by testing. The lime is generally applied on corn stubble land and disked in with the small grain. Alfalfa is fertilized with 500 to 600 pounds of 2–14–4 complete fertilizer or 20-percent superphosphate. Valuable suggestions on the growing of alfalfa are given by Friant and Garber in a bulletin of the West Virginia Agricultural Experiment Station (*7*).

For the limestone valley it is recommended [11] that alfalfa be sown with clover, if alfalfa has not been grown before, in the ratio of 4 pounds of alfalfa to 8 pounds of clover. This ratio is desirable because of the slowness of alfalfa to get a start in a new area. In the previous fall timothy would have been sown with the wheat. Good seed is important to the success of alfalfa. The varieties best adapted to West Virginia are northern-grown Common, Lebeau, Grimm, Cossack, Hardigan, Canadian Variegated, and Ladak.

More attention should be given to the small fruit orchards that are associated with practically every farm. Pruning and the addition of a nitrate fertilizer will help to improve the sturdiness of the trees. Spraying will increase the crop yields. The West Virginia Agricultural Experiment Station has made recommendations for orchard spraying (*15*).

An improved variety of winter wheat has been developed by the West Virginia station. It is known as the Canawa. It has practically awnless spikes that droop when ripe. The seed is short, semihard, and red (*8*).

FERTILIZERS

The soils of Greenbrier County have been leached of a large part of their plant nutrients; consequently it is necessary to resort to the use of fertilizers if satisfactory yields of crops are to be obtained. The three essential elements used in greatest amounts by growing plants are nitrogen, phosphorus, and potassium. The soils of this county are deficient in phosphorus. In addition, sandy or light-textured soils and soils that are low in organic matter are likely to be deficient in potash.

Most of these deficiencies are supplied by the use of a complete fertilizer. Wherever stable manure is available, it is used on land and generally supplemented with 20-percent superphosphate. Turning under legumes or green manures helps to build up the nitrogen or organic-matter content of soils. According to experiments, the increase in nitrogen brought about either by turning under sweetclover or including clover and timothy in a rotation of corn and wheat gave increases in the yield of corn comparable with those obtained by a liberal application of nitrogen.

[11] United States Soil Conservation Service, Lewisburg, W. Va.

The West Virginia Agricultural Experiment Station has compiled a list of fertilizers to be used for different crops. The soils are grouped in two broad groups—productive and unproductive soils. With the productive soils are included those that have received manure or had a legume turned under during the last 2 years. Table 9 presents these recommendations. It appears that these suggestions are applicable to silt loam soils. Sandy soils will demand a higher potash fertilizer than the one recommended. As fertilizer recommendations for definite soil types are not available, these general recommendations are presented herewith.

TABLE 9.—*Suggested fertilizers for West Virginia farms* [1]

Crop	Rate of application and kind of fertilizer recommended for—	
	Unproductive soils	Productive soils [2]
	Pounds	*Pounds*
Corn [3]	400 of 4-12-4 [4]	300 of 20-percent superphosphate.
Small grain (seeded to alfalfa) or alfalfa seeded alone.	500 to 600 of 2-14-4	400 of 20-percent superphosphate.
Small grain (seeded to other hay crop).	300 to 400 of 2-14-4	200 to 250 of 20-percent superphosphate.
Small grain (seeded alone) [5]	200 to 250 of 20-percent superphosphate.	None.
Small grain (for cover crop in orchards).	400 to 500 of 4-12-4	200 to 300 of 4-12-4.
Buckwheat	200 to 250 of 2-14-4	150 to 200 of 20-percent superphosphate
Sweetclover (for cover crop in orchards).	300 to 400 of 0-14-6	200 to 300 of 20-percent superphosphate.
Soybeans	250 to 300 of 0-14-6	150 of 20-percent superphosphate.
Alfalfa (top dressing)	250 to 350 of 0-14-6	200 to 300 of 20-percent superphosphate
Timothy (top dressing) [6]	150 to 200 of nitrogen fertilizer	100 to 150 of nitrogen fertilizer.
Pastures [7]	300 to 400 of 20-percent superphosphate	200 to 300 of 20-percent superphosphate
Potatoes [3]	1,500 to 2,000 of 4-10-6	1,000 to 1,500 of 4-10-6.
Tobacco [8]	800 to 1,200 of 4-10-6	500 to 800 of 4-10-6.
Truck crops [3] [8]	1,500 to 2,000 of 4-10-6	1,000 to 1,500 of 4-10-6.
Lawns and fairways (established)		150 to 200 of 10-6-4 in spring, early summer, and fall.

[1] Recommendations based on results obtained by the West Virginia Agricultural Experiment Station.
[2] Soils that have received manure or had a legume turned under during the last 2 years.
[3] Recommendations are for broadcast applications. If fertilizer is applied in the hill or row, use one-half to two-thirds of the quantities given
[4] The series of figures in the formula analyses express the percentages of total nitrogen, available phosphoric acid, and water-soluble potash, respectively.
[5] For wheat apply 100 to 150 pounds of a nitrogen fertilizer as soon as growth starts in the spring.
[6] Not recommended if sod is very poor.
[7] Apply every 2 years. On high-priced land under intensive grazing, a yearly application of 100 to 150 pounds of a nitrogen fertilizer early in spring is also recommended.
[8] For leafy truck crops apply 100 to 150 pounds of a nitrogen fertilizer as a side dressing.

In general much of the fertilizer used on the farms in this county is lower in phosphate content than the recommended analyses. Recent trends are toward the use of more highly concentrated products and the adoption of nonacid-forming complete fertilizers made through the use of dolomitic limestone fillers.

LIMING

Liming of the land should be more general than it is at present, particularly because the lime can be obtained within the county.[12] Obviously the financial condition of the individual farmers, as well as

[12] Information on the burning of lime may be obtained free from the West Virginia Agricultural College Extension Circular 258 (6).

distance from the source of material, govern the extensiveness of any such program. It is for this reason that the best farming land is now being limed. Liming should not be confined to cropland, however, but should be extended to pastures also.

Lime can be used either in a very finely ground or burned state. Burned lime has the advantage over ground lime in that it reacts more rapidly with the soil. If the materials were pure, three-fourths of a ton of slaked lime would be equivalent to about a ton of ground limestone. Owing to the proportion of impurities and coarse particles in the ground limestone, the general practice is to use twice as much ground limestone as burned lime. Because the quantity of lime required varies with the acidity of the land, the soil should be tested to determine its requirements. Common requirements for moderately acid soil are 1½ tons of burned lime, or 3 tons of ground limestone, for the crop soils, and about one-half these quantities for similar types of pasture soils. Lime generally is applied on corn stubble land and disked in with the wheat. On pastures it is applied as a top dressing. Experimental work has shown that after 4 years most of the lime is still in the first 3 inches of the surface soil of a silt loam soil in pasture.

Crop responses to liming vary with the plants. Certain plants are more sensitive to soil acidity than others, and the more sensitive species will show the quickest and greatest response to liming. This is particularly true of clover and alfalfa. Higher yields and better stands of clover are soon noticed on soils that are limed and supplied with available plant nutrients, particularly phosphorus, if the soils are at the same time in a good physical state.

The question of overliming has often been raised in the field work. This has been answered by Pierre and Browning (*11*). Their experiments show that overliming results in a temporary injury due to a disturbed phosphate nutrition. This condition largely disappears in the second year. It appears that overliming decreases the amount of phosphorus available to plants, causing them to develop the light-green to purplish hue characteristic of phosphorus starvation. Dolomitic limestones do not seem to affect plant growth to any marked degree, owing to the greater solubility of compounds of magnesium and phosphorus. The condition, if it appears in the field, can be best remedied by the application of superphosphate fertilizer or manure.

PASTURES

In 1935 a study of pastures in Greenbrier County and other counties of West Virginia brought out some interesting facts regarding pasture conditions (*12*). These findings are discussed briefly here.

In a cattle-raising section such as Greenbrier County, pastures are of prime importance. According to the census for 1935, 21.4 percent of the total area of the county is in nonwoodland pasture.

Kentucky bluegrass and white clover are the most desirable species in pastures here. Other desirable species, such as timothy, orchard grass, hop clover, redtop, Canada bluegrass, red clover, and lespedeza, are present in smaller quantities. The carrying capacity of a pasture is directly proportional to the percentage of these species in relation to the total cover that could occupy the space. For Greenbrier County these species constitute 32.5 percent of a perfect sod of the

average pasture land underlain by limestone. Undesirable species, such as poverty oatgrass, broomsedge, and weeds, comprise 43.6 percent of the total cover, and bare space amounts to 23.9 percent. Thus, it may be concluded that even the pastures that are considered among the best in the county are far below their maximum productivity.

In order to obtain a comparison of the values of the various soils for pasture, they are arranged in order of increasing proportion of desirable pasture plants present, as follows: Upshur-Dekalb (Meigs), Dekalb, Upshur, Westmoreland, Pope and related soils, Frederick, and Frankstown soils. These soils were studied in various parts of the State, but it is believed that pasture conditions are comparable.

An experimental study of soil acidity brought out the fact that "soils of pH 5.8 or above were found generally to support a good stand of Kentucky bluegrass and white clover, provided the available phosphorus was adequate and other conditions were favorable." Furthermore, it was found that 78 percent of the pastures studied in the limestone valley needed lime, and 93 percent showed a deficiency of phosphorus. Of the 93 percent showing a deficiency of phosphorus, 70 percent had less than 10 pounds of available phosphorus per acre, and 23 percent less than 20 pounds. These same studies showed that at least 20 pounds of readily available phosphorus per acre were needed to maintain a sod of Kentucky bluegrass and white clover. These figures indicate the need of both lime and superphosphate in order to improve the pastures adequately. The presence of lime and available phosphate in the soil enables Kentucky bluegrass and white clover to crowd out weeds and poor native grasses, such as poverty oatgrass.

Other management practices should be observed to conserve the pastures. Many farmers turn the animals onto pasture too early in the spring, before the ground is sufficiently dry, and the vegetation is still too short. In general the vegetation should be 3 or 4 inches tall before grazing is started. Cattle or sheep should not be left on pastures too late in the fall or during winter. Experiments by the West Virginia Agricultural Experiment Station show that cattle left on pasture after about the first of November lose weight because of an insufficient feed supply. Too early or too late grazing destroys the small plants through grazing and, if the soil is wet, through tramping. The data indicate that about 20 percent of the pastures in the limestone valley are too heavily grazed. On the other hand, too light grazing encourages a rank growth, which also is undesirable. The herbage is less palatable and nutritious than that which is more closely grazed. Also, relatively close grazing favors the growth of white clover.

Pastures should be mowed regularly in order to control rank-growing weeds and grasses, especially when the weeds are in full bloom or shortly thereafter.

CATTLE RAISING

Experimental studies dealing with winter rations and the growth of steers have been conducted in Greenbrier County by the Bureau of Animal Industry of the United States Department of Agriculture

and the West Virginia Agricultural Experiment Station. The results are summarized briefly here.

The cattle are finished on grass, because an insufficient quantity of grain can be produced. Since pasture is plentiful and relatively cheap in comparison to grain, most of the gain in weight of steers is made on grass. In winter, however, when pastures are not available, the cattleman has the problem of wintering his livestock most economically in order to obtain the greatest benefit from grass pastures the following spring. In general, the plan of winter feeding is to bring the steers through with no gains or only slight gains in weight. It has been found that beef cattle making large winter gains do not gain so much on grass the following summer. It is desirable, however, to have calves and yearlings put on from 50 to 75 pounds during the winter. Experiments have shown that corn silage, wheat straw, and cottonseed meal make a better ration than hay, corn stover, and wheat straw considering the immediate and subsequent gains of steers. Other protein concentrates or legumes can be used to replace or diminish the cottonseed meal with equally satisfactory results. The value of corn silage in a winter ration has been definitely shown.

The grass-fattened cattle that are sent to eastern markets from here command a lower price than the grain-fed cattle of similar grade, mainly because most meat packers and retailers think the beef will be dark. Experiments show that brightness of lean beef is related directly to the degree of finish of the beef cattle (*3*). Beef from grass-finished cattle can be expected to be as bright as beef from grain-finished cattle which show a comparable degree of finish.

DRAINAGE

In the southwestern part of the county along the Meadow River and its tributaries are more than 6,000 acres of flood plain that need to be drained. The soil is chiefly Atkins silt loam but includes some areas of Monongahela silt loam. This section presents a unique problem because individual farms cannot be drained by open ditches or tile drains, owing to the high water table and slow run-off after an inundation. The present drainage channels are inadequate to care for the water that comes into them, causing the water to overflow on the valley and then slowly to work its way downstream. Overflows are frequent, coming each year late in the winter and early in the spring. The channel of the Meadow River is very crooked, shallow, and largely filled with debris. The average fall is only 3.8 feet per mile. Before any individual improvement of land can be undertaken, it is necessary to straighten and deepen the main drainage channel in order to remove run-off rapidly and lower the water table.

The drainage engineer's report on the Meadow River bottom lands[13] recommends (1) the construction of a new channel for the Meadow River from Patterson Creek to a point about 1¼ miles below

[13] For detailed information the reader is referred to the following: SHAFER, FRED F THE PROPOSED DRAINAGE OF MEADOW RIVER BOTTOM LANDS, GREENBRIER COUNTY, WEST VIRGINIA. U. S Dept. Agr., Office of Public Roads and Rural Engin. 15 pp 1918 [Mimeographed.]

Rupert, and (2) the construction of tributary ditches in the branch valleys. The area that would be benefited by such a project is 6,045 acres, and the average estimated cost per acre in 1918 was $29.

After the improvement of the main drainage system it is probable that individual farmers will have to construct some system of open-ditch or tile drains on their land. Atkins silt loam has a heavy subsoil underlain by water-impervious clay shales. The practicability of tile drainage is not known. It is probable that open-ditch drainage may be more satisfactory and economical. It must be remembered that after the land is sufficiently well drained, it will be necessary to lime it heavily if cultivated crops are to be grown successfully. Atkins silt loam is the most acid soil in the county; consequently, the cost of improving this land is considerable. Any such program depends on economic conditions, as it appears that the individuals to be benefited will have to stand the cost of the improvements.

Closely associated with areas of the Atkins soil are areas of Monongahela silt loam and Philo silt loam. These would be materially benefited by any general drainage project. Monongahela silt loam occurs in many parts of the county. It might be profitably drained by tile. Pickaway silt loam, together with the inclusions of the Burgin soil, needs artificial drainage. Large areas already have been improved by tile drainage.

MORPHOLOGY AND GENESIS OF SOILS

Soil is the product of the forces of environment acting upon the soil materials deposited or accumulated by geologic agencies. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent soil material; (2) the climate under which the soil material has accumulated and existed since accumulation; (3) the relief, or lay of the land, which determines the local or internal climate of the soil, its drainage, moisture content, aeration, and susceptibility to erosion; (4) the biologic forces acting upon the soil material, that is, the plants and animals living upon and in it; and (5) the length of time the climatic and biologic forces have acted on the soil material.

Greenbrier County lies partly in the Appalachian Plateaus and partly in the Valley and Ridge province. Greenbrier Valley is included in the Valley and Ridge province. The mountains comprising the western upland plateau are in general rather rounded. They have altitudes ranging from 3,000 feet in the southern to over 4,000 feet in the northwestern part of the county. The ridges in the eastern part rise rather uniformly to an elevation of a little more than 3,000 feet.

The soils of Greenbrier County belong to the Gray-Brown Podzolic soils group (*10*). They have developed from various parent materials chiefly under a deciduous forest cover in a humid climate where the winters are not extremely cold and the summers not extremely hot. The ground is frozen for only short periods of each year. The average annual rainfall of 38.80 inches is well distributed throughout the year, although it is slightly heavier in spring and summer than in fall and winter. These climatic conditions are conducive to active leaching of the soils for a large part of each year. Soil-forming

processes operating in such an environment over a period of time have resulted in the development of certain common distinguishing features in the soils which place them in the Gray-Brown Podzolic group.

The color of the soils is dominantly light, ranging from grayish yellow or light yellow to light brown in the surface soil and from yellow or brownish yellow to brown and light red in the subsoil. Throughout most of the county the texture of the surface soil is fine, chiefly silt loam. All the surface soils are friable. The subsoils are heavier textured than the surface soils but nevertheless are prevailingly friable, and only a few local areas have very heavy or plastic subsoils. The subsoils of the soils developed from limestone and shales become hard and brittle when dry. The agricultural soils contain little or no stone on the surface. Chert or gravel fragments are present on some of the soils, but the quantity is not sufficient to interfere with cultivation of the land. Stones or stone fragments are scattered over the surface of a large part of the steep and mountainous lands.

The soils of this county do not contain much organic matter. They have developed under a forest cover consisting chiefly of hardwoods, but climatic conditions, except at the highest elevations, have not favored the accumulation of an appreciable quantity of organic matter. In forested areas a thin layer of leafmold is mixed with the topmost layers of the surface soil. Most of the arable soils have been farmed a long time, and much of the original organic matter has been lost through cultivation.

Active leaching has resulted in the removal of bases from the A horizons, leaving the exchange complex or soil colloid in an unsaturated condition. Consequently, the illuvial horizon has been relatively enriched with bases to the degree that it is less unsaturated than the overlying horizons. Calcium carbonate, however, has accumulated nowhere in the solum, and all the soils, except those recently limed, are acid throughout.

The greater part of the available bases and other plant nutrients, particularly phosphorus, has been removed. The soils of the area are very low in phosphate available to plants; consequently fertilizers are needed to supply the essential elements for plant growth.

Mechanical eluviation has resulted in the translocation of fine particles and colloidal material from the A horizons to the underlying B horizons, the maximum concentration appearing in the B_2 horizon. The result has been the development of a texture profile in which the surface layer, or A horizon, is comparatively light textured, the B horizon is heavier textured and thicker than the A horizon, and the C horizon generally is lighter textured than the B horizon.

Analytical data of Alexander, Byers, and Edgington (*1*) pertaining to Frederick silt loam best show the podzolic processes involved in the formation of the normal upland soils of this county. The Frederick soil sample used for this analysis was obtained in Rockbridge County, Va. The data and the profile description are applicable to Frederick silt loam, as developed in Greenbrier County.

The profile was described by these authors as follows:

A_1. 0 to 2 inches, grayish-brown silt loam containing a small quantity of organic matter. A shallow veneer of leafmold covers the surface.

A_2. 2 to 11 inches, grayish-yellow mellow friable silt loam. When moist it is light brown. Many small and some large roots are present in this layer.

B_1. 11 to 16 inches, reddish-yellow firm but friable and brittle silty clay loam. Faint shades of yellow are characteristic. This is an intermediate or gradational layer between the A_2 and B_2 horizons, but probably it would be well to call it the B_1 horizon.

B_2. 16 to 36 inches, light-red silty clay faintly mottled with shades of yellow. It is firm but brittle, breaks into irregular-shaped lumps, and has no definite cleavage planes.

C. 36 to 56 inches +, light-red material with mottles and streaks of yellow silty clay or clay. Slightly heavier in texture than the above layer.

A few soft partly decomposed chert or limestone fragments occur throughout the soil mass, whereas a few small angular chert particles are present on the surface.

Table 10 presents the mechanical composition of this soil, table 11 the chemical composition of the soil, table 12 the chemical analysis of the extracted colloids, and table 13 the derived data on the extracted colloids.

TABLE 10.—*Mechanical composition of Frederick silt loam*

Sample No.	Horizon	Depth	Fine gravel 2–1 mm.	Coarse sand 1–0.5 mm.	Medium sand 0.5–0.25 mm.	Fine sand 0.25–0.1 mm.	Very fine sand 0.1–0.05 mm.	Silt 0.05–0.002 mm.	Clay <0.002 mm.	Material <0.005 mm.	Organic matter by H_2O_2	pH
		In.	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*	*Pct.*
C–807	A_1	0–2	1.6	3.2	4.6	9.3	10.4	52.2	13.8	25.3	4.3	5.1
C–808	A_2	2–11	1.5	3.0	4.5	7.6	10.3	59.3	12.7	26.9	.8	4.7
C–809	B_1	11–16	1.1	2.2	3.3	5.8	8.0	52.4	26.8	40.1	.1	4.8
C–810	B_2	16–36	.1	.7	1.3	2.1	3.3	22.2	70.0	73.6	.0	4.9
C–811	C	36–56	.0	.2	.2	.7	1.5	19.7	77.5	85.3	.0	4.6

TABLE 11.—*Chemical composition of Frederick silt loam*

Sample No.	Horizon	Depth	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	Na_2O	MnO	P_2O_5	SO_3	Ignition loss	Total	Organic matter	Nitrogen
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
C–807	A_1	0– 2	82.18	5.52	2.25	1.24	0.36	0.13	0.89	0.06	0.03	0 07	0.10	7.08	99.91	5.45	0 16
C–808	A_2	2–11	87.63	4.93	1.82	1.43	.23	.13	.71	(1)	.02	.03	.06	2.80	99.79	1.82	.03
C–809	B_1	11–16	81.56	8.71	3.32	1.45	.28	.26	.79	(1)	.02	.04	.05	3.32	99.80	.36	.02
C–810	B_2	16–36	58.32	21.46	8.54	1.26	.10	.81	1.02	(1)	.02	03	.04	8.20	99.80	.33	.02
C–811	C	36–56	46.63	28.15	10.48	1.06	.24	1.04	1.26	(1)	.03	.04	.05	10.87	99.85	.33	.02

[1] Trace.

TABLE 12.—*Chemical composition of colloids extracted from Frederick silt loam*

Sample No.	Horizon	Depth	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	K_2O	Na_2O	MnO	P_2O_5	SO_3	Ignition loss	Total	Organic matter	Nitrogen
		Inches	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
C–807	A_1	0– 2	37.02	28.02	10.33	0.79	0.18	1.15	1.00	(1)	0.07	0.24	0.18	20.52	99 50	9.90	0.61
C–808	A_2	2–11	38.60	29.79	11.04	.83	.07	1.14	.98	(1)	.08	.21	.15	16.63	99.52	5.20	.35
C–809	B_1	11–16	40.73	31.13	11.53	.86	.10	1.25	1.09	0.03	.05	.10	.11	12.80	99.78	1.40	.11
C–810	B_2	16–36	40.29	32.59	11.49	.80	.10	1.23	1.22	(1)	.04	05	.05	12.09	99.95	.64	.19
C–811	C	36–56	41.03	33.19	10.40	68	.08	1.22	1.24	02	.04	.04	02	12.20	100.16	.40	.17

[1] Trace.

TABLE 13.—*Derived data of colloids extracted from Frederick silt loam*

Sample No.	Horizon	Depth	Molecular ratio				Combined water
			SiO_2	SiO_2	SiO_2	SiO_2	
			R_2O_3	Al_2O_3	Fe_2O_3	Bases	
		Inches					*Percent*
C-807	A_1	0–2	1.82	2.24	9.5	14.6	10.01
C-808	A_2	2–11	1.78	2.20	9.3	16.1	11.09
C-809	B_1	11–16	1.80	2.22	9.4	15.1	11.29
C-810	B_2	16–36	1.71	2.10	9.3	14.8	11.26
C-811	C	36–56	1.72	2.10	9.6	15.1	11.63

The mechanical analysis shows a heavy-textured clay B_2 horizon. The C horizon, however, is heavier than the B_2. Likewise, the chemical composition of the soil shows that iron oxide and alumina are more abundant in the parent material than in the B_2 horizon, which is known as the zone of illuviation. These authors explain this as follows: "Marbut has pointed out that the residue from limestone decomposition may have a higher percentage of iron and alumina when first formed than at any subsequent time." The question arises, however, whether this is a B horizon rather than a C.

The chemical analysis of the soil shows that the A_2 horizon is more siliceous than the B_2. Iron and aluminum have been leached from the A horizons and deposited in the B_2 horizon and possibly in the C horizon. This is characteristic of podzolic processes. Since silica is more resistant to weathering than are other constituents, it remains behind while other materials are carried into the lower horizons. The silica-sesquioxide ratio bears out this fact. The ratio for the A horizons is greater than for the B or C horizons, which indicates that some iron and aluminum must have been lost from the upper part of the solum.

In summing up some of the important chemical data on Frederick silt loam, which is representative of the normal upland soils belonging to the Gray-Brown Podzolic group, the following conclusions may be drawn: (1) The organic matter is most abundant in the A horizon, particularly A_1, and low elsewhere in the profile; (2) the A_2 horizon is the most impoverished of bases, iron, and aluminum—an evidence of podzolization; (3) the A_2 horizon has a slightly lower pH value than either the A_1 or B horizons, although the pH value of the whole profile does not vary much, which is characteristic of the Gray-Brown Podzolic soils; and (4) the silica-base ratio appears to indicate that the B_2 horizon is very slightly enriched in bases. It is not likely, however, that much of the bases remains at this depth; the greater part probably has been removed by drainage waters.

Morphologically, Pickaway silt loam is an interesting soil, but it is inextensive. It is an intrazonal soil, dominantly a planosol, having developed on fairly smooth land under conditions of impeded drainage. To a certain degree, normal erosion has been lacking because of this smooth surface. The soil has been highly leached, has a very light A_2 horizon, and has developed a zone of compaction in the subsoil. Translocation of iron has taken place, the maximum concentration, as evidenced by the abundance of dark-red or nearly black soft

concretions, being in the heavy horizon. Impeded drainage has been responsible for gray mottlings in the subsoil.

As mapped in this county, the soil includes the Burgin soil, which is poorly drained. Morphologically the Burgin soil belongs to the Wiesenboden group of soils. It has a black silty clay loam surface soil and a light-gray or olive-gray heavy plastic subsoil. All gradations of drainage and color of the subsoil exist between those typical of the Pickaway soils and those typical of the Burgin soils. A typical profile of Pickaway silt loam in a gently undulating grass field, about 2 miles west of Lewisburg, was examined and showed the following characteristics:

A_1. 0 to 8 inches, light-gray floury silt loam.
A_2. 8 to 14 inches, light grayish-yellow friable heavy silt loam.
B_1. 14 to 26 inches, light-yellow slightly compact friable silty clay loam. Numerous small soft iron concretions are present.
B_2. 26 to 36 inches, light-yellow compact silty clay loam or silty clay. This layer contains numerous dark-red iron concretions and is highly mottled with grayish white.
B_3. 36 to 42 inches, light brownish-yellow or yellow silty clay loam. The material breaks out in large lumps, which show some streaking of black along the cut surfaces.
C. 42 inches +, light-yellow or light-yellow streaked with gray and black plastic clay shale material. Siliceous limestone occurs at a varying depth.

The reaction is acid throughout.

Extensive soils of the hilly and steep uplands have had little opportunity for development. Here erosion generally is active enough, unless the surface is protected by a vegetative cover, to prevent the formation of a well-developed normal profile. Here, too, increased surface run-off leaves little moisture for the growth of plants and thereby slows down soil-forming processes (*9*). Most of these soils have a thin solum and contain fragments of the underlying rock or shale scattered over the surface. In places, particularly on slopes where the soil is derived from shale, soil erosion keeps pace with weathering, leaving exposed the underlying broken shale. In this group can be placed the Dekalb soils, the Berks soils, Westmoreland silt loam, the steep and stony Belmont and Upshur soils, the stony Elliber soil, the Upshur-Dekalb soils, rough stony land (Frederick-Hagerstown soil materials), and rough stony land (Dekalb soil material).

The soils of the terraces include the Elk, Holston, Monongahela, and Sequatchie. These soils differ from one another not only in the character of the parent material but also in the stage of soil development. The youngest member of the group is Sequatchie loam. It resembles the Pope soil, which occurs on the flood plain. Elk silt loam is not fully mature. The parent material for this soil is old alluvium from limestone uplands and to a lesser degree from Upshur soils. The color is light brown throughout. The parent materials of the Sequatchie, Monongahela, and Holston soils were washed from areas of Dekalb soils. Monongahela silt loam is imperfectly drained and is classified as a planosol. It resembles Philo silt loam, which occurs on the flood plain. Holston loam, the mature soil of this group, is highly leached and possesses a gray or grayish-yellow surface soil with a light-yellow subsoil.

The alluvial soils include the Moshannon, Pope, Philo, and Atkins soils. They occur on the flood plains and are subject to frequent overflow, resulting in deposition of new material. They have not developed a distinct profile because the parent material has not been in place sufficiently long to be altered by the normal soil-forming processes of the region. The Pope and Philo soils resemble each other in the color of the surface soil, being light brown or brownish yellow. The Philo soil differs from the Pope in that it becomes mottled with gray and rust brown at a depth of 14 or 16 inches. The Atkins soil is poorly drained and is gray throughout. Much of this land is marshy throughout the year. Moshannon silt loam is one of the most productive soils. The alluvium has been washed from Upshur soils and soils underlain by limestone. The color of the Moshannon soil resembles that of the Upshur soils.

In table 14 is presented a summary of the internal and external characteristics of the soils and land types occurring in Greenbrier County. They have been placed into five groups on the basis of soil characteristics, as follows: (1) Gray-Brown Podzolic soils, (2) shallow soils, (3) Lithosols, (4) Planosols, and (5) alluvial soils (*2*). The Gray-Brown Podzolic soils are the true zonal soils of the area. They possess well-developed soil characteristics that reflect the influence of the active factors of soil genesis, namely, climate and biologic forces.

TABLE 14.—*Summary of internal and external soil and land type characteristics of Greenbrier County, W. Va.*

Great soil group and topographic position	Parent material	Soil type	Drainage	Surface soil (A horizons)	Subsoil description (B horizons)	Relief
Gray-Brown Podzolic:						
Terrace	Old alluvium from sandstone and shale uplands.	Sequatchie loam	Good external and internal.	Brown friable loam	Light-brown or yellowish-brown friable heavy loam.	Very gently sloping.
		Holston loam	Good external; fair internal.	Gray or grayish-yellow loam.	Light-yellow friable clay loam.	Do.
	Old alluvium from limestone uplands and from Upshur soils.	Elk silt loam	Good internal and external.	Light-brown, yellowish-brown, or light purplish-brown silt loam.	Yellowish-brown, brownish-yellow, or light-brown friable silty clay loam.	Do.
Upland	Limestone	Frederick silt loam	Good internal and external; subterranean drainage.	Light-brown, grayish-brown or brownish-yellow friable silt loam.	Reddish-yellow silty clay loam to a depth of 12 to 15 inches, overlying light-red, yellowish-red, yellowish-brown, or light reddish-brown friable yet brittle clay or silty clay.	Gently rolling to rolling.
	Cherty limestone	Frederick cherty silt loam	do	Light-brown, grayish-brown, or brownish-yellow friable silt loam but contains angular chert fragments from ¼ to 2 inches in diameter.	Same as for Frederick silt loam but contains some chert throughout subsoil.	Do.
	Limestone	Frederick stony silt loam.	Excessive run-off	Similar to Frederick silt loam, but outcrops of rock are numerous.	Similar to Frederick silt loam but shallower, bedrock at a depth of 30 to 40 inches	Rolling to hilly.
	Siliceous limestone	Frankstown silt loam	Good internal and external.	Grayish-yellow, grayish-brown, or light-brown mellow silt loam.	Light-yellow or light brownish-yellow heavy silt loam, overlying yellow or light brownish-yellow friable crumbly silty clay loam.	Gently rolling.
		Frankstown silt loam, hilly phase.	Good internal and excessive external.	do		Hilly.
	Calcareous light-colored shales, interbedded limestones, and some intermixed sandstones.	Westmoreland silt loam, smooth phase.	Good internal and external.	Light-brown, brownish-yellow, or light grayish-yellow silt loam.	Brownish-yellow, yellowish-brown, or light reddish-brown friable silty clay loam or silty clay.	Gently rolling to rolling
	Indian-red slightly calcareous shales.	Upshur silt loam, smooth phase.	Excessive run-off	Light-brown or light purplish-brown friable silt loam.	Purplish-brown or purplish-red silty clay, slightly plastic when wet	Sloping.
	Cherty limestones and calcareous cherts.	Elliber cherty loam	do	Gray or grayish-yellow cherty loam.	Yellow or brownish-yellow heavy loam to a depth of 15 to 18 inches, over yellowish-brown or brown silt loam or clay loam.	Strongly rolling to hilly

	Sandstone	Clymer loam	Good internal and external.	Light grayish-yellow friable loam.	Yellow or light brownish-yellow friable heavy loam.	Gently to strongly rolling.
	Shale and fine-grained sandstone.	Clymer silt loam	Fair to good internal and external.	Light-yellow or grayish-yellow silt loam.	Yellow or brownish-yellow silty clay loam or silty clay	Undulating to gently rolling.
	Indian-red shales, red and yellow fine-grained sandstones.	Upshur-Clymer (Meigs) silt loams	Good external and internal.	Complex of Upshur silt loam and Clymer loam closely associated and intermixed.		Gently rolling to rolling.
Colluvial fan	Shale and fine-grained sandstone colluvium	Jefferson stony silt loam	External good: internal slightly impeded.	Pale-yellow or grayish-yellow silt loam to a depth of 10 to 12 inches.	Yellow or light brownish-yellow silty clay loam or silty clay to a depth of 24 to 30 inches.	Gently sloping to rolling
Shallow soils:						
	Hard and siliceous limestone.	Frederick - Hagerstown stony silt loams	Excessive run-off	Includes areas of Frederick and Hagerstown soils Frederick areas similar to Frederick silt loam. Hagerstown areas have brown, dark-brown, or brownish-red granular silt loam surface soils.	Subsoil of Frederick areas similar to that of Frederick silt loam. Hagerstown subsoil is dark reddish-brown, brownish-red, or dark-red silty clay or clay	Steep.
	Coarse-grained yellow and pink sandstones.	Dekalb fine sandy loam	Good internal and external.	Grayish-yellow friable fine sandy loam 4 to 6 inches thick	Light-yellow compact loam or fine sandy clay.	Sloping to strongly sloping.
	do	Dekalb gravelly loam	do	Grayish-yellow or light-gray friable loam.	Light-yellow, yellow, or light brownish - yellow friable silt loam	Rolling to hilly.
	Shale and fine-grained sandstone	Dekalb silt loam	Rapid surface run-off, good internal drainage	Grayish-brown or grayish-yellow silt loam	Yellow or brownish-yellow friable silty clay loam.	Gently rolling to hilly.
Upland	Calcareous light-colored shales, interbedded limestones, and some intermixed sandstones.	Westmoreland silt loam	Excessive run-off	Light-brown or brownish-yellow friable silt loam, 4 to 6 inches thick	Yellow-brown, brown, or light reddish-brown friable silty clay loam.	Hilly to steep.
	Cherty limestones and calcareous cherts.	Elliber stony loam	do	Gray or grayish-yellow cherty loam.	Yellow or brownish-yellow heavy loam or silt loam to a depth of 24 to 36 inches.	Steep
	Indian-red shales and fine-grained sandstones.	Upshur-Dekalb (Meigs) gravelly silt loams.	Rapid run-off	Complex of Upshur silt loam and Dekalb gravelly loam, closely intermixed.		Strongly rolling.
	Indian-red and light-colored calcareous shales with interbedded limestone.	Belmont silt loam	do	Light-brown, grayish-yellow, or purplish-red silt loam, 4 to 6 inches thick.	Yellow or brownish-yellow silty clay loam to a depth of 12 to 20 inches, or purplish-red silty clay loam or silty clay to a depth of 8 to 12 inches.	Hilly to steep.

Resemble the Gray-Brown Podzolic soils but have some characteristics of the Lithosols.

TABLE 14.—*Summary of internal and external soil and land type characteristics of Greenbrier County, W. Va.*—Continued.

Great soil group and topographic position	Parent material	Soil type	Drainage	Surface soil (A horizons)	Subsoil description (B horizons)	Relief
Lithosols	Reddish-yellow, light-gray, or yellowish-brown finely laminated shales.	Berks shaly silt loam	Excessive run-off	Pale-yellow, light reddish-brown, or brownish-yellow silt loam.	Yellowish-brown or brownish-yellow silty clay loam, tinged with red to a depth of 8 to 12 inches.	Steep.
	Indian-red slightly calcareous shales and interbedded red or gray fine-grained sandstones with a few limestone outcrops.	Upshur silt loam	do	Light-brown or light reddish-brown friable silt loam, 3 to 5 inches thick.	Indian-red or purplish-red friable silty clay loam, 3 to 8 inches thick.	Hilly to steep
		Upshur silt loam, eroded phase	do	Similar to Upshur silt loam, but severely gullied		Do
		Upshur stony silt loam	do	Light-brown or light reddish-brown friable silt loam, 2 to 5 inches thick.	Indian-red or purplish-red friable silty clay loam, 3 to 8 inches thick.	Very steep.
Upland	Yellow or brownish-yellow shales and fine-grained interbedded sandstones.	Dekalb shaly silt loam	do	Grayish-yellow or brownish-yellow friable silt loam, 5 or 6 inches thick.	Light-yellow or brownish-yellow silty clay loam to a depth of 10 to 20 inches.	Steep.
		Dekalb stony silt loam	do	Grayish-yellow or grayish-brown friable silt loam.	Light-yellow or brownish-yellow silty clay loam to a depth of 12 to 20 inches.	Very steep
	Sandstone	Dekalb stony loam	do	Grayish-yellow friable loam.	Yellow to brownish-yellow heavy loam or silt loam.	Steep.
	Thick bedded coarse-grained sandstones.	Dekalb stony fine sandy loam	do	Light grayish-brown or grayish-yellow loose fine sandy loam.	Light-yellow or brownish-yellow friable heavy fine sandy loam to a depth of 14 to 24 inches	Do.
	Light-colored and Indian-red shales; gray, yellow, and variegated sandstones.	Upshur-Dekalb (Meigs) stony loams.	do	Complex of Upshur stony silt loam and Dekalb stony loam or silt loam.		Do
	Limestone	Rough stony land (Frederick-Hagerstown soil materials).	do	Little or no soil, except in spots These spots resemble Frederick or Hagerstown soils.		Very steep.
	Sandstone and shales	Rough stony land (Dekalb soil material).	do	Soil, where not stony, resembles Dekalb soils		Sloping on ridge tops; very steep on hillsides
Planosols						
Terrace	Old alluvium from sandstone and shale uplands.	Monongahela silt loam	Slow external and internal.	Brownish-gray, grayish-yellow, or light-gray friable silt loam.	Grayish-yellow or light grayish-brown friable silty clay loam to a depth of 12 to 16 inches, underlain by compact light-yellow and gray mottled silty clay loam.	Flat.

Upland	Siliceous limestone	Pickaway silt loam	Fair external, poor internal.	Light-gray or grayish-yellow mealy silt loam.	Light-yellow compact silty clay loam to a depth of 20 to 26 inches, overlying light-yellow silty clay loam mottled with gray. Soft brown concretions throughout subsoil.	Undulating to gently sloping.
Alluvial soils						
Bottom land	Alluvium from Upshur soils and limestone uplands.	Moshannon silt loam	Good internal and external.	Reddish-brown or purplish-brown silt loam.	Brownish-red or Indian-red heavy silt loam. May be slightly mottled below a depth of 24 inches	Flat.
	Alluvium from sandstone and shale uplands.	Pope fine sandy loam	Excellent internal and external.	Brown or yellowish-brown loose fine sandy loam.	Light - brown, yellowish-brown, or brownish-yellow heavy fine sandy loam.	Do.
		Pope silt loam	Good internal and external.	Light-brown, brown, or yellowish-brown silt loam.	Brownish-yellow or light brownish-yellow compact silt loam.	Do.
		Pope gravelly silt loam	do	do	do	Do
		Philo silt loam	Imperfect internal; slow external.	Grayish-brown, light-brown, or brownish-yellow to a depth of 15 to 18 inches.	Grayish-yellow or yellow heavy silt loam or silty clay loam, mottled with gray and rust brown.	Do.
		Atkins silt loam	Very poor throughout	Gray granular silt loam	Gray silty clay loam highly mottled with rust brown, overlying gray or yellowish-gray plastic silty clay or clay.	Do.

The shallow soils are intermediate between the Lithosols and the Gray-Brown Podzolic soils, possessing some of the characteristics of both soil groups. In many places they are complexes of Gray-Brown Podzolic soils and Lithosols. In general, the profile is shallower than that of the Gray-Brown Podzolic soils, but not so shallow as that of the Lithosols. These soils have developed A and B horizons, but the influence of the parent material has not been completely overcome by the normal soil-forming agencies. This is evidenced by the presence of rock outcrops and fragments of the parent rock on the surface or throughout the profile.

The Lithosols are azonal soils and are without well-developed soil profile characteristics, because the normal soil-forming processes have not been able to overcome the effects of parent material and steep slope. Specifically, these soils have shallow A horizons and little or no B horizons. Many of them are very stony, and most of them occur on steep or very steep slopes. The Upshur soils included in the Lithosols are considered by some authorities to be Brown Forest soils or intrazonal in character. Brown Forest soils are high in absorbed calcium and do not have completely developed eluvial and illuvial horizons (*2*). In this county, however, they appear to fit in with the Lithosols more closely than in any other group.

The Planosols are intrazonal soils. They have well-developed soil characteristics which reflect the dominating influence of poor or inadequate drainage, caused by lack of an appreciable slope, over the normal effect of climate and vegetation.

The alluvial soils are azonal or young soils. They have not been in place sufficiently long to allow the soil-forming factors of climate and vegetation to overcome the characteristics of the parent material. They possess, however, color profiles that are characteristic of the drainage condition of each soil.

Greenbrier Valley is underlain with a thick layer of Greenbrier limestone. Various members comprising this limestone cause some variation in the types of the resultant soils. The purer members give rise to the Frederick soils, which have grayish-brown or brownish-yellow surface soils and reddish-yellow or light-red subsoils. Locally some shale is included with the Frederick soils. Steep slopes where great thicknesses of the Greenbrier formation are mapped together include some intermixed areas of Hagerstown soils and are mapped as Frederick-Hagerstown stony silt loams. The Hagerstown soils have browner surface soils and darker red subsoils than the Frederick. They are developed from the residue that is left after the solution of limestone of a high degree of purity. Siliceous and platy limestones that are practically free from chert give rise to the Frankstown soils. These soils differ from the Frederick in having yellow or brownish-yellow more friable subsoils. Cherty limestones, as the Hillsdale member, give rise to Frederick cherty silt loam, which differs from Frederick silt loam in having angular fragments scattered on the surface and throughout the soil mass. Associated with the Frankstown and Frederick soils, but occurring on smoother relief is a small area of Pickaway silt loam that is mottled and slightly plastic in the subsoil. The surface soil is gray or grayish yellow. The soils of the limestone valley dominate the agriculture of the county and are the most productive.

Directly overlying the Greenbrier formation is the Mauch Chunk series comprising in ascending stratigraphic order the Bluefield, Hinton, Princeton conglomerate, and Bluestone groups (*13*). The Bluefield group occurs as a wide belt running in a southwest-northeast direction through the central part of the county. It is dominantly shaly, comprising yellow and greenish-gray shales, together with some interbedded impure limestone. Generally the tops of ridges are capped with sandstone. At the junction of the Greenbrier series with the Bluefield group the material is very heterogeneous. This mixture of materials has developed into the Westmoreland soil. It has a grayish-yellow or brownish-yellow surface soil and a yellowish-brown friable subsoil. As typically developed here Westmoreland silt loam is characteristically hilly to steep and, therefore, in many places is limited in profile development. A smooth phase of this soil also is recognized.

Indian-red or purplish-red more or less calcareous shales, together with some embedded limestone, give rise to the Upshur soils. This type of parent material occurs in the Bluefield and Hinton groups of the Mauch Chunk series and in the Maccrady series, which directly underlies the Greenbrier series. The surface layer of the Upshur soils is reddish brown, and the subsoil is purplish red. The Upshur soils in most places are limited in profile development, owing to the steepness of the slopes. Where the red shales are intermixed with light-colored calcareous shales and embedded limestones, the resultant soil is mapped as the Belmont soil. An intermixing of red shales with light-colored noncalcareous shales and sandstone, which cannot be separated into definite soil types, leads to Upshur-Dekalb (Meigs) or Upshur-Clymer (Meigs) complexes. These complexes have been called Meigs in surrounding counties.

The Dekalb soils are developed by soil-forming processes from the weathered products of sandstones and light-colored noncalcareous shales on the less stony areas of the Bluestone group and the Pottsville, Pocono, Chemung, and Portage series. The Bluestone group of the Mauch Chunk series and the Pottsville series occur chiefly in the northwestern part of the county. The Pocono series outcrops along the Greenbrier River, on Brushy Ridge, and along Meadow Creek in the northeastern part. The Chemung and Portage series formations belong to the Devonian period, which preceded the Mississippian. These formations occur in the eastern part of the county. The surface soils of the Dekalb soils are grayish yellow or light grayish brown, and the subsoils are light yellow or brownish yellow. In general the Dekalb is a shallow soil and has fragments of the underlying rock or shale scattered over the surface and throughout the profile. This limited profile development is due to the relief, which is dominantly steep to very steep. A few smoother areas occur on the tops of ridges at high elevations. The soils of such areas exhibit to a marked degree the result of podzolic processes involved in their development. They have a thicker mat of organic matter and a slightly browner surface soil than the typical Dekalb soils. They appear to be more nearly Brown Podzolic soils (*2*).

Much of the area underlain by the New River group of the Pottsville series of rocks in the northern part of the county is mapped as rough stony land (Dekalb soil material). This is a part of the

western plateau section and has some fairly level areas on the summits. The land is not suitable for farming, however, because the surface is strewn with boulders.

Closely related to and resembling the Dekalb soils in color are the Clymer soils. They are developed from the same parent materials but occupy less steeply sloping land. The loam type occurs on the tops of ridges that are capped with sandstone. The silt loam type generally occurs at lower elevations and is developed from sandstone and shale material. In the early soil-survey mapping, such areas were included with the Dekalb soils. Recently they have been separated from this series because of the deeper soil development and better agricultural adaptation.

The Marcellus series of rocks occurs in the eastern part of the county as a continuous narrow belt occupying the lower mountain slopes and low rounded hills immediately adjacent to the small streams. This series is composed for the most part of finely laminated shales from which is developed Berks shaly silt loam. This is a very shallow nonagricultural soil. The surface soil is light yellow or brownish yellow, and the subsoil is yellowish brown or brownish yellow tinged with red.

Below the Marcellus series are the Oriskany and Helderberg series. These outcrop on Coles and Beaver Lick Mountains. The Huntersville chert member of the Oriskany series contains a small quantity of lime and, together with the siliceous limestones of the Helderberg, gives the Elliber soils. Where not too stony the Elliber soil makes better grassland than the surrounding areas of Dekalb or Berks soils. Weathering of the parent material leaves the chert fragments strewn over the surface and throughout the soil. Virgin areas of Elliber soils have a mat of organic matter on the surface, as much as 3 or 4 inches thick. The surface soil is gray or grayish yellow, and the subsoil is brownish yellow or yellowish brown. The purer limestone members of the Helderberg series give rise to Hagerstown soil. Such areas are inextensive, and have been included with the Frederick soils.

In the eastern part of the county rocks of Silurian age are exposed. These are unimportant so far as soils are concerned because the areas are too stony and are mapped chiefly as rough stony land (Dekalb soil material).

SUMMARY

Greenbrier County is in the southeastern part of West Virginia, adjoining the State of Virginia. The general relief is that of a broad rolling valley extending from northeast to southwest. The valley is bounded on the east and west by comparatively high mountains. It is underlain by limestone and is a part of the Valley and Ridge province. The mountains to the east also belong to this same physiographic province. The northwestern part of the county is a highly dissected plateau of the Appalachian Plateaus. This section is very mountainous and is not important agriculturally. Coal mining is the chief industry here, and lumbering still is important. The tree growth is principally hardwoods. Much of the rough mountainous areas of the eastern and northern parts of the county is now included in the Monongahela National Forest.

The southwestern part, which is a part of the Appalachian Plateaus, has large areas of poorly drained soils occurring on the flood plain. The areas that can be drained, together with the smoother areas of upland soils, are used for farming.

The average annual rainfall is 38.80 inches, and the average frost-free period is 149 days. The delightful climate and mountain surroundings contribute to make the county a popular summer resort area.

The main agricultural enterprises are cattle raising and sheep raising. Most of the animals are beef cattle, which are marketed as grass-fattened. Dairying, however, is becoming increasingly important. The crops grown are those that provide winter feed for livestock and for home needs. Wheat is the chief cash crop. The present-day agriculture consists of the production of hay, corn, and wheat as the principal crops, and of barley, oats, and potatoes as minor crops.

The comparatively smooth areas of well-drained soils are used for cultivated crops. The hilly areas, which comprise so large a proportion of the farm land, are not suitable for cultivation but are best adapted for pasture. The extent of land suitable only for grazing largely explains the dominance of cattle raising as an agricultural pursuit. The stony soils underlain by limestone have the highest carrying capacity of any classed in this category. Areas that are too steep or too stony to have any agricultural adaptation are left in forest. Such land comprises more than 50 percent of the total area.

The soils are prevailingly light in color, low in organic matter, and more or less acid in reaction. In the Greenbrier Valley they have developed mainly over limestone, although some have developed from materials washed from calcareous shales. In the mountains most of the soils have formed from sandstone or sandstone and shale. The parent material of the soils of the flood plains and terraces, with the exception of those of the Elk and Moshannon soils, has washed from soils of sandstone and shale origin.

The soils are classified on the basis of soil characteristics, relief, and crop adaptabilities into First-class, Second-class, Third-class, Fourth-class, and Fifth-class soils. The First-class soils include the most productive and dominant agricultural soils. They are underlain by or are derived from materials derived from limestone. The Second-class soils are not so productive as the First-class soils, owing to less favorable relief, poorer drainage, or lower fertility. The Third-class soils comprise soils that are developed chiefly from sandstone and shale materials. They are inherently less productive than the soils of either of the two preceding groups. Fourth-class soils include those that are too hilly or too stony for cultivated crops but are well adapted to pasture. Pastures are important in this county, as the cattle are finished for market on bluegrass. The Fifth-class soils are too steep, stony, or shallow to be used profitably for any agricultural use other than forestry.

The important soils for farming are the Frederick, Frankstown, Westmoreland, Upshur, Elk, and Moshannon soils. The Frederick and Frankstown soils are underlain by limestone. The Moshannon soil occupies the flood plain and the Elk soil the terraces. The West-

moreland and Upshur soils are developed from weathered shale, some of which is calcareous. These soils are important in the cattle-raising section. The smooth areas are used to produce the required feed. The hilly or stony areas that are not too steep furnish good bluegrass pasture. The Dekalb soils occupy the largest total acreage, but most of them are suitable only for forestry.

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